

University of Missouri Center for Agroforestry Training Manual for Applied Agroforestry Practices - 2006 Edition





Training Manual for Applied Agroforestry Practices

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User's Guide to the Training Manual

Farmers and other landowners drawing sustenance from the land strive continually to produce goods through methods that are economical, conservation-minded and socially acceptable.



There is a very small window of opportunity for farming practices to meet these diverse, and often seemingly opposed, objectives. However, agroforestry practices are unique in that through their application each objective of economy, conservation of resources and social acceptance, can be met.

Yet, as each agroforestry practice is applied to the landscape, there will most likely be a balance between each of the objectives. This manual will help explain each of the agroforestry practices and their application. Additionally, the manual is designed to assist in the decision process so that, when established or managed, the agroforestry practice is most effective at achieving the desired objectives.

About this manual

This guide is designed to provide easy-to-use information about agroforestry. The intended au-

dience is both forest and agricultural landowners and resource professionals; yet, anyone interested in establishing or managing trees for multiple functions on the landscape can use the guidelines of agroforestry to assist in achieving success.

This is not an exhaustive source of information on agroforestry. Agroforestry is both an art and a science. Therefore, do not assume this guide is an exhaustive resource of agroforestry practices. Rather, it is a tool to be used in the decision-making process. There are countless ways for trees to meet conservation, economic and societal goals, and we are learning more and more each day about effective designs that better ensure agroforestry will meet one or more specific goals.

How this Guide is Organized

This manual is divided into specific sections explaining agroforestry practices and management. Section two is intended to assist you in implementing your knowledge of agroforestry into your operation in a step-by-step process. The appendix contains information about the economics and taxation involved with agroforestry, as well as crop sheets for selecting the appropriate trees, shrubs, grasses, forbs and crops for your agroforestry practice. You may pull out sections and use them independently as needed.

Let's Begin

From specific land management practices designed to conserve limited resources to the marketing of specialty, noncommodity products, the ideas in this manual can improve the likelihood of your success. We hope it is both a useful tool and a source of inspiration for additional management practices that utilize trees or shrubs on the farm for multiple benefits.

Land management practices that integrate trees and shrubs with agriculture can provide benefits to the farm and the surrounding landscape. We hope that the ideas and practices put forth in this manual inspire and assist in making decisions related

to managing land resources that involve trees and shrubs. It is our desire to help farm managers and land owners achieve long-term satisfaction from working harmoniously with the soil, water, air, forests and wildlife resources of this Earth.



Gene Garrett, left, director of the Center for Agroforestry, and Michael Gold, right, associate director, speak about the opportunities agroforestry provides at the First World Congress of Agroforestry, Orlando, Fl.

About the University of Missouri Center for Agroforestry (UMCA)

Agroforestry practices help landowners diversify products, markets and farm income; improve soil and water quality; and reduce erosion, non-point source pollution and flood damage. The integrated practices of agroforestry enhance land and aquatic habitats for fish and wildlife and improve biodiversity while sustaining land resources for generations to come.

UMCA, which was established in 1998, is one of the world's leading centers contributing to the science underlying agroforestry. Since 1998, UMCA has been supported by and managed three significant USDA-ARS programs representing more than 50 individual projects. Eleven interdisciplinary cluster groups comprised of faculty and research specialists representing forestry, wildlife, agronomy, animal science, horticulture, soils and agricultural economics collaborate to provide sound science that uncovers new benefits from agroforestry practices and solves production challenges.

Linked to the center's solid science and research programs are several key partnerships with landowners, natural resource professionals, federal and state agencies and non-profit organizations. Through these critical relationships, UMCA and its partners are producing an expanding list of positive outcomes for landowners, the natural environment and society as a whole.

UMCA Philosophy:

"A farm can be regarded as a food factory and the criterion for its success is saleable products. Or, it can be regarded as a place to live, and the criterion for its success is harmonious balance between plants, animals and people; between the domestic and the wild; and between utility and beauty." - Aldo Leopold

UMCA Mission:

To initiate, coordinate and enhance agroforestry activities to meet the environmental, social and economic needs of land management within the state of Missouri, North America and the temperate zone worldwide.



Ken Hunt, UMCA post-doctoral fellow, discusses Chinese chestnut production at the HARC farm.

To accomplish our mission, UMCA:

- Conducts, coordinates and promotes interactive research on agroforestry practices to improve the productive and protective functions of agricultural and forest lands.
- Conducts, coordinates and promotes interdisciplinary research on the social, economic and market dimensions of agroforestry.
- Conducts a technology transfer program that increases the awareness and adoption of agroforestry practices.
- Conducts, coordinates and promotes interdisciplinary research on the policy dimensions of agroforestry.
- Provides opportunities for formal education in agroforestry through the University of Missouri
- Develops and carries out a collaborative international agroforestry program in the areas of instruction, research and outreach.

Goals for our efforts:

- To protect the environment by reducing nonpoint source pollution
- To create and improve natural habitats for wildlife
- To mitigate against the impacts of periodic flooding
- To sequester carbon for reducing the impacts of greenhouse gases
- To generate income and develop new market opportunities for landowners and farmers

The Horticulture and Agroforestry Research Center (HARC)

The Horticulture and Agroforestry Research Center (HARC), located at New Franklin, Mo., is the primary research site for UMCA. This 660-acre farm opened in 1953, incorporated a major agroforestry dimension in 1993, and includes several experimental fruit and nut orchards; forest farming, riparian buffer and silvopasture demonstrations; forage shade trials; greenhouses; a flood tolerance laboratory; five lakes and ponds and one of Missouri's oldest brick homes, the 1819 Thomas Hickman House. The farm, set in the beautiful, rolling Missouri River hills, is also the U.S. National Arboretum Midwest Plant Research and Education Test Site. Tours and educational events are hosted regularly.

HARC Farm Highlights:

- *Forest farming, riparian buffer and silvopasture demonstrations*
- *Forage shade trials and greenhouses*
- *The U.S. National Arboretum Midwest Plant Research and Education Test Site*
- *Premier research studies on the development of eastern black walnut, northern pecan and Chinese chestnut into profitable orchard crops*
- *An innovative, outdoor 12-channel flood tolerance research laboratory*
- *Projects for producing gourmet, high-value mushrooms, including morel and shiitake*
- *Location of one of Missouri's oldest brick homes, the historic 1819 Thomas Hickman House*

Examples of current HARC Research projects:

Pitch x Loblolly Pine and Black Walnut Winter Forage Alley Cropping Study: This study explores the effects of row spacing on tree growth and tree/forage interactions in an alley cropping practice. Pitch pine/loblolly pine hybrids and black walnut planted in single, double and triple rows are grown to examine the effects of row configuration on these species.

Riparian Buffer Biofilter Livestock Trial: Assesses the value of riparian buffers in filtering nitrates and phosphates out of runoff from adjacent livestock grazing.

Mushroom Trials for Forest Farming: Researchers are evaluating morel, shiitake and other gourmet mushrooms for landowner production and profit.

Cottonwood Clonal Trial: This project seeks to identify poplar clones that are well-adapted to the climate of the lower Midwest floodplain and that produce substantial wood crops for fiber, chips or energy over short (4-5 year) rotations. The project also will provide estimates of total carbon sequestered by such plantations, data that will be useful in determining potential economic returns from carbon credit programs that may emerge.

Silvopastoral Practice: Researchers are investigating the similarities and differences in cattle performance between traditional open grazing and silvopastoral grazing practices. Factors also being evaluated include the success of electric fences as deterrents to protect young trees from grazing damage, and how grazing and forage production affect tree growth.

Pine-Straw: The purpose of this study is to evaluate pitch x loblolly hybrid pines (*Pinus rigida x taeda*) along with cold-tolerant selections of pure loblolly pine for their suitability for the production of pine straw mulch in Missouri.

Missouri Gravel Bed for Nursery Stock: The Missouri Gravel Bed (MGB) is a method, devel-

Aerial view, 660-acre Horticulture and Agroforestry Research Center



oped at HARC, that allows planting of bare rooted nursery stock at any time of the year. Dormant, bare rooted trees and shrubs are set into a frequently irrigated mixture of pea gravel and sand. Plants can be removed from the gravel at any time during the summer and fall and field planted as bare root stock. The main objective of this project is to evaluate the potential of MGB to facilitate planting of trees and shrubs in agroforestry and landscape plantings.

Forage Shade Study: In 1994, researchers began this project by examining 27 forage species (native and exotic legumes, warm season and cool season grasses) for the effect of shade on dry weight production and nutritional value. The goal is to determine growth and development under different shade levels when forages are grown as companion crops in agroforestry practices or for savanna and woodland restoration.

Evaluating the MDC quail cover bundle shrubs: Bare root seedlings of false indigo, wild plum, fragrant sumac and dogwood were established in 2001. These shrubs were chosen for their potential to provide quality escape cover and food for bobwhite quail. The main objective is to compare their growth and development with moderate management under field conditions.

Flood Tolerance: This facility provides a unique field laboratory for studying the response of plant species to the periodic flooding common to mid-western floodplains. The laboratory has 12 channels, each approximately 20-ft wide by 600-ft long. Each channel can be independently adjusted for water depth, standing or flowing water, and duration of flooding.

Nut Tree Improvement: The tree improvement program focuses on identifying and testing selections of black walnut (*Juglans nigra*), pecan (*Carya illinoensis*) and chestnut (*Castanea mollissima*) for incorporation into agroforestry plantings. Major components of this research include (1) testing cultivars on various sites; (2) identifying superior rootstocks for grafting and dwarfing; (3) developing improved vegetative propagation techniques; and (4) creating a breeding program to develop improved selections.

Notes

SECTION 1: Defining Agroforestry

Agroforestry: Definition and Practices

What is agroforestry?

Agroforestry is new market opportunities. Sustainable agriculture. Land stewardship. Habitat for wildlife. Improved water quality. Diversified farm income.

In simple terms, agroforestry is intensive land-use management combining trees and/or shrubs with crops and/or livestock.

Agroforestry practices are designed to fit specific niches within the farm to meet specific landowner objectives.

Agroforestry practices help landowners to diversify products, markets, and farm income; improve soil and water quality; and reduce erosion, non-point source pollution and damage due to flooding. The integrated practices of agroforestry enhance land and aquatic habitats for fish and wildlife and improve biodiversity while sustaining land resources for generations to come.

Temperate USA:

Intensive land-use management that optimizes the benefits (physical, biological, ecological, economic, social) from biophysical interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock.

Agroforestry Key Criteria:

Four key criteria characterize agroforestry practices. Application of the 4 “I” criteria are key to determine what is and what is not an AF practice:

Intentional

Combinations of trees, crops, and/or livestock are intentionally designed, established, and/or managed to work together and yield multiple products

and benefits, rather than as individual elements which may occur together but are managed separately. Agroforestry is neither monoculture farming, nor is it a mixture of monocultures.

Intensive

Agroforestry practices are created and intensively managed to maintain their productive and protective functions, and often involve cultural operations such as cultivation, fertilization, irrigation, pruning and thinning.

Integrated

Components are structurally and functionally combined into a single, integrated management unit tailored to meet the objectives of the landowner. Integration may be horizontal or vertical, above- or below-ground, simultaneous or sequential. Integration of multiple crops utilizes more of the productive capacity of the land and helps to balance economic production with resource conservation.

Interactive

Agroforestry actively manipulates and utilizes the interactions among components to yield multiple harvestable products, while concurrently providing numerous conservation and ecological benefits.



Working with UMCA staff and natural resources professionals helps landowners plan and implement agroforestry practices.



Specialty mushrooms can be grown on logs in a forest farming practice for additional income, as explained by a mushroom grower at this field day.

The five recognized agroforestry practices are:

- **Riparian Forest Buffers**
- **Windbreaks**
- **Alley Cropping**
- **Silvopasture**
- **Forest Farming**

1. Riparian Forest Buffers

Riparian forest buffers are strips of permanent vegetation, consisting of trees, shrubs, and grasses, planted or managed between agricultural land (usually cropland or pastureland) and water bodies (rivers, streams, creeks, lakes, wetlands) to reduce runoff and non-point source pollution. Forest buffers are usually planted in three distinct zones near an agricultural stream for stabilizing streambanks, improving aquatic and terrestrial habitats, and providing harvestable products.

2. Windbreaks

Windbreak practices (shelterbelts, timberbelts, hedgerows, and living snowfences) are planted and managed as part of a crop or livestock operation to enhance crop production, protect crops and livestock, manage snow distribution, and/or control soil erosion.

Field windbreaks are used to protect a variety of wind-sensitive row crops, forage, tree, and vine crops to control soil erosion, and to provide other benefits such as improved insect pollination of crops and enhanced wildlife habitat.

Characteristics of Agroforestry Practices

Land-use practices deliberately integrated into the whole farm

Contain complex interactions among components suited to particular environments and human needs

Competition and its management is critical

Has two or more outputs

The “cycle” of an agroforestry practice is always more than one year

Even the simplest agroforestry practice is more complex, ecologically (in terms of structure and function) and economically than monocropping

For the landowner, often judged successful or not by the bottom line “does it pay?”



Forest Farming

Silvopasture

Alley Cropping

Riparian Forest Buffers

Windbreaks

DEFINITION AND PRACTICES

*Is it agroforestry?
Application of the 4 “I”’s*

The four key criteria revisited:

Application of the 4 “I” criteria are key to determine what is and what is not an AF practice:

*Intentional
Intensive
Integrated
Interactive*

Livestock windbreaks help reduce animal stress and mortality, improve feed and water consumption, enhance weight gain and calving success rates, and control odor. Timberbelts are managed windbreaks designed to increase the value of the forestry component.

3. Alley Cropping

This practice combines trees planted in single or multiple rows with agricultural or horticultural crops cultivated in the wide alleys between the tree rows. High-value hardwoods such as oak, walnut, ash, and pecan are favored species in alley cropping practices, and can potentially provide high-value lumber or veneer logs in the long-term.

Crops or forages grown in the alleys, and nuts from walnut, pecan and chestnut trees, provide annual income from the land while the longer-term wood crop matures. Specialty crops (herbs, fruits, vegetables, nursery stock, flowers, etc.) can be grown in alleys, utilizing the microclimate created by trees, to boost economic production from each acre.

4. Silvopasture:

This practice combines trees with forage (pasture or hay) and livestock production.

Silvopasture can be established by adding trees to existing pasture, or by thinning an existing forest

stand and adding (or improving) a forage component. Trees are managed for high-value timber or sawlogs, and at the same time they provide shelter for livestock, reduce heat stress and improve food and water consumption. In the winter, the protection of trees reduces cold stress — therefore, animals do not lose as much energy keeping warm and are able to gain more weight.

Forage and livestock provide short-term income at the same time a crop of high-value sawlogs is being grown, providing a greater overall economic return from the land.

5. Forest Farming

In forest farming practices, high-value specialty crops are cultivated under the protection of a forest overstory that has been modified and managed for sustained timber production and to provide the appropriate microclimate conditions.

Shade-tolerant specialty crops like ginseng, shiitake mushrooms, and decorative ferns grown in the understory are sold for medicinal/botanical, decorative/handicraft, or food products. Overstory trees are managed to produce timber and veneer logs.

A key concern in developing agroforestry nomenclature for the U.S. is overlap and confusion with mainstream land use management disciplines, e.g., forestry, agriculture, and livestock production. There is a fundamental need to develop a definition and criteria that would effectively distinguish practices that are agroforestry from those that are not. Application of the four criteria defining agroforestry (intentional, intensive, integrative, and interactive) provide the key to determine what is and is not an agroforestry practice.

Perspectives on U.S. Agroforestry

- *Agroforestry at the Practice Level* - pragmatic, workable
- *Agroforestry at the Technology Transfer level* - barriers of tradition, lack of knowledge, need for concrete financial information, need to establish new social networks
- *Agroforestry at the Science Level* - need more process-level knowledge

Where do we need to go? How will we get there?

- Grassroots, common-sense approach
- Partnerships and working demonstrations
- Creation of shared knowledge networks
- Develop farmer-to-farmer idea exchanges
- Train a leadership group of informed, supportive professionals
- Understand the scientific principles
- Understand component interactions
- Developing markets and value-added products
- The bottom line - \$

To achieve widespread adoption of agroforestry practices, it will also require:

- *Openness to new ways of seeing the world and a willingness to explore*
- *Openness to do different things and to do things differently*
- *Focusing on the value of finding new ideas and acting on them*
- *Striving to create value in new ways*

Additional Resources

In Print:

- Garrett, H.E., W.J. Rietveld and R.F. Fisher (eds.) 2000. North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy.
- Gordon, A.M. and S.M. Newman. 1997. Temperate Agroforestry Systems. CAB International, 269 p.

Online:

- National Agroforestry Center: <http://www.unl.edu/nac/>
- Association For Temperate Agroforestry: <http://www.aftaweb.org/>

Notes

SECTION 2: Introduction to Planning for Agroforestry

In this chapter:

- **Developing a Plan for Agroforestry**
- **Identifying Land Uses, Resources, Goals and Market Opportunities**

Developing a plan may seem tedious at the beginning, but the long term benefits far outweigh the difficulties of plan creation. By having a plan, landowners can better envision how to successfully integrate an Agroforestry Practice to their farm. And, the planning process will also help develop a familiarity with the management that is required in order to reach the goals, objectives, benefits and economics that are desired. The best way to ensure success is by thoughtful and honest planning.

A Plan for Integrating Agroforestry on the Farm:

Developing a Workplan

Why plan? The development of a plan for integrating agroforestry practices to the farm system is as important as the actual establishment of the practice itself. Planning -- and the development of a timeline -- will help maximize the chances for the success of the agroforestry practice. Planning will not only assist in understanding how the practice and its placement on the landscape can accomplish specific on farm goals, but will provide assistance in identifying market opportunities for products that may be grown in the practice. **Remember: Diagnosis precedes treatment.**

The culmination of the planning process is the development of a 5-year management and activities schedule. This final, yet very important step, will help line out the inputs needed over time in order to keep the agroforestry practice a meaningful and productive component of the farm system for years to come.

Steps to Developing an Agroforestry Plan

Objectives for Development Area

- Step 1: Initial Objectives and Priorities
- Step 2: Evaluate Personal Resources
- Step 3: Identify Current Land Uses
- Step 4: Map Area(s) for Agroforestry Development

Site Assessment

- Step 5: Climate Assessment
- Step 6: Soil Assessment
- Step 7: Physical Features (Terrain)

Vegetation Inventory

- Step 8: Timber and Non-Timber Forest Crop Inventory

Brainstorming

- Step 9: Agroforestry Development Ideas

Choosing your 'Best Bet'

- Step 10: Listing 'Best Bets'
- Step 11: Revising Your 'Best Bets'
- Step 12: Identifying Buyers and Their Needs
- Step 13: Researching the Competition
- Step 14: Exploring the Industry
- Step 15: Adding Value to Products
- Step 16: Setting the Price
- Step 17: Getting Products to the Buyer
- Step 18: The 'Final Cut'

Agroforestry Practice Design and Management

- Step 19: Revisit Your Objectives and Priorities
- Step 20: Detailed Crop Information
- Step 21: Designing Your Agroforestry Practices

The Agroforestry Development Plan

- Step 22: A Five-Year Management Projection
- Step 23: Yearly Activity Schedule

What is a Workplan?

Your agroforestry Workplan is the primary agroforestry planning tool. Coupled with the Workbook (See Appendix Section 5: Planning for Agroforestry Workbook), this section is designed to help guide you through the various stages of creating a Workplan for your agroforestry development area(s), and will assist you in gathering information on:

- your objectives and priorities
- personal resources (e.g., labor, equipment, buildings, animals, plants)
- climate, soil conditions and physical features
- current land use
- land available to practice agroforestry
- a non-timber plant inventory (for woodland only)
- market conditions for potential products.

Together with sections three to 10 of this manual and the tree/shrub/grass/forage information provided in the appendices, the Workplan will allow you to identify what agroforestry products can grow on your land, which of these products you can sell profitably, and how to develop basic business and marketing strategies. The final section is a five-year development plan and yearly activity schedule, outlining the work you plan to do to establish your agroforestry development(s). The time you put into researching, preparing and following your Workplan is an investment in your future agroforestry success.

The steps presented in the following pages—designed to guide you in creating an agroforestry Workplan—are often inter-related, and information gathered in one step will likely impact information gathered in other steps. For this reason, the creation of your Workplan will likely require you to revisit (and expand) each step as you learn more and develop new ideas.

Note: The succession of steps has been organized to help you develop your Workplan logically. You need not complete each step in the order they are presented. You may prefer to gather information in a way that best suits your circumstances.

In addition to identifying available resources, site conditions and marketable plants, filling in the Workplan will help you explore and articulate your values and attitudes. Every landowner will have different personal and production goals for an agroforestry development, and your plan for your land will be different from someone across the country, State, or even across the road. To accommodate these differences, this guide is not based on a single set of goals. Instead, it has been developed to provide a set of tools that you can use to make informed decisions in creating a profitable agroforestry business.

An agroforestry development plan is based on the capability of your land, your personal goals, your business goals, and your land stewardship objectives. These goals and objectives will be re-assessed and changed as you obtain new information during the planning and initiation of an agroforestry development. Agroforestry practices are always changing, and understanding and working with change will help you best achieve your goals.

The Workplan includes key assessments you are likely to need to plan a successful agroforestry development.

There are many sources of information and advice available to assist you with your agroforestry development. Since agroforestry practices often involve various fields (e.g., forestry, agronomy, animal husbandry, horticulture, soil science, marketing) you may have to augment your personal knowledge. Sources listed at the end of each section in the training manual are designed to guide you.

How to Proceed

You'll find a pull-out Workplan in Appendix 5. The Workplan can be photocopied as needed. The information, tools and links you need to complete the Workplan are found in sections that follow (sections 3 to 10).

It is recommended that you read through these steps before you begin to write down information in the corresponding sections of the Workplan.

Note: Depending on the size of your property, you may have one or more areas on which you want to develop agroforestry practices. Planning will be easier if you prepare a Workplan for each separate development area, especially if potential agroforestry development areas have different site conditions and current uses.

Step 1: Initial Objectives and Priorities

Landowners exploring multiple uses for their property face many preliminary decisions. Not least, if you have a number of different objectives for an area, some may seem to be in conflict. The choices each landowner makes reflect a set of individual values and attitudes. Your personal and business goals become the criteria for assessing the different possibilities for your land.

Your land management objectives and priorities will be specific to your circumstances and the area you want to develop for agroforestry. **However, among other possibilities, you may want to:**

- *develop a new source of income from unproductive land (diversification)*
- *reduce costs of an existing farm or forest operation*
- *develop a source of long-term income*
- *develop a source of short-term income while awaiting long-term income from timber*
- *reduce property taxes*
- *protect or improve environmental conditions*
- *increase grazing opportunities.*

Turn to the Agroforestry Workbook: Appendix 5 and complete the table of initial objectives and priorities. Remember that these initial objectives may change as you learn more about your land and your agroforestry business. After you finish this assessment, you will be able to weigh your objectives against what you can actually produce on each area

of your land.

Step 2: Evaluate Personal Resources

In addition to your land base, your agroforestry development will require the input of other personal resources. An evaluation of the resources available to you will help determine which agroforestry options are best suited to your operation. An evaluation should include:

Management and labor availability – Periods during which you are not busy (between or after harvests) and the periods during which labor and management time will be committed to other activities

Equipment and buildings – Buildings and equipment, including machines and hand tools, that can be used for this development.

Livestock – Your operation may already have cattle, sheep or other animals

Plant material – Your own sources of seed, seedlings, cuttings and larger trees

Other materials – Resources such as sawdust or shavings, manure and straw for mulch.

List these personal resources, as well as anything else that you consider of importance, in the table provided in the Workbook.

Step 3: Identify Current Land Uses

List the present uses of each area of your land and the products you harvest, and record them in your Workbook. These uses could include:

residential

recreational

farming (which crops)

grazing (type of livestock)

timber production

non-timber production

environmental use

Step 4: Map Area(s) for Agroforestry Development

An agroforestry development may include all of your land or only specific areas, such as existing woodlands, open field, logged-over area or riparian zone. In either case, identifying objectives and making decisions will be much easier if you break your land into separate development areas with similar current uses and site conditions (such as soil, moisture and existing plants). Steps in the Workbook, including the sketch map, should be completed for each separate development area. Pages of the Workbook can be copied for this purpose.

For each agroforestry development area, you should:

- Draw a sketch map of the area you are targeting for agroforestry development. Using the legend provided in the Workbook, indicate boundary lines, main geographic features, houses, other buildings and roads.
 - Identify and measure the area approximately, marking these measurements on the sketch. This will help determine planting requirements and potential crop production.
- There is some overlap between Step 3 and Step 4, since you will indicate these uses on your sketch map. Step 3 gives an opportunity to provide information on land use in greater detail, and by thinking about land uses, you may decide to modify your sketch map.

Why Assess Your Land?

Assess climate, soil and physical features on each site on which you intend to develop an agroforestry practice. These assessments will allow you to determine:

- which plants you can successfully grow on each site
- limitations to planting and growing these plants
- the most effective management practices

Assessments can be as detailed as you want, or as required by the project. The introduction of long-term or special-needs crops such as black walnut

trees requires a different level of site assessment than the planting of a shallow-rooted annual crop. Even if you plan to begin small, with a few tree seedlings on a fence line and a small planting of medicinal herbs, you should still assess the limitations and potential of your land.

The information provided here, and the accompanying form in the Workbook, provides a basic site assessment. More detailed assessments require added time, equipment and expertise. They are only worth doing if it will help with a critical aspect of your agroforestry development. For most developments, they are not necessary.

Step 5: Climate Assessment

Climate on your site ultimately determines what you can grow on your land. Combining this data with the information provided in Appendices 2 and 3 will establish the range of possibilities for your agroforestry practice.

Hardiness Zone - The US Department of Agriculture Plant Hardiness Zone Map has mapped plant hardiness zones for the entire country. You can find the Plant Hardiness Zone Map for different regions of the USA at the USDA National Arboretum website: <http://www.usna.usda.gov/Hardzone/ush-zmap.html>

To locate a Plant Hardiness Zone Map specific to your State go to the following website and click on your State: <http://www.growit.com/bin/USDAZoneMaps.exe?MyState=MO>

These zones rate the conditions affecting winter survival of plants. The primary factor is the minimum (coldest) winter temperature, with some consideration for the number of frost-free days, summer rainfall, maximum temperatures, snow cover and wind.

Most information sources, and suppliers of seeds and plants, list the minimum hardiness zone for particular plants. Plant breeding programs have resulted in cultivars or selections of many plants that differ in hardiness from their parent (check this

carefully to prevent a costly error).

In some cases, the hardiness zone mapping is only an approximate guide for local conditions. Enter hardiness zone information in the table provided in the Workbook. Additional information you may find, such as frost-free days and date of soil thaw, should also be included in the table.

Step 6: Soil Assessment

Land Capability Classification - The Land Capability Classification shows, in a general way, the suitability of soils for most kinds of agricultural land use or field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. There are two principle categories in this classification system, the Capability Class and Capability Subclass.

The Land Capability Classification identifies the potential of local areas for agricultural production. County Soil Surveys contain the Land Capability Classification for all soils in your county. The County Soil Surveys also provide useful climate information.

The classes are ranked from I (highest) to VIII (lowest), but the capability subclasses refer to soil groups within a class. Classes I - IV are considered capable of the sustained production of common field crops. Crop species become limiting as the land capability declines from Class I to Class IV. Class V lands are only capable of producing perennial forage crops or specially adapted crops. Class VI lands are capable of providing sustained pasture. Class VII land are incapable of either arable culture or grazing.

Capability Subclasses include: (e) runoff and erosion; (w) wetness; and (s) root zone or tillage problems - shallow, droughty or stony.

List the climatic, capability rating and limiting factors for your site, as well as any other information you believe might be useful, in your Workbook.

Soils are an extremely important feature of your land base because they are the material in which the plants of your agroforestry practice will grow.

Soil Information Sources

Information about various versions of a soil survey can be obtained one of three ways:

- *By checking the list of published surveys on the soils web site of the USDA*
- *By contacting the appropriate state office of the NRCS*
- *By contacting the appropriate local office of the NRCS*

Note: *Additional information about Missouri soils can be found at the Missouri Cooperative Soil Survey web site at (<http://soils.missouri.edu>).*

Soil survey publications represent a snapshot in time. They contain information that was current as of the indicated publication date. The text, tables and soil maps may have been updated since publication. The most up-to-date information is available on the NRCS Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/>) or the Soil Data Mart online at (<http://soildatamart.nrcs.usda.gov/>).

Read about the soils (formation of soils), look at a soils map, then examine your soils. One way to gain an understanding of your soil is to dig several soil pits at least 18" deep, and examine your soils for several important features. However, soils are landform dependent, and samples taken should represent different landforms and positions on those landforms. It is recommended to dig one or two pits per acre, and more if the area/landform is not uniform. For more detail on soil assessment, see Additional Resources at the end of this section.

Important note: If you are planning to practice agroforestry on a woodland area, plan to do a plant inventory. Since this requires setting up survey plots in a grid system, you probably want to do

your soil assessments at the same time as your plant inventory.

Soil Texture and Composition

Mineral soils are particles of rock or minerals produced from rock by weathering and other geological processes. Soil textures are grouped into the three particle sizes shown in the table below. Sands and gravel are the largest particles, while clay and silt soils contain the smallest particles. The finer textured soils hold more water and dry out more slowly. Organic soil layers or horizons are derived from decaying vegetation, usually in a thin layer above mineral soils. Where found in a sizable layer, they tend to retain both water and nutrients.

In your Workbook list the soil type(s) found in each of your agroforestry development areas, and map the locations if there is more than one type.

Soil Depth

Soil depth determines the rooting capability of the plants you may wish to grow. In particular, forest soils can be quite shallow, requiring extra care in management. You will notice distinct layers as you dig down and you may come across restricting layers such as: 1) stones and rock outcrops that can interfere with digging and cultivation, and can reduce the nutrient and water-holding capacity of the soil. Rock outcroppings are areas with very little soil; and 2) hardpan, a hardened layer below the surface of the soil that can prevent penetration of water and roots. Additional soil features that may be problematic include: fragipans, claypans, abrupt textural changes and general discontinuity. Deep-rooted plants such as alfalfa or black walnut will be severely impacted by hardpan. Neighbors and previous landowners may know if there is a hardpan, but you may have to dig several holes to determine the extent.

Note and record in your Workbook the approximate percentage of rock fragments in the soil (stoniness), and depth and type of any restricting layers. Show their extent on the sketch map.

Soil Moisture

Soil moisture, which is key to the establishment

and growth of plants, is closely linked to soil texture. The spaces (pores) between soil particles hold water and air needed by plants for good growth. Generally, coarser soils are well-drained and are often dry for longer periods, while soils with finer textures hold more water and are likely to remain moist longer. Other factors, such as ground water level or the presence of an impermeable layer that restricts drainage, also determine soil moisture. As you dig your pit, is the soil dusty and dry? Does water seep into the bottom of the hole? Often, the time of year and recent weather will influence soil moisture.

High Water Table, Standing Water or Flooding

Areas such as wetlands and parts of riparian zones which remain fully saturated for extended periods of time are of special concern. These areas are sensitive to access development and machine use, and are important for wildlife habitat and other environmental values. You will need to identify these areas of your land and plan to use especially careful management. Access may be limited for all or part of the year.

In your Workbook and on your sketch map, it is important to note any: wetland features, evidence of flooding, areas that experience overland flows or standing water during spring runoff, and areas with continual seepage or high water table.

Both very wet or dry conditions pose challenges for planting and management. However, some plants are particularly adapted to one or the other of these extremes (see Appendices 2 & 3 for a listing of suitable plants). Note the moisture conditions of various portions of your proposed development area on both your sketch map and in your Workbook.

Nutrients

The availability of nutrients in the soil affects the quantity and quality of products produced. You can undertake a soil test to determine the soil pH (acid/alkaline balance), specific nutrient levels, and recommendations for various crops. Tissue analysis is also an effective way (preferred in forest soils) to determine nutritional status of existing trees and

plants. Although there are soil sampling field kits, soil and tissue samples are usually sent to a laboratory for analysis and interpretation. In your Workbook note the status of soil nutrients that you have determined and attach any lab reports.

Step 7: Physical Features (Topography)

The physical features outlined in Step 7 are closely related to—but also different from—the soil characteristics described in Step 6. For ease-of-use, physical features are described separately from soil characteristics. However, the information you generate through each step is entered into the same table in the Workbook. This allows you to easily see the relationships between physical features and soil characteristics. There are several physical features that can influence your capability to produce particular crops on a site.

Aspect refers to the direction toward which the site slopes (if any). South and southwest-facing slopes are usually warmer and drier than those facing north, and naturally support different plant communities. Terrain relief refers to whether the site is steep, flat, sloped, rolling, gullied or broken (steep slopes between benches). This will influence access and machine capability, water management, cold air drainage, and other microclimate factors. Frost pockets are one additional feature to consider. Cold air flows downhill and pools in low areas. The resulting localized frosts can damage delicate flowers and shoots that start to grow early in the spring. Even crop plants correctly chosen for your hardiness zone can be affected. Assess low areas on your land for potential frost pockets—the absence of native berry plants can be a good indicator. Avoid these areas for frost-sensitive plants. Sloped or bench land that has good air drainage is a better choice.

Enter your observations of the physical features mentioned above in your Workbook and on your sketch map.

Step 8: Timber and Non-timber Forest Crop Inventory

If you want to practice agroforestry in woodland areas, this chapter will help you inventory the variety of plants growing on your land—everything from trees to herbs on the forest floor. The inventory of trees described here is restricted to their potential production of non-timber products (e.g., medicinals, florals) and their interactions with other plants (e.g., shade, moisture, nutrients). A non-timber vegetation inventory can be used to help create a list of ‘best bets’—plants that can be successfully grown on your land, and will also help you decide how to manage your woodland efficiently and productively (i.e., managing competition for sun, water and nutrients). There is literature available elsewhere on timber inventory methods (see Additional Resources).

If you own more than a few acres of land, you should sample your land base, using inventory plots to obtain a ‘best approximation’ of the vegetation. Sampling is an excellent compromise between doing nothing (and having a very limited picture of your land) and trying to do the impossible: counting every tree, shrub and herb on your property.

A. Preparing Your Inventory

An inventory should give you a timely snapshot of your land; it should not take too long, nor should it be too difficult. Inventory plots are the sites where you record information about vegetation and other features on your land. They form a pre-determined portion (or percentage) of the larger area you’re interested in sampling. Multiplying your plot data by the number of plots that would fit in the larger area will give an estimate of what you would find if you actually measured everything. Size of inventory plots depends on what you’re trying to survey and the vegetation cover on the plot. In your forest vegetation survey, you will actually take two separate surveys from the same plot center. This is because you need to collect information about two very different types of vegetation: Trees; shrubs and other smaller plants.

Plot cruises can be used to estimate the number of plants in a forest by species, diameter, height, form class and grade. All fixed plot cruises have statistical sampling error which is important to know and understand before relying on the data. A plot cruise simply consists of counting and classifying all trees or plants species in a series of circular sample plots. Circular plots are usually 1/10-acre in size (37.2 feet radius). The plots are evenly spaced throughout the stand to provide an equal sampling of all forest types across all topographic changes

B. Doing Your Inventory

Locating your plots in the field. Following a compass line is a vital skill when conducting your vegetation inventory. It is beyond the scope of this training manual to review compass work in detail but there are a couple of points to remember:

- The right compass for the job. Ideally, you should have a ‘ranger’ type with a mirror in the lid, gunsight sighting, liquid dampened needle, and an adjustment for setting declination.
- Staying on track. With a little practice, staying on your traverse line is not difficult. Hold the compass level, line up the arrow in the mirror face, sight on the farthest object you can pick out through the gunsight (e.g., recognizable tree, rock, stump), and walk toward it. When you reach that landmark, sight again and find a new object to focus on.

Obtain a good guidebook to the plants of your area. Remember that quality can have a big impact on the prices you receive for non-timber forest products. That means you will have to make judgment calls when doing your inventory. Information on product specifications—including acceptable quality—can be found in Appendices 2 and 3. It is also important to remember that you should contact buyers before you harvest, so that you can harvest to the correct specifications.

Tree Inventory

The tree inventory described here is only intended to determine the non-timber resources available (e.g., boughs, vines, bark, burls).

Number of trees and species. Record the number of trees of each species found at the plot. This will

assist in determining what non-timber products can be obtained, and what plants can be grown under the canopy.

Tree age. This is optional, but can be useful to know. An increment borer is easy to use and will not harm the trees. Record the age of one or two average trees per plot.

Tree height. This is also optional, and only really useful for a timber inventory. Details on calculating height are provided in Appendix 5: Inventory Information.

Condition of trees. Helpful in determining whether marketable non-timber products can be harvested. Also helpful in assessing the possible function as a windbreak.

Crown closure. The degree of canopy closure will determine the conditions for raising or enhancing shade-loving species in the under storey. See the diagram below for estimates of crown closure.

Non-tree Inventory

Begin your inventory by identifying and listing all the harvestable non-tree species found in the plot on your plot sheet. Include plants that provide good browse if you intend to graze the area.

For each species, record the following:

Total number of plants for each species. Where possible/feasible, count the number of individual plants of each species found in the plot. This will be easier on an open forest floor than it will be on dense sites. You may choose to record sites like the latter simply as ‘dense coverage.’ This is one of those instances where judgment calls come in. Even an approximate number could be useful in developing a harvesting plan.

Estimate of the percentage cover for each species. How much of the plot do you think the species covers? Provide an estimate to the closest 10%.

Proportion of harvestable vs. non-harvestable individuals. The aim here is estimate the amount of harvestable individuals for each species (none,

20%, 50%). Your decisions will be based on factors such as size, color, and insect or other damage. If many of the plants are not harvestable in their current condition, cultural practices such as fertilization and pruning may be available that would improve product quantity and quality.

C. Using Your Inventory

First, make sure all areas inventoried are marked on your map(s). Next, you need to take the raw data from your inventory (plot sheets), compile it, and present it in a useful format. That means taking the information from your sample plots and organizing the information so it represents your entire development area.

Trees and/or Other Resources per acre

Among your survey information, you have recorded the number of each plant species that appears in each inventory plot. Now you want to convert that number into the number of plants per acre. This is done using the plots per acre factor. The plot information is then extrapolated to one acre and then multiplied by the total acres. For example, if you counted ten individual witch hazel shrubs in your plot cruise

One plot on 1-acre:

Plot size 1/10-acre

Plot radius (feet) 37.2

Average trillium plants /plot 8

Factor to 1-acre, multiply times 10

Total estimated witch hazel per acre = 80

Once you know the approximate number of plants of a given species per are you have a fairly good idea of the plant resources you have on your land. Record the information in the tables provided in the Workbook.

Step 9: Agroforestry Development Ideas - Brainstorming

After reading the sections 3 through 10 in this training manual, you will probably come up with some ideas for agroforestry developments on your property. Once you have done this, it is time to engage in some brainstorming. In addition, check out the appendices 2 (Trees and Shrubs

for Agroforestry) and 3 (Grasses and Forages for Agroforestry) to develop additional ideas.

Brainstorming is the process of putting ideas down on paper as they come into your head. List them all and don't try to self-censor the ideas. You can reduce this list to 'best bets' later. Input from family and friends, as well as ideas from neighboring landowners, can help generate useful ideas. This is also a point at which expert advice may expand the list of possibilities. For additional assistance consult the Additional Resources that are listed at the end of every section.

For each development area, sort the list by practice and record this information in your Workbook. In general, more intensive agroforestry practices (e.g., forest farming) are suited for smaller units of land, while the more extensive practices (e.g., silvopasture) are suited to larger units of land.

Step 10: Listing 'Best Bets'

The intent of this short but important section is to create a list of potential crops that can be grown on your land. This list of 'best bets' will be based on the information you have gathered so far—including land and personal resources, site conditions and current land use—combined with the plant information provided in Appendices 2 and 3.

Perhaps the easiest way to approach this list is by first determining what plants can grow under the climatic, soil and physical conditions that occur in each of your agroforestry development areas. Plants you already cultivate on your land, plants revealed by your non-timber inventory, and crop ideas you have developed while gathering information will all form part of this list.

You can add substantially to the list by looking at Appendices 2 and 3 to see what other plants can be successfully grown on your site, and what products can be made from them. You want this list to be as extensive as possible, so you can consider the widest possible range of options.

Your list can be refined by considering the resourc-

es at your disposal (e.g., labor, buildings, equipment) at different times of the year. These factors will limit the crops and crop combinations you can grow. Finally, you can further refine your list by revisiting the objectives you have for your land, such as income diversification, reduction of land taxes or environmental protection.

The list of ‘best bets’ you make in this part of your Workbook should include all the plants that can grow on your land, and the products that can be derived. Make sure you include timber products that can be made from trees you would plant as part of an agroforestry development. If you have done a timber inventory—in addition to the non-timber vegetation inventory list those possible timber products as well.

Along with Section 10 of the Training Manual, the following steps will help you develop a marketing strategy, or marketing plan. Each step contains directions needed to complete corresponding sections in your Workbook. You should note that every part of every step might not apply to your situation.

Step 11: Revising Your ‘Best Bets’

In Step 10 of your Workplan you identified the plants that can grow on your land, and which you can produce with the resources you have available. In Step 11, the list of ‘best bets’ will be refined to include those plants and products you think have the best market potential. This revised list of ‘best bets’ will provide direction for your in-depth market research.

When selecting a list of marketable ‘best bets,’ consider:

- *Are there buyers nearby?*
- *What is the demand for the crop, relative to supply?*
- *How does harvesting and selling these crops fit in with the rest of your production system? For example, will the crop(s) require big inputs of labor during an already busy period?*
- *Is investment of resources (labor and capital) likely to provide an adequate return?*
- *How does that return compare to other pos-*

sible crop/product options?

Where possible, use your vegetation inventory information to list the approximate volumes of the crops you have for sale. For crops not yet planted, you should estimate how much you’ll be able to sell so you have an idea of how much to plant.

Step 12: Identifying Buyers and Their Needs

Your customers are the consumers, brokers, wholesalers and others who will potentially buy your product. Generally, buyers for NTFPs and agricultural crops or products include: consumers, wholesalers/brokers, supermarkets, small retailers, processors, restaurants and exporters.

The needs of these different buyers can vary significantly. Take the time to find out what your potential buyers want before you go any further.

Important information includes:

- *What quantity and quality of product do they expect?*
- *How much are they willing to pay?*
- *When do they need the product?*
- *Does the market area have an adequate customer base?*
- *Ideally, you will be able to focus on one primary market—or group of buyers—that looks like the best fit and is large enough to provide a reasonable return for your efforts.*

Step 13: Researching the Competition

Understanding the competition will influence the way you customize your marketing plan. Speaking with potential buyers is a good place to start developing a list of competitors. Next, determine as much as you can about your competitors, including:

- *Are they working at full capacity (i.e., can they produce more)?*
- *Do they have a particular niche?*
- *What are their marketing methods?*

- *What are they doing right? What are they doing wrong?*
- *How long have they been in business?*
- *Can you offer something they cannot?*

One way to get around approaching competitors for business information is to contact similar businesses in different areas. They are more likely to share their knowledge because you're not in direct competition. You can also try: checking competitors' prices, talking to their customers/buyers/suppliers, collecting their promotional material.

After assessing the competition, you may choose a different approach. Keep in mind that potential competitors may also be potential buyers for your products. Perhaps you can explore marketing with other producers where there are advantages in assembling larger volumes for sale.

Step 14: Exploring the Industry

Getting to know your potential competitors is important, but it is also necessary to have a clear picture of the entire industry in which you intend to participate. You should focus on three main areas.

1. Knowledge of standards, including:
 - the form in which products are sold
 - required methods of product handling
 - minimum or preferred purchasing amounts.
2. Awareness of influences within the industry (largely beyond your control), including:
 - fluctuations of markets, primarily regional but also national and international
 - the effect of climatic variables on local supplies
 - seasonal purchasing trends.
3. Anticipation of industry trends, helping you take advantage of opportunities and protect yourself as markets change. Trends include:
 - expected long-term growth or shrinkage in markets
 - development of new product areas
 - pricing directions, shifts and swings
 - new varieties or cultivars.

Step 15: Adding Value to Products

When making decisions about your choice of products and how you can market them, consider ways to add value. Adding value will allow you to obtain a better price for the same amount of raw material. For small landowners, adding value to agricultural and non-timber crops can make an enormous difference to the bottom line.

The common view is that adding value involves changing the form of a harvested product. For example, turning berries into jam may multiply the value of berries by as much as 10 to 15 times over selling them fresh. Processing raw materials can provide other benefits, including:

- being able to sell some products out-of-season or over a longer period of time (e.g., berries which often all become ripe at the same time)
- minimizing the need for cold storage and reducing losses during the shipping of fresh products over long distances
- differentiating your product from others using the same primary material, and creating a 'niche' market.

Less well-known are ways of adding value that do not involve changing the form of the raw materials. For example, selling further down the marketing chain—by-passing a middleman or two—may significantly increase the price you get for your product. Even delivering your own products or providing other services to the buyer could result in a higher price.

In other situations, processors prefer to buy from brokers who provide the amounts needed in one transaction. In this case, a co-operative venture with other producers will create the bulk shipments needed to attract buyer interest.

Ideas for Adding Value

A few of the more common methods of adding value to your agroforestry products are described below. Many edibles you could produce in an agroforestry practice also have a market in a value-added form. Fresh products are usually perishable

and only available for short periods. Processing extends the period during which products can be made available, and allows processors to increase potential returns.

Examples of Value-added Edibles

Processed fruit products (jams, jellies, fruit leathers, sauces, chutneys, vinegars); Lower quality/broken mushrooms (dried and used to create a flavorful spice or thickening agent for use in soups). Frozen products (berries are the most obvious candidates, though mushrooms are sometimes frozen); Dried products (mushrooms, berries). Other creative ways for adding value to edible (or other) products include direct marketing to consumers. In addition to the more traditional farm stands or farmers' markets, there are also options for supplying consumers with agricultural products through community supported agriculture (CSA) programs. (Check with your local organic producers associations).

It is important to be aware of complications that come with making processed food products. Carefully research regulations and standards before you begin production. Value-added decorative and craft products can provide immediate returns. The amount of skill required to produce these products varies. Some products (e.g., wreaths) are fairly easy to produce, while others (e.g., baskets and furniture) may require more time to develop proper skills.

Herbal products offer a number of opportunities for adding value. Medicinal herbs are a good option for marketing at a local level but you must adhere to regulations that govern the sale of these products. Getting into the business of selling 'drugs' to the mass market should not be taken lightly. Herbal teas sold under food regulations may offer a much easier approach.

Is it Worth it?: The 'Cons' of Adding Value

Adding value is not always the best option. Ask yourself some hard questions before you embark on the value-added route:

- *Are financial and human resources/expertise available to develop value-added processing?*

If not, what will it take to acquire them (e.g., loans, training)?

- *Do you have the long-term supply of resources to support a value-added strategy?*
- *What are the markets for potential value-added products? Can you meet the requirements of the marketplace? How easy will it be to break in to those markets?*
- *How long will it take to recoup the costs of any processing equipment involved?*
- *Can you handle the risks sometimes involved in adding value? For example, are you better off taking less for your product but letting a middleman absorb the risk?*

As with any business, you have to do the research, consider your resources and crunch the numbers to see if it's worthwhile. Usually, adding value is smart marketing.

Step 16: Setting the Price

The price you set will be a major factor in determining the success you have in marketing your agroforestry crops and products.

The two basic functions of pricing are to cover costs and make a profit, and to encourage customers to buy. You can either price to the market or price to your costs.

Pricing to the Market

When you're just starting out, pricing to the market is often the simplest approach. Pricing to the market involves finding out what others are charging for the same products, and then using that information to establish a similar price range. Buyers are also pricing to the market when they tell you what they're willing to pay for your products.

Pricing information on agricultural products can be obtained from a number of sources. If you plan to sell directly to the public, various retail market outlets will provide you with information on the going rate for your product. Buyers will also provide pricing information, but keep in mind that these prices are usually negotiable. For traditional agricultural crops, specialists at the MAFF should be able to assist you with pricing information. The Internet may

be another source of pricing information, depending on the market you are seeking to access. NTFP pricing information can be difficult to obtain, but your best bet is talking to other producers and the buyers you've identified. The Internet also has limited pricing information for some products, especially for 'finished' or value-added products such as crafts, wreaths, berry jam and the like (these may also be obtained from catalogues from various companies).

Pricing to Your Costs

Pricing to your costs ensures that what you charge covers all your expenses—not necessarily the case when pricing to the market. Businesses sometimes start out by pricing to the market, and then shift to pricing according to costs once these become clearly identified. If you find that similar products are available for a much lower price than you could charge, you'll have to either adjust your profit margin or differentiate your product so that consumers feel it is worth the higher price.

The timing of sales has a strong influence over the price which can be obtained, and the obvious objective is to sell when prices are highest (i.e., demand is high relative to supply). Non-perishable products allow greater flexibility in this choice, as do products processed to allow out-of-season sales. You may also wish to explore different management practices that will enable you to harvest early or late in the season when other supplies may be limited.

What goes into the cost equation?

Production costs, materials, fixed overhead, time/labor and profit.

A simple formula for setting the price per unit is:
Total costs of production per unit + Desired profit per unit = Price per unit.

Price Setter or Price Taker?

Sometimes you will be able to set prices for your product, other times you won't. A number of factors will influence whether you are a price-setter or a price-taker:

- **The scale of the market.** Prices for internationally traded commodities (e.g., lumber,

wheat) tend to be set far from the place of production. This is also true for many agricultural commodities and NTFPs (e.g., mushrooms, some floral greens, medicinal herbs) that are traded in international or other extended markets.

- **Product differentiation.** If your product is unique (the opposite of a commodity) you are more likely able to influence the price you receive. 'Niche' market and value-added products usually have superior opportunities for cost-driven pricing.
- **Your reputation within the industry.** Sometimes experienced, dependable suppliers are able to get a higher price for their products (a 'premium') because buyers know they will reliably supply a high quality product.
- **Your negotiating skills.** If you have good negotiating skills, your ability to influence the prices you receive for a product will increase greatly.

In the end, the single most important influence on your pricing decisions will be your customer's ability and willingness to pay the price you are asking. However, keep in mind that you can also influence prices by promoting your products.

Step 17: Getting Products to Buyers

There are three aspects to getting your products to buyers:

- A. Distribution: The sales channel(s) your product will follow.
- B. Location: Where you sell your product.
- C. Transportation: How your product will reach the buyer.

A. Distribution: Sales Channels

Your product may be able to take a number of different routes—or sales channels—to the end user. Which sales channel(s) you end up using will depend on a number of factors, such as:

- existence of a 'dominant' distribution system for your product
- demand for your product from various levels in the marketing chain

-
- time you have available and your marketing abilities
 - your own preferences.

Using these criteria, among others, you can choose one of the three basic marketing channels that most products follow:

- Direct marketing: From producer to the consumer
- Single-stage: From the producer to a retail business to the consumer
- Traditional or multi-stage: From producer through several others (broker and/or processor and/or wholesaler) to retailer to the consumer.

In general, the closer the producer is to the consumer, the greater the return as well as the workload. Your choice of sales channels may significantly impact your bottom line.

You may be tempted to eliminate one or more middlemen in the chain. Remember that if you're being paid outright by a broker/buyer/wholesaler, that person is also accepting the risk of selling your product to the next level in the sales chain. Before you take over that role yourself, make sure that you are willing to accept the additional risk. Also, some products and markets may allow you to invite bids from different buyers and possibly obtain a better price.

Knowing how your product is being distributed could, over time, help you establish 'alternative marketing strategies' to improve your returns. You may find opportunities to sell your products at a higher level and to cut out some of the middlemen. You may also discover potential channels that will provide other business opportunities.

B. Location

When selling directly to consumers, there is a range of choices as to where you will offer your product. Possible sites for marketing agroforestry products include:

- your property (everything from timber to berry jam), if not too remote
- roadside stands (your driveway, highway rest areas, park-and-ride locations)

- farmers markets (in urban areas these can be especially lucrative)
- craft markets
- co-operative marketing with other firms (e.g., renting seasonal space at a plant nursery, Christmas tree lot, supermarket, bed and breakfast).

Many businesses take orders over the phone, by fax, email, or regular mail, and deliver the product (themselves or using a delivery service) directly to customers. For some products, particularly specialty foods and crafts, the Internet can provide easier access to a wider market than traditional mail-order techniques. All 'mail-order' type direct marketing systems require a product that is easily handled and access to reliable transportation for it.

C. Transportation Options

If you are pursuing a sales channel where your customers are not coming to you, it is necessary to consider how your product will get to them. Important factors to consider include:

- cost to ship to distant markets via various transportation modes
- inclusion (or not) of transportation costs in the selling price (i.e., whether you or the buyer pays the freight costs)
- the reliability and timeliness of various modes of transportation (especially for perishable goods).

Negotiating favorable freight terms may be critical to the viability of your business, so do not simply accept the first quote you receive from a shipper. For air cargoes, some freight brokers may be able to offer much better rates than the airlines. Greater volumes may permit price breaks, so partnering with another businesses in assembling loads can be beneficial.

Another way to reduce freight costs is to find trucking firms which are seeking 'back-haul' loads (i.e., freight for trucks from regional or provincial distribution centers that would otherwise be returning empty). It is important to compile a list of prospective transport options and their respective costs. In some cases it is simply not profitable to ship a

specific product into a particular market.

Step 18: The ‘Final Cut’

Now that you have applied your market research to your list of ‘best bets,’ you are ready to establish a final listing of the crops and products that appear best suited to your production and marketing efforts. You may find that the initial ‘best bets’ you chose at the beginning of this chapter still look good, or you may decide to shelve some ideas and work through some other opportunities. Over the long-term, your choice of crops and products is likely to evolve as your business and woodland matures.

Step 19: Re-visit Your Objectives and Priorities

The first step in developing your Workbook was to outline your initial objectives and priorities for your land-based business. Since then, you have gathered considerable amounts of information that will likely change at least some of those original goals. Record your revised objectives and priorities in the space provided in the Workbook.

Step 20: Detailed Crop Information

In order to develop the most functional and profitable agroforestry practices, you should know as much as possible about each plant you intend to grow. You will have gathered much of this information while filling out your Workbook, using your land assessment, plant inventory (where appropriate), market research, Appendices 2 and 3, and possibly your own additional research. Important information includes the biological requirements of each plant, the agroforestry practices they can be grown in, what other plants (and animals) they are compatible with, labor requirements for harvesting, potential volumes, value-added opportunities, and useful market information.

The table provided in the Workbook may include categories of information you do not have. You

can exclude these or take extra time to find the information. There is also extra space for additional information you consider important but not specifically listed here.

Step 21: Designing Your Agroforestry Practices

Now is the time to arrange your plants into agroforestry practices that best meet the management objectives you outlined in Step 19. The information on each plant crop, and the management information provided earlier in this chapter, will allow you to design and manage agroforestry practices that best meet your objectives. Fill in a table in the Workbook for each agroforestry practice you intend to develop.

Note: Remember that price and marketability are not the only criteria for selection of the plants you will include in your agroforestry practices. Some plants may be chosen because they provide valuable ecological functions to your agroforestry practice, such as trees for shade and windbreaks, or legumes for nitrogen fixation.

Building an Agroforestry Development Plan

The purpose of building an agroforestry development plan is to create a schedule of the work that needs to be done in the years ahead in order to fully develop your agroforestry area(s). Your completed Agroforestry Development Workplan will include specific tasks, timelines, and labor projections for each agroforestry practice on a year-by-year basis. You will need a Development Plan for each agroforestry development area. The Development Workplan is the final step in your Workbook, and will form the practical basis for your agroforestry development. You will no doubt change and adapt your work projections in the years ahead, but a good Development Plan will form a clear starting point and help focus your management efforts.

The Development Plan includes two distinct parts:

- *A five-year plan outlining specific tasks for each agroforestry practice*
- *A yearly activity plan, broken down into specific tasks for each month.*

Step 22: A Five-year Management Projection

Your five-year management projection is a schedule of the work you plan to undertake in the next five years in order to develop your agroforestry practices. The specific tasks and timelines you prepare will form the basis for your yearly activity schedule.

Don't worry too much about getting absolutely everything right on the first pass. Your plans will change over time and you can go back and adjust your projections accordingly. For now, you are mainly interested in conceptualizing the overall operation on paper.

The five-year management projection has four sections:

- **Area:** size of the area to be managed.
- **Practice:** agroforestry practice and its associated products.
- **Year:** year that you want the management activity to take place.
- **Management Objective:** specific objective you hope to accomplish.

Use the template provided in the Workbook to create your own five-year management projection.

Step 23: Yearly Activity Schedule

The yearly activity schedule describes specific tasks that need to be done, when and by whom. This is the document you will use to plan your work schedule on a month-by-month basis. A good yearly activity schedule will allow you to identify potential time and business conflicts, and ensure you avoid overlapping seasonal activities that could create shortages of labor and resources.

A yearly activity schedule—one for each agroforestry practice—has five sections:

- **Crop Plant:** the plants that you have decided you can grow and market.
- **Management Objectives:** a record of objectives, transferred from your five-year projection.
- **Task and Time of Year:** a list of specific tasks that must be accomplished to achieve each objective, including timelines associated with each task.
- **Materials:** estimates of seed, seedlings, fertilizer, fencing, animals, feed and other items necessary for corresponding tasks.
- **Labor and Equipment:** a record of labor and equipment needs (if any) for each of the specific tasks.

Like the five-year management projection, your yearly activity schedule will likely change as you learn more. Remember to leave yourself plenty of time to complete all the work. As landowners well know, most tasks take longer than expected. The yearly activity schedule will also be helpful in costing the materials, labor and equipment that are necessary for the cash flow projection of your business plan. For details on business planning, refer to *Building a Sustainable Business: A Guide to Developing a Business Plan for Farms and Rural Businesses*. The information in the Workbook will provide a good basis for a business plan that includes a comprehensive cash flow projection.

Notes

Notes

Section 3: Alley Cropping

In this chapter:

- Defining Alley Cropping
- General Benefits of Alley Cropping
- Potential Functions of Alley Cropping
- Alley Cropping Design Considerations



In this alley cropping example, soybeans are planted in the alleyways between nut trees for short-term income and a possible long-term timber harvest.

Alley Cropping

Alley cropping is broadly defined as the planting of two or more sets of single or multiple rows of trees or shrubs at wide spacings, creating alleyways within which agricultural, horticultural, or forage crops are cultivated. The trees may include valuable hardwood species, such as nut trees, or trees desirable for wood products. This approach is sometimes called intercropping and multi-cropping. Currently most of the emphasis and research focuses on pecan and black walnut alley cropping or intercropping applications. However, there are numerous other potential tree, shrub, and crop combinations.

Role on the Farm

Alley cropping provides the opportunity to grow wood or other tree products such as nuts or fruit, while providing an annual income through the

production of companion crops.

Benefits of Alley Cropping

- *Diversify farm enterprise*
- *Reduce erosion*
- *Improve water quality*
- *Protect crops*
- *Enhance wildlife*
- *Improve aesthetics*

Diversifying farm products and supplementing income:

Alley cropping diversifies farm enterprises by providing short-term cash flow from annual crops while also providing medium to long-term products from the trees. Timber and non-timber products may contribute to income generation from the farm. In addition to the potential for producing nuts, berries, and fruits, well-managed timber can provide a long-term investment.

Reducing soil erosion from wind and water:

Soils with a high erodibility index (>8) are highly susceptible to damage and are difficult to protect when used as crop land. The soil erodibility index provides a numerical expression of the potential for a soil to erode considering the physical and chemical properties of the soil and the climatic conditions where it is located. The higher the index, the greater the investment needed to maintain the sustainability of the soil resource base if intensively cropped.

Alley cropping protects fragile soils through a network of roots produced by the trees and supplemental ground-cover resulting from fallen leaves and the companion crop. Rows of trees, shrubs, and/or grasses planted on the contour of a slope will also serve to reduce soil movement down the slope.

Reducing water erosion on sloping cropland:

The interception of rainfall by the tree canopy and increased infiltration due to tree and herbaceous roots protects the soil; water quality is improved due to interception of sediment by herbaceous cover in tree rows and interception, sequestration, and decomposition of agricultural chemicals by tree and herbaceous root environment.

Reducing erosion:

Trees and shrubs improve crop production by slowing wind speed and reducing wind erosion, modifying the crop microclimate with similar effects to that of windbreaks (see section #6 on windbreaks). Alley cropping can reduce crop evapotranspiration by 15-30 percent and increase water content in the tillage layer by 5-15 percent. Deep tree roots transport soil nutrients to leaves. Leaves contribute organic matter to soil and release nutrients as they decompose.

Protecting crops:

Alley cropping protects crops from insect pests by reducing crop visibility, diluting pest hosts due to plant diversity, interfering with pest movement, and creating environments less favorable to pests and more favorable to beneficial insects.

Enhancing wildlife habitat and aesthetics:

Linear plantings of trees and/or shrubs in an agricultural landscape increases the habitat diversity for wildlife, both through increased amount of edge and/or as a result of the increased diversity (vertical and horizontal) of vegetative types. Increased vertical complexity has been correlated with increased bird numbers. These areas can also serve as protective corridors for wildlife movement and provide a food source.

Limitations to Alley Cropping:

Alley cropping, as with other forms of multi-cropping, requires more intensive technical management skill and marketing knowledge. The following limitations should be considered:

- *Requires a more intensive management system including specialized equipment for the tree management and additional managerial*

skills and training to manage multiple crops on a given site

- *Removes land from annual crop production and may not provide a financial return from the trees for several years*
- *Requires a marketing infrastructure for the tree products that may not be present in the local area*
- *Trees may be an obstacle to crop cultivation if not carefully planned and designed*
- *Trees compete with companion crops for sun, moisture and nutrients*
- *Companion crops may compete with trees for moisture and nutrients*
- *Herbicide drift from crops may damage trees*

Alley Cropping Functions

There are numerous mechanisms in which alley cropping impacts the landscapes to which it is applied, including water management, nutrient cycling, soil quality, microclimate modification and pest management.

- Alley cropping impacts water management by altering the hydrologic cycle through increased water infiltration via disruption of overland flow by the tree/grass strip. Water cycled through the system is more thoroughly filtered and any excess is gradually released.
- Nutrient cycling and soil quality are impacted as deeply rooted trees exploit lower soil horizons and cycle the nutrients to the surface through litterfall. Additional nitrogen is added to the nutrient pool if a nitrogen-fixing tree or shrub is used. Reduced soil erosion by wind and water help maintain soil quality. Additional moisture is added to the site through interception of rainfall by the tree canopy.
- Microclimates are modified due to reductions in wind velocity which reduces air temperatures and evapotranspiration of intercropped plants and soil.
- Pest management can be strengthened through the structural diversity in the landscape de-

veloped by the intentional association of trees and crops. Alley cropping creates habitat to build up biodiversity and associated populations of natural enemies of insects, diseases, or weed pests and can interrupt pest cycles.

- Similar to the function of riparian forest buffers, alley cropping practices may help intercept, fix and biodegrade sediments, nutrients, pesticides, and other biological pollutants present on the site.
- Similar to the establishment of windbreaks, alley cropping may improve wildlife habitat by providing food, cover, nesting sites, and travel lanes for a variety of wildlife species.
- Incorporation of trees and shrubs add opportunity for additional products which are derived from the tree/shrub component (wood, nuts, fruit, foliage) as well as the option to plant sensitive crops which can be grown due to the protection from the trees.

Not all of these functions may exist with each application of alley cropping. The function is dependent upon the way the plant components are manipulated in the design process. There is also a lack of understanding of all the different interactions that can occur with the different combinations of tree/shrub/herbaceous (annual and perennial) plants. For example, we do not have enough information to evaluate all the different pest interactions to positively say that beneficial insects will be favored and the negative pests will be reduced, although there are examples of this.

Designs Unique to Each Landowner

Each alley cropping practice can be uniquely designed to reflect landowner needs and site potential. However, there are physical interactions between the rows of woody species and the companion crop that should be understood and reflected in plans for the alley cropping practice design.

Physical growth traits of individual trees and

how these influence the crop, are based on three factors:

A. Light Competition

B. Root Competition

C. Allelopathy

A) Light Competition (above ground)

A tree species should be selected that best accommodates the sunlight requirements of a specific crop. Some tree species have small leaves and feathery foliage casting a light shade and lend themselves well to alley cropping. When considering a tree species for an alley cropping practice, small leaves and light shade is preferable to heavy shade.

In what ways can light competition be reduced?

• Spacing

When the distance between rows of trees is increased, the years an alleyway may be cropped with minimal competition from the trees is also increased.

• Row Orientation

An East-West orientation of tree rows will maximize the sunlight received by an alley crop, provided the topography permits this arrangement. Trees may have to be planted on the contour if erosion is a consideration. Trees may be planted in other orientations if prevailing winds have a negative influence on crop yields.

• Maximizing available light

Trees with small fine leaves will allow more light through the canopy. These leaves decompose rapidly and allow nutrients to be recycled into the soil faster. As decomposed materials contribute organic matter to the soil, the soil moisture-holding capacity is increased. Increased organic matter enhances soil microbe and earthworm activity. Taken together, this also improves soil tilth and health.

• Understanding crown and foliage characteristics - phenology

Utilize trees that leaf-out late in the spring and/or drop leaves early in the fall. If the agronomic crop component matures in the early spring, such

as winter wheat (*Triticum aestivum* L.) does, or heads out in the late fall, such as milo does, a tree species should be incorporated that best accommodates the light needs of that specific crop (e.g., a tree species that breaks dormancy late for winter wheat or a species that drops its leaves early for milo - a good example of a tree that satisfies both needs is black walnut).

- *Timely Thinning and Pruning*

Properly thinning trees within rows can maintain semi-open crown conditions. Maintained through regular thinning, these openings can help continue the vigorous growth of shade intolerant companion crops. Pruning basal branches before they reach 1" in diameter improves future wood quality and thins the depth of the canopy permitting more sunlight to reach companion crops.

B) Root Competition (below ground)

Competition for water and nutrients between the tree and the intercropped species not only affects the yields of the companion crop but also the growth of the trees.

What ways can root competition be reduced?

- *Understanding rooting zones*

Vertical distribution of root systems varies among species. Deep-rooted species have a reduced volume of roots near the surface (good for minimizing competition with adjacent crops). Erosion can be addressed through ground cover establishment and management.

- *Which trees have deep roots?*

Species have different site requirements. For instance, as a rule, wetland species tend to be shallow rooted. While a potential species list has been included in the appendices, it is always useful to consult your local forester for assistance in determining species suitable to your planting site.

- *What can be done if the trees are more shallow rooted?*

Through the use of a Ripper, Coulter, or Chisel Plow, roots can be severed (the addition of sub-surface knives may also be used to sever more

roots outside the rip).

Trenching trials strongly suggest that even during the early years of tree development, competition for water and/or nutrients is the major reason for reduced crop yields. By early (beginning with young trees) and repeated (every couple of years) severing of shallow lateral roots, the number of tree roots can be significantly decreased in the plow zone. The remaining roots will remain active deeper in the soil profile.

C) Allelopathy (Chemical Interactions)

Traditionally, the term allelopathy denotes the negative biochemical influence exerted by one plant on the growth of nearby plants. For example, pine needles may produce acids that inhibit growth of plants on the forest floor, while roots of black walnut trees produce a compound called juglone, which also inhibits the growth of other plants.

A broader definition would also include positive influences. For example, some plants (e.g., legumes, European black alder, black locust) fix nitrogen that can benefit nearby plants.

Chemical interactions can be controlled by choosing plant combinations that work together. Juglone, for instance, does not affect all plants. Conversely, nitrogen-fixing plants are only useful to neighboring plants that require extra nitrogen.

Tree arrangement on the land Layout

The tree and/or shrub row(s) are placed at intervals across the crop field, depending on the purpose, either on the contour or perhaps even perpendicular to prevailing troublesome winds. Several factors are used to determine the interval between the row(s) of trees or shrubs including slope length, field width, crop light requirements and equipment width.

As mentioned earlier, landowner objectives will determine the products to be harvested from the alley cropping practice. These objectives also determine the arrangement of trees and crops and

the set of management practices needed to obtain those products. Alley cropping practices are highly diverse and range from simple to complex. Plantings can consist of a single tree species or a number of species. Similarly, single tree rows or multiple rows may be used.

There are several key factors to consider when planning and establishing the practice on a given site:

Layout - Tree Arrangement

- Single or mixed species
- Number of tree rows - single vs. multiple
- Alley width: Between row spacing
- Within row spacing

With a conservation perspective in mind, slope length relates to the spacing needed to reduce water erosion. The light requirement for the crop or forage to be grown in the alleyway must be considered prior to tree establishment. Finally, alley width must be set as multiples of the widest field equipment width.



Single vs. Mixed Species - The row(s) of trees can have either a single species in the row or mixed species. A single species is the easiest to plant but a mixed species planting with similar growth rates and site requirements may provide

greater economic and environmental diversity. Factors to consider when deciding how many rows to establish and the arrangement of the trees within the rows may be based on a number of potential benefits including:

- *Annual crop being produced and area removed from production by tree/shrub rows*
- *Desired tree/shrub crops and management needed to enhance production (such as weed control and pruning)*
- *Erosion concerns that multiple rows and combinations of trees/shrubs/grasses can better address*
- *Wildlife habitat created through multiple rows of combined trees/shrubs/grasses*

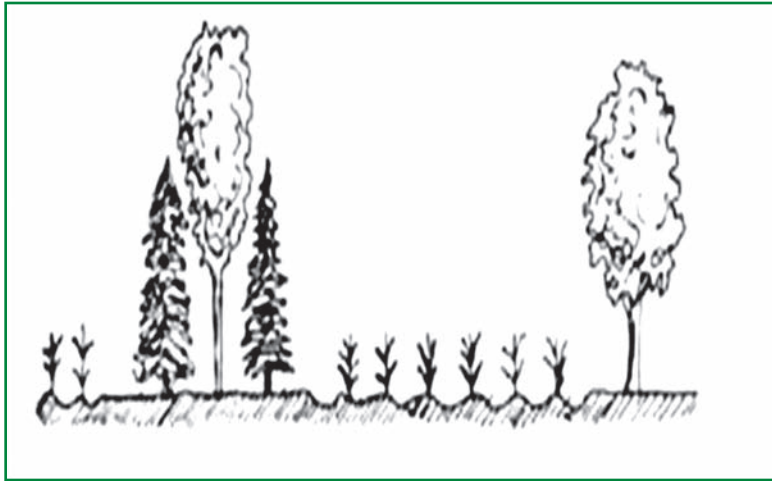
Single vs. Multiple Row Sets of Trees -

The single row takes up the least amount of space but the trees will probably require pruning to enhance the quality of the future wood product. Multiple rows, however, will result in self-pruning of the interior row(s). Conifers are a good choice as the “trainer” trees in the outside rows since hardwood species will tend to bend toward the light in the alleyway thus reducing their wood value except for chips. Nitrogen-fixing “nurse trees” can also be used.

Advantages to single rows:

- *Environment maintained*
- *Less tree to tree competition*
- *Reduced competition*
- *Wildlife habitat*
- *Plant-Insect relationships*
- *Economics*

Excellent environment for nut trees to develop full crowns. Trees in single rows which are spaced further apart develop wider, more branched crowns. Conversely, if high value tree form is important, then closely spaced trees may encourage self-pruning and straight bole development. Trees are open on at least two sides, and therefore have less competition between trees within each row, when compared to multiple row configurations. Single tree rows add diversity to a typical row



Top: Triple row of trees using conifers to train high-value hardwoods. A single-row tree strip is also shown. Bottom: aerial view of single, double and triple row configurations for alley cropping at the Horticulture and Agroforestry Research Center, New Franklin, Mo.

crop field. Researchers think the greatest value to wildlife of woody-herbaceous buffers are the benefits created through breaking-up the traditional mono-culture setting associated with agriculture. Vegetation change and structural diversity is an important tool in controlling agricultural pests. Products coming from the farm are diversified through the addition of trees and their products.

Advantages to double rows:

- *Environment maintained*
- *Reduced competition*
- *Wildlife habitat*
- *Economics*

When rows are offset, double rows of trees maintain similar advantages to that of single row plantings while improving the potential to realize environmental benefits, such as soil and water protection. Compared to rectangular grid patterns of tree planting, double rows allow maximum utilization of space for companion crops.

Competition for light between trees can be reduced through offset row configurations.*

Multiple rows of trees planted in offset configurations maintain exposure of a majority of each trees crown/canopy to sunlight. Double rows provide the same benefits as a single row alley crop setting, but allow structure (vertical and horizontal vegetative layering and density components) and diversity

(variety of species planted) to be increased. This creates an environment for greater utilization of the tree row by increased numbers of wildlife species. Finally, products coming from the farm are further diversified. It is also possible that thinned trees can provide early economic gain (prior to final crop tree maturation).

[*As mentioned, caution should be observed since deciduous hardwood trees will exhibit a tendency to grow towards light. If an environment of unequal lighting is created (more light to one side of a trees' crown), most hardwood species will grow towards sunlight, and away from competition. This can cause devaluing of the tree for wood products due to sweep (stem curvature).]

Advantages to multiple rows:

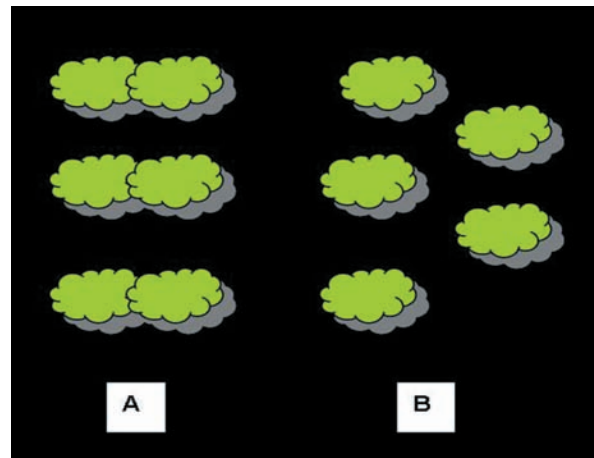
- *Benefit from competition between tree rows*
- *Wildlife habitat*
- *Plant-Insect relationships*
- *Economics*

Certain trees will benefit from some light competition. For high value wood, it is desirable to grow a single, straight stem. Trees and /or shrubs planted on either side of a high value tree species, can be used to train the stem of that tree. By using ‘trainer’ trees on either side of the high value tree, natural pruning and straight stem growth can be encouraged. Ultimately, this starts the process (may also require pruning) of producing a straight, clear (small or no knots) log of higher quality than might be grown in an open setting. However, choosing the correct ‘trainer’ species is important because you do not want the outside trees to outgrow your center tree. If they do, they will provide too much shade.

Wildlife habitat potential increases greatly with a wider row of trees. Increased numbers of animals will use this area for travel lanes and the interior creates protective cover opportunities for birds and small mammals.

Plant-insect benefits are the same for single and double row configurations, though some additional advantages may be realized by diversifying the species planted.

Economic benefits are similar to double row configurations. As with double rows, additional trees per acre in multiple row configurations may also qualify these plantings for cost-share assistance and create opportunities for medium-term tree crops to be removed for cash flow (e.g., trees grown for landscaping).

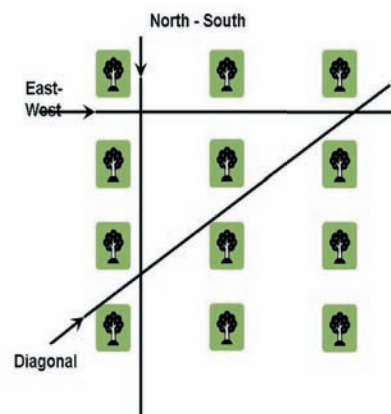


Crown competition between adjacent trees (A) as compared to the increased growing space available to individual trees when planting in an offset configuration (B). Double or triple rows of long-needed hard pines (e.g., cold tolerant loblolly or pitch x loblolly hybrids) can be grown either as (A) or (B). A byproduct of a double or triple planting is the potential for pine straw production within tree rows.

Tree and shrub arrangement

To enhance the growth of trees in multiple-row plantings, staggering the trees between adjacent rows will permit maximum crown development. Staggered spacing provides more room to grow.

Alley Width: between tree row/set spacing: If wood production is of primary importance, closer row spacing is desirable. Wider row spacing is preferred when nut production is desired.



Equipment Travel Lanes: The use of trees planted in rows can allow equipment passage in any number of directions.

The spacing should also be adjusted based on multiples of the widest farm equipment to be used in the alley way. Spacing to accommodate equipment is particularly important in nut production when early crown development is desirable. Plan alleys such that full, or multiple, passes of the equipment are utilized. For example, if using a 13-foot wide disk it may be desirable to have an alleyway 60 feet wide. This allows for 4 passes with the disk (52 feet) and a buffer (to ensure damage is not done to the base of the tree) of 4 feet adjacent to each tree row (8 feet; 4 feet on either side of the cropped alley).

The number of years that light-demanding crops are to be grown in the alleyways is another consideration:

- 60 feet spacing will generally allow crop production (e.g. corn, soybeans, cereals, etc.) for 5-10 years
- 80-120 foot spacing will allow production for up to 20 years or more
- As the shade increases over the life of the trees, it may be necessary to change the companion crop being grown in the alleyway (see plant material section).

Within Tree Row Spacing: The primary objective for the trees, and the cost of the planting stock, will help determine the within-row spacing. If erosion control is desired, a closer spacing would give better results. If the tree stock is of unknown origin and quality, a closer spacing would also be desirable to give more opportunities to select the best quality trees during succeeding thinnings. Closer spacing may also be required if minimum numbers of trees per acre are required to meet government cost share requirements. However, if expensive grafted tree stock is used for nut production, a wider spacing may be used to reduce cost.

For example, trees that are grown tightly spaced will have a tendency to grow up, towards the light. This growth trait is highly desirable when growing trees for quality wood production. Additionally, as these tightly spaced trees begin to shade one another, each of their branches in the

shade will begin to die and eventually fall off. This is called self-pruning, and is again desirable when trying to grow high quality wood in timber production.

Tree and Shrub Selection: Desirable Characteristics

There are a number of desirable characteristics for trees or shrubs that will be grown in an alley cropping system. It is not necessary (probably not possible) that all the following characteristics be exhibited by one tree species:

- *Produces a commercially valuable product or multiple products (i.e., timber, nuts) that has an acceptable local market.*
- *Relatively fast growing (medium growth rate on high value trees is acceptable) or highly valued for production or conservation benefits*
- *Produces appropriate shade for the companion crop*
- *Be adapted to a variety of sites and soils*
- *Deep-rooted with minimal roots at the soil surface to minimize competition with crops in the alleyway.*
- *Have foliage with minimal acid-generating potential if companion crops prefer a pH neutral soil. Conifers acidify soil, combine well with acid loving crops.*
- *Does not produce growth inhibitory chemicals (allelochemicals) that would prevent some crops from growing near them (e.g., black walnut)*
- *Have a growing season that complements the companion crop*
- *Produces wildlife benefits*

Selecting companion crops

Companion crops are planted in the alleys between the tree rows. The choice of companion crop will vary depending on the types of trees selected and the crop(s) desired by the grower. There are three major groups of crops which can be grown in an alley cropping practice: 1) Row/cereal and forage crops; 2) Fruits and other specialty crops; and 3) biomass producing crops.

Initially, the growing environment in the alley will

be favorable to row crops requiring full sun (corn, soybeans, wheat) or forages. Potential companion crops include row/cereal crops, forages, fruits and other specialty crops, biomass producing crops.

As trees grow taller and develop larger crowns, they will exert greater influence on the growing environment in the alley with increased shade, water and nutrient competition and humidity levels, along with decreased temperatures and decreased wind movement.

Plant Materials - Trees for Alley Cropping
Black walnut: Outstanding markets available for wood. Opportunities exist for the sale of wild nuts, cultivars provide a higher return. Produces light shade, has a short foliage period, and is deep rooted. The juglone allelochemical limits companion crop choices somewhat.
Pecan: Markets available for both wood and nuts. Markets exist for nuts from native wild pecans and for cultivars. Nuts more valuable than the wood. More shade produced than with walnut but no allelochemicals.
Oaks: The wood has a high value and the acorns are good wildlife food. The oaks are relatively slow growing and produce fairly dense shade.
Chestnuts: Chinese chestnut produce valuable nuts at an early age, are blight resistant and adapted to the climate of the eastern US. Markets are growing for domestic producers.
Ash: The wood is high value but there are no other potential products. They are relatively fast growing and produce a light shade.
Nut or fruit bearing shrubs: The hazelnut, pawpaw, blueberries, etc. could be used as stand-alone hedgerows or in combination with other taller tree species.

While availability of sunlight is a primary factor that determines how well row crops or forages perform in the alley, water and nutrient competi-

tion is even more significant. The tree canopy density will be partially determined by the spacing of the trees within a row and the width between tree rows. This spacing will also influence below ground competition.

Tree/Shrub selection for row crops - - Corn, soybeans, wheat, milo, barley, oats, potatoes, pumpkins, lettuce, peas, etc. have demonstrated success in alley cropping. Most of these crops have high light demands. Using corn in the first few years speeds tree growth by creating a greenhouse effect for the tree rows. In an alleyway 60 feet wide, shade will limit their use after 5-10 years depending on the tree species.

Selection of forage crops - In an alley cropping practice, forage crops such as fescue, orchard grass, bluegrass, or alfalfa, are grown for hay production between rows of planted trees, but are not grazed. This distinguishes the alley cropping practice from a silvopasture practice.

Kentucky 31 tall fescue and orchardgrass tolerate considerable shade and are very productive cool-season grasses. Other potential forages that show shade tolerance include Kentucky bluegrass, ryegrass, smooth brome, timothy and white clover. Winter annuals such as cereal grains, crimson clover, and hairy vetch must be reseeded every year and only provide one cutting of hay, but do not compete with the trees and provide good erosion control.



Bluegrass hay is harvested between rows of pecan trees in this alley cropping example.

Cool vs. warm-season forages

It is also necessary to consider whether a cool or warm season crop and/or forage may be more appropriate for the site conditions and objectives. Studies conducted by the University of Missouri have found that many cool-season legumes and grasses produce greater biomass when grown under partial shade as compared to full sun. Some warm-season grasses showed similar responses, but most were southern temperate zone species.

- **Advantages and Disadvantages of Cool Season Forages**

Cool-season perennial species are most productive in the spring when temperatures are typically cool and moisture plentiful. They grow less or become dormant during the hot summer months when moisture is often limiting, then increase growth in the fall.

Cool-season forages can be highly competitive with tree crops for moisture and nutrients, especially in the spring as trees break dormancy. As young trees are becoming established, it is desirable that no vegetation grow within a 3-foot radius. To maximize the growth of older trees, vegetation should be controlled in a diameter approximately equal to the crown diameter size. However, this may or may not result in the greatest economic gain.

Warm-season forages

Warm-season perennial species grow most during the summer months. Though warm-season forages have a shorter growing season, they are still very productive.

Eastern gamagrass, bermuda grass, Switchgrass, Indiangrass, and big bluestem are examples of warm-season perennial grasses identified for use in Missouri. Southern climates may use bahiagrass or bermudagrass.

- **Advantages and Disadvantages of Warm-Season Forages**

The root systems associated with warm-season forages are typically deeper than cool-season grasses. This makes them an excellent choice for controlling erosion and protecting sub-surface water from leached pesticides and nutrients. These forages will likely be less competitive in the early spring when many trees are beginning their annual growth. Warm season “clump” grasses provide excellent habitat for quail in combination with woody shrubs.

Warm-season forages grow vigorously in the hot summer months. Therefore, a consideration is that this may put them in competition with trees and other woody vegetation at a time of the year when water is quite possibly the most limited resource. On the other hand, if a tree species puts on its growth in late spring, in certain instances a warm-season forage can make a good companion crop.

The point is that compatibility, even seasonal compatibility, must be considered when selecting trees, shrubs, grasses, and crops for an alley cropping practice.

Integrating Specialty Crops into an Alley Cropping Practice

Most often associated with the forest farming practice, specialty crops also have potential for integration into alley cropping practices. Landscaping plants, Christmas trees, small fruit trees or shrubs and berries can be grown either temporarily between the permanent in-row crop trees or in the alleyways. As the alleyways become more shaded, shade tolerant species such as redbud, dogwood and spruce could be grown for landscaping if there is a nearby market. Plants which can be marketed for their medicinal, ornamental, or food values (including St. John’s Wort, wildflowers for seed, pumpkins, etc.) also provide unique opportunities for alley cropping. Species that are light demanding can be established in the alleyways while those requiring some shade can be planted within the tree rows as shade develops.

Specialty crops that can be produced in full sun include:

- Horticultural plants, such as tomatoes, pumpkins and blackberries
- Forages, grains and oilseeds
- Tree crops, such as nuts
- Seed production, such as wildflower or select grasses
- Christmas trees
- Shrubs and other landscaping plants
- Trees for lumber and wood fiber products

Biomass Crops

Both woody and herbaceous plants for biomass production could be an option for the alleyways. Soft hardwood species such as cottonwood, hybrid poplars, willow, sycamore and silver maple could be grown for pulp, paper or oriented strand board if markets are available. Herbaceous biomass crops (e.g. switchgrass) could be another alternative.

Operation and Maintenance:

Pest management: Periodic inspection of the crops and trees is recommended to detect and identify possible pests. Insects and diseases can be significant factors in reducing the health and vigor of both the tree crop and the intercrop. The corrective actions should minimize the impacts on beneficial insects.

Fertilization and nutrient management: A normal fertility program should be applied for the intercrop in the alleyway. Generally, fertilization of the tree crop is not needed, but fertilizing the intercrop may also benefit the trees. Competition for nutrients can be minimized by root pruning or by adding more nutrients. Nutrients can be added in the form of chemical fertilizer, animal manure or a wide range of other materials. This may also include the use of living mulches or green manures.

Canopy management (Pruning):

If there is too much shade under an existing stand of trees, the canopy can be pruned to allow more light to reach the understory plants. You may be able to accomplish this by clear-stem pruning for improved timber production. This involves the removal of branches low on the stem of a tree in order to raise the height at which the canopy begins. This allows more light to enter the understory from side angles while also creating adequate space for operating equipment. Remember, removing more than 40% of the trees foliage will significantly reduce the growth of the tree. It is best to always have 40-50% of a tree's height in crown or foliage.



Top: Lettuce intercropped until mid-June followed immediately by a pumpkin intercrop until October. Vineland, Ontario. **Bottom:** Grain is alley-cropped in a young pecan orchard, Georgia, U.S.



Alley cropping example: *Paulownia and winter wheat in China-- Through careful pruning, the proper shade canopy can be developed and light levels can be manipulated in an alley cropping practice. Often, the alley cropping practice will transition to more shade tolerant crops, or extensive tree removal by thinning will be needed in order to maintain light levels.*

Periodic root “training” will improve crop yields:

Based on research into tree and crop interactions it has been shown that even during the early years of tree development, competition for water and/or nutrients is the major reason for reduced crop yields. By early (beginning with young trees) and repeated (every couple of years) severing of lateral roots, the number of tree roots can be significantly decreased in the plow zone. Row crops will continue to produce commercial yields even as shade levels increase.

Weed Control:

Weed control for an alley cropping includes both the rows of trees and the intercrop. For the tree row(s), weeds need to be minimized usually for the first three to five years in a band about three feet on each side of the trees. Weed removal can be done in a number of different ways, from herbicides and cutting to cultivation. An additional consideration for use in controlling weeds adjacent to trees may include mulch, fabric barriers or living mulches. Nothing will improve the growth of trees and shrubs like the control of competing grasses.

Maintenance tasks specific to trees:

- *Replanting: Replant all trees or shrubs that have failed for the first 3 years.*
- *Branch Pruning: Pruning of the trees may be necessary to improve wood quality, the micro-environment for the companion crop, allow equipment access, or correct storm damage.*
- *Root Pruning: Pruning tree roots (up to 24 inches deep) projecting into the companion crop area may reduce competition. Do not prune both sides of the trees the same year. Allow a 3-year interval before pruning the other side. Pruning will need to be repeated on a 5- to 8-year interval.*
- *Thinning: The tree rows will normally need to be thinned to increase light in the alleyways and speed production of high value crop trees.*

To achieve the objective of maximum tree growth rates throughout the timber rotation, growers must be willing to periodically thin out trees. Failure to do so dramatically and adversely impacts future tree growth rates and rotation length.

Economic incentives for alley cropping:

There are many agencies offering programs that can be used to establish and maintain agroforestry practices on private land. One of the most significant of these agencies is the USDA Natural Resource Conservation Service (NRCS), which offers the Environmental Quality Incentive Program (EQIP) that may be utilized toward agroforestry practices like alley cropping.

The EQIP program is designated for environmental concerns associated with livestock production. Landowners engaged in livestock or agricultural production can apply for 1-to 10-year contracts through a competitive application process based on environmental benefits. Eligible lands include cropland, rangeland, pasture, forestland, and other farm and ranch lands. Conservation practices are designed with the help of USDA/NRCS and other agencies to address the locally-identified priority resource concerns. EQIP contracts provide cost-

share payments up to 50 percent of the establishment cost for conservation practices and various incentive payments. For alley cropping practices, EQIP will pay \$50 per acre for first 3 years on land planted in trees and the grass strip adjacent to trees. No more than 50% of the cropland can be enrolled.

Funding incentive for Alley Cropping through EQIP:

\$50 payment per acre for first 3 years on land in trees and grass strip adjacent to trees. No more than 50% of the cropland can be enrolled.

NRCS Standard 311 identifies the guidelines for establishing an alley cropping practice for EQIP. For more information, contact your local USDA/NRCS office.

Additional USDA programs to establish and maintain an alley cropping practice are offered through the Forest Service (FS) and the Sustainable Agriculture Research and Education (SARE) program. See chart below for a listing of incentives offered by these federal agencies or consult the UMCA publication “Funding Incentives for Agroforestry in Missouri.”

Cost Share Opportunities:

Alley cropping is the tree or shrub component of an overall conservation management system for cropland or hayland. To be an effective conservation management system, several other conservation practices need to be considered for inclusion in the system depending on the objectives to be achieved.

- Conservation Crop Rotation (328)
- Crop Residue Management (329, 344)
- Contour Farming (330)
- Contour Buffer Strips (332)
- Contour Orchard & Other Fruit Area (331)
- Filter Strip (393)
- Forage Harvest Management (511)
- Grassed Waterway (412)
- Stripcropping, Contour (585)

Federal Agency and Programs Offered	Programs available for Alley Cropping	Key to programs
USDA/NRCS		<ul style="list-style-type: none"> • CS = Cost Share (ranges from 50% to 90%, based on a predetermined expected cost structure) • LE = Land Easement (Rental payments based on an average rental rate per land use type; easements are typically 5, 10, 15, 30 years or permanent) • M = Annual maintenance payments (range from \$5 - \$10 per acre) • IP = Additional incentive payments (payments could include sign-up bonuses, additional cost-share, and/or increased land easement rates) • G = Grants
Environmental Quality Incentive Program (EQIP)	IP	
Conservation Security Program (CSP)	CS,LE	
USDA/FS		
Forest Land Enhancement Program (FLEP)	CS	
SARE		
Producer Grants	G	

- Terrace (600)
- Pasture and Hayland Planting (512)
- Nutrient Management (590)
- Pest Management (595)
- Wildlife Upland Habitat Management (645)

Summary

Alley cropping needs to be part of an overall management system including crop rotation, crop residue management, combinations of buffer practices, pest management and nutrient management. Alley Cropping can help diversify farm enterprises, protect soil, improve air and water quality, enhance fish and wildlife habitat, conserve biodiversity, and beautify the landscape.

Success Stories:

Paul Smith

*20-acre alley cropping practice
Northwest Missouri, near Claremont*



“I guess I was a little hesitant at first to plant trees. I wondered at times what some of my farmer friends and neighbors would think of covering good bottomland with trees. My wife reminded me that her father had spent his lifetime clearing this off and now we're planting it back in trees.

In 1999 we seeded this field to orchard grass, and alfalfa. The first cutting that year produced about

3 tons per acre, and I feel that we benefit from the alley cropping because we have a short-term benefit of the crops between the tree rows -- and eventually, my family or someone else will benefit from the tree crop.”

Dan Shepherd

Shepherd Farms - Bluegrass hay and pecan alley cropping practice; buffalo ranch and agritourism business, Clifton Hill, Mo.



Dan Shepherd raises buffalo for processing into lean, high-quality meats and jerky, in addition to his pecan and bluegrass hay alley cropping practice. Shepherd Farms is also a nationwide leader in production, wholesale and retail distribution of Eastern Gamagrass seed.

“Alley cropping is ideal for achieving both our production and conservation benefits,” said Shepherd. “We earn an annual income off the ground, while the trees are being established. We also enjoy an abundance of wildlife in the habitat created by alley cropping. While the crops are growing we see deer, turkey and quail utilizing this ground and the trees.”

Additional Resources

National Agroforestry Center:

<http://www.unl.edu/nac/alley-cropping.html>

UMCA DVD:

Visit www.centerforagroforestry.org or the University of Missouri Extension web page at <http://extension.missouri.edu/explore/agguides/agroforestry/index.htm> to purchase.

In Print:

Garrett, H.E., W.J. Rietveld and R.F. Fisher (eds.) 2000. *North American Agroforestry: An Integrated Science and Practice*. American Society of Agronomy. pp. 149-188. (Chapter 6)

UMCA Research Publications:

<http://www.centerforagroforestry.org/research/pubs.asp>

From the United Kingdom:

<http://www.agroforestry.co.uk/silvoar.html>

From the Association For Temperate Agroforestry (AFTA):

<http://www.aftaweb.org/entserv1.php?page=1>

From the University of Florida:

<http://cstaf.ifas.ufl.edu/research2.htm>

From Australia:

<http://www.rirdc.gov.au/pub/shortreps/sr8.html>

For additional information on the characteristics of individual forage species:

Forages Vol. 1: An Introduction to Grassland Agriculture by Barnes, Miller, & Nelson, 1995, Iowa State University Press.

Southern Forages by Ball, Hoveland, & Lacefield, 1991, Potash and Phosphate Institute

Pasture Management Guide for Northern Missouri by USDA NRCS, Ingalls, John J., 1998.

From USDA SARE:

Manage Insects on Your Farm. <http://www.sare.org/publications/insect.htm>

EXERCISE: REVIEW OF ALLEY CROPPING

1. *What factors affect the width between your rows?*
2. *What are some of the advantages and disadvantages to alley cropping?*
3. *What are advantages and drawbacks of utilizing narrow vs. wide alleyways?*
4. *Identify two management practices that are critical to maintaining tree growth over time.*
5. *Why is root pruning performed on tree/shrub species in alley cropping?*
6. *Removing what percent or more of the tree's foliage can have a serious impact on the growth of the tree?*
7. *How do you determine how far apart to plant trees in a tree line and how far apart to plant the tree rows? Is there such a thing as a wrong distance, such as too far apart or too close together?*

EXERCISE KEY

1. What factors affect the width between your rows?

Landowner goals and objectives, desired crops, uses for trees, and width of existing crop production equipment all impact between and within row widths.

2. What are some of the advantages and disadvantages to alley cropping?

Advantages: Short-term cash flow, trees benefit from crop fertilization, sun crops compete with weeds, reduce runoff, form of windbreaks, provide increased economic diversity and long-term payoff.

Disadvantages- Tree rows are obstacles for cultivation, provide competition for sunlight, moisture, and nutrients, and require more intensive management. Herbicide drift from crops may damage trees. Sun crops will need to be exchanged for more shade tolerant crops over time.

3. What are advantages and drawbacks of utilizing narrow vs. wide alleyways?

Narrow alleys with more tree rows permit greater production of trees and shrubs per acre of land putting an emphasis on the value of the woody crop. Narrower alleys will also become shaded within just a few years forcing a shift from sun to shade loving crops. Wide alleys permit sun loving crops to be grown for many years and are often more compatible with farm equipment

4. Identify two management practices that are critical to maintaining tree growth over time.

Ongoing weed control around the base of the trees, using herbicides, mulch, fabric barriers or living mulches is absolutely essential for rapid tree growth and establishment. As the trees age and grow, thinning out crowded trees within the row will enable the trees to maintain maximum growth rates over the long haul.

5. Why is root pruning performed on tree/shrub species in alley cropping?

Tree roots can be pruned (severed) or “trained” to reduce competition for water and nutrients.

6. Removing what percent or more of the tree’s foliage can have a serious impact on the growth of the tree?

Removing over 40% of the crown of the tree will reduce its growth.

7. How do you determine how far apart to plant trees in a tree line and how far apart to plant the tree rows? Is there such a thing as a wrong distance, such as too far apart or too close together? (see question #1)

Depending on the emphasis of nut or wood production, and what kinds of crops are planned on, the width of the alleys must be adjusted to meet these plans. Wood production is compatible with narrow rows and multiple rows, nut production requires single rows and wide spacing between trees.

A “wrong” distance would be any planting configuration that does not meet the landowners short-, medium- and long-term objectives resulting in lower production from desired crops or reduced tree growth or poor tree form. Row-to-row distance also must match with existing equipment.

UMCA Research: Shade Tolerance of Forage Crops

Since 2001, UMCA has been supported by and managed three significant USDA - ARS programs, representing more than 50 individual projects. The Center seeks to develop the scientific basis for designing and prescribing agroforestry practices within a “systems context,” which allows technology to be used most effectively.

Project Team: Jerry Van Sambeek, Gene Garrett, Bob McGraw, Nadia Navarrete-Tindall

When utilizing agroforestry practices for short- and long-term income, especially in an alley cropping, silvopasture or forest farming setting, the management of ground cover under decreasing amounts of light as the tree canopy develops is critical. The landowner must understand how different plant species will respond when grown under the shade of trees.

UMCA’s shade tolerance research project is conducted in a specially designed shade laboratory at the Horticulture and Agroforestry Research Center to evaluate these factors. The laboratory allows researchers the opportunity to evaluate forage yield and quality of grasses and legumes with light as the only limiting factor. The goal of the project is to identify which species or cultivars should be further tested in field trials for optimizing their success in agroforestry practices.



UMCA shade tolerance laboratory, Horticulture and Agroforestry Research Center, New Franklin, MO.



Within the shade tolerance laboratory, 20 to 27 grasses and legumes are simultaneously grown under 20, 45, and 100 percent of full sunlight and periodically harvested to determine yield and forage quality as percent crude protein, neutral detergent fiber (NDF), and acid digestible fiber (ADF). Through multiple screening trials, researchers have determined a ranking of the shade tolerance of grasses and legumes.

The following species have performed well under moderate to heavy shade in multiple studies (ranked from very shade tolerant to moderately shade tolerant):

Very Shade Tolerant

	Hoary tick clover (<i>Desmodium canescens</i>)
	Kura clover (<i>Trifolium ambiguum</i>)
	Crownvetch (<i>Coronilla varia</i>)
	Crimson clover (<i>Trifolium incarnatum</i>)
	Cluster fescue (<i>Festuca paradoxa</i>)
	Paniculated tick clover (<i>Desmodium paniculatum</i>)
	Reed canarygrass (<i>Phalaris arundinacea</i>)
	Kentucky bluegrass (<i>Poa pratensis</i>)
	Red clover (<i>Trifolium pretense</i>)
	Subterranean clover (<i>Trifolium subterraneum</i>)
	Kentucky 31 tall fescue (<i>Festuca arundinacea</i>)

Moderately Shade Tolerant



Top: Shade tolerance laboratory in full sun.
Bottom: Shade tolerance laboratory covered with 55% shade cloth.

Notes

Section 4: Silvopasture

In this chapter:

- **Defining a Silvopasture Practice**
- **Advantages and Disadvantages to Silvopasturing**
- **Tree Arrangement on the Land**
- **Understanding and Managing Tree/Forage/Livestock Interactions**
- **Success Story**



Cattle graze among Missouri pecan trees in this well-managed silvopasture practice.

Properly applied on a landscape, the silvopasture practice can enhance and diversify farm income opportunities, provide environmental benefits and create wildlife habitat. Current research is focused on understanding the interaction dynamics of the silvopastoral practice (i.e., interactions between trees, forages and livestock). The expected outcome is that silvopastoral practices will be employable that improve the productivity of the grazing animal, the quality and diversity of forage available to the grazing animal and wildlife, and effectively interpose timber stand improvement across a wide array of forested land.

What is the Objective of a Silvopasture Practice?

The objective of employing silvopastoral practices is to integrate trees, forage, and grazing herbivores for a production benefit. It is important to note that allowing livestock to graze in a natural woodland area without any type of tree or forage management is NOT considered agroforestry.

Silvopasture Two Ways

- **Establishing trees to pastures: “Trees in the pasture”:** The right choice of tree crop (often matched to soils) allows you to carry on a profitable livestock operation while creating a long-term investment in timber and/or forest products. Young trees allow plenty of light for forage production. Additionally, as the tree component develops, shade and wind protection will enhance livestock performance. Success and longevity of the practice hinges on two primary factors: control of the grass growth around young trees (necessary for early tree development) and proper management of tree densities (necessary for light management and forage production).
- **Establishing forages in the woods: ‘Pasture in the Forest’ (experimental):** By establishing select forages in the forest environment, the area can then be managed for grazing and timber production. In most forests, the key to successful grazing will be forage production. Levels of forage production will hinge on two factors: having the light necessary for forage growth and response, and proper rotational grazing.

Fit Silvopastures into a Grazing System

Converting all of a pasture system to silvopastures is unlikely on a wide scale. Choose pastures where tree growth could be ideal and mix with a compatible forage(s). Use the silvopastures strategically to compliment the grazing system. Many farm managers have a wide variety of existing resources. Management Intensive Grazing (MiG) helps to divide the farm into management units. Creating small, fenced paddocks and rotating cattle builds in “recovery periods” for the forage and protects the soil and the trees. Grazing recovery periods can only be achieved when well designed livestock water supplies and cross fences are used.

Opportunities for income from the silvopasture practice:

- *meat and dairy goats*
- *forage and hay*
- *wood products*
- *nut, fruit, and berry crops*
- *improved wildlife habitat/ lease hunting*

Advantages of a Silvopasture Practice:

- *Trees improve climate for grazing*
- *Complements ongoing pasture operations*
- *Shade enhances growth of some forages*
- *Livestock address short-term cash-flow*
- *Problems of forestry*
- *Improved nutrient cycling*
- *Nitrogen-fixing forage crops also benefit trees*
- *Complements ongoing pasture operations*

Disadvantages of a Silvopasture Practice:

- *Fencing cost may be increased*
- *Management intensive grazing is required*
- *Equipment operation may be more difficult*

Components of a Silvopasture Practice:

Silvopasture practices are different from other types of agroforestry because they require landowners to manage livestock, as well as trees and forage plants. This three-way interaction means

there are three factors to consider when designing your agroforestry practice: livestock, trees and forages.

The four variables in a silvopastoral practice that can be subjected to management are livestock maintenance, tree species, tree density, and forage species. The majority of research conducted has evaluated silvopastoral practices under conifers (mostly pine) with only limited evaluation of hardwood-based practices. Most hardwood research has been conducted with either oak species or nut-bearing species (e.g., black walnut). In certain instances under deciduous tree stands, forage production has been reported to be equal or even greater than in open exposure to sunlight. Fescue and orchardgrass production has been shown to be greater under a 35-year-old walnut canopy than in open pastures.

Managed grazing practices, similar to open pastures, should be developed and implemented to maximize forage production in a silvopastoral practice. The increased forage production under a canopy would result in increased stocking rate potential and greater productivity per unit of land.

A. Livestock

Cattle and sheep are primarily used in silvopastoral practices. Animal performance can be enhanced via use of silvopastoral practices. This occurs from reduction of heat stress and improved forage availability and nutritional quality.

The greatest difference between silvopastoral and “open” management of cattle or sheep is the contrasting environmental conditions. In the open, such as a conventional pasture or range, radiant heat can be much more intense than in a shaded environment. Shade has been shown to improve animal performance, with primary emphasis placed upon heat stress amelioration. Research with cattle has shown that compared to unshaded or sparsely shaded pasture, uniformly distributed shade results in maximum grazing time.

Heat and cold stress can adversely affect cattle throughout much of the temperate zone in North

America. Protection from cold can be important for livestock in northern climates. Properly positioned trees and shrubs can provide much needed protection for pastures, feedlots and calving areas. Reducing wind speed lowers animal stress, improves animal health and increases feeding efficiency of livestock.

It takes careful management to ensure livestock do not damage young trees. Success will depend on your understanding of livestock behavior.

Grazing Considerations

Grazing - early stages:

Protect trees from livestock in early stages of growth...Electric fencing works well. Once trees limbs are out of reach of stock, there is less to worry about.

Grazing - later stages:

Tree growth likely to reduce forage production annually once a full canopy develops. Choosing a shade tolerant forage is important. More aggressive forages less of a problem. Fit silvopasture practices into the overall grazing “system”.

Water: Special Water Considerations for Silvopasture

- Consider using portable water tanks.
- If installing permanent tanks, consider concrete tanks.
- Consider using tank covers on permanent tanks.
- Consider installing water within 600 feet travel distance.

Animals acquire water through drinking and from the moisture in the forage they eat. As air temperature increases water requirements also increase. This becomes especially critical as air temperatures exceed 77 degrees F. The need for available drinking water is compounded because forages become drier at higher temperatures. At 90 F, a 600 pound growing steer needs about 13 gallons of water per day. At 60 F, that need falls to eight gallons per day. One distinct advantage of a silvopasture system is that shade is distributed throughout the pasture and greatly reduces high

temperature stress on livestock.

Water requirements vary for the kind, size, age, and breed of livestock. For example, *Bos taurus* breeds of cattle (European types) generally consume more water than *Bos indicus* breeds (such as Brahman-influenced breeds). Dairy breeds need significantly more water than beef breeds. The rule-of-thumb used by some livestock managers is one gallon of water per day per 100 pounds of body weight per animal. Water use also varies considerably depending upon the animal’s health, air temperature, water temperature, stage of lactation, and other environmental factors.

Water Distribution

Daily intake of water increases when travel distance is less than 600 feet. Water consumption may be 15 percent higher in small paddocks with water in every field (less than 600 feet of travel) than in similar systems with water available at a single source (where cattle may travel between 600 and 2000 feet to water). When water is located close to the forage resource, the herd’s “social structure” is modified such that animals tend to water more frequently as individuals. This tends to keep the herd dispersed throughout the paddock and results in a greater portion of time spent grazing.

Of course, it is not always possible to install the “ideal” water system and many successful grazers utilize water in pastures larger than 32 acres with travel distances to water greater than 600 feet. Dedicated travel lanes have been successful to allow cattle to travel to central water locations. This approach, however, is best suited to level terrain and locations with only slight erosion hazards. To compensate for less than ideal situations special care must be taken to monitor grazing impacts on trees and forages. Adjusting the stocking levels and grazing rotation periods can help protect both the forage and the trees in a silvopasture practice with water distribution problems.

Water supply options for silvopasture include wells, creeks, ponds, spring developments and even municipal or rural water systems. Ponds can

provide a good reliable source of drinking water for livestock and wildlife, as well as providing other benefits. Consider utilizing portable livestock tanks that can be removed during tree management or harvesting operations.

Browsing:

Poorly managed livestock can cause two types of damage to trees: browsing and trampling. Livestock preferences are predictable; they will choose grass before they browse conifer trees. However, conifers are attractive to livestock when they are flushing in spring, so that is a good time to keep animals and trees apart.

In hardwoods/deciduous trees, livestock browse can be a problem at anytime. When available, livestock will seek out nutritional forage. The browsing of terminal shoots by domestic or wild animals will result in deformity and loss of tree growth. It is therefore desirable to have physical protection around hardwood seedlings. Wire cages, or a single strand of high tensile electric wire along both sides of a seedling (usually 3 feet from seedlings), or seedling row, have been shown effective at reducing browse damage.

Fencing:

Proper pasture rotation provides “recovery periods” for the grazed forage, minimizes soil compaction, and protects trees in a silvopasture system. There are several key components in an effective and easily-managed fencing system:

An energized fence is primarily a psychological barrier and can only be effective if the fence carries enough current to deliver a “deterrent” shock. Alternating current (AC) powered units are generally the best choice for energizing a fence if 220- or 110-volt power is available. For remote areas, battery powered systems with solar recharge may be necessary. In a silvopasture practice, the potential for malfunction increases with the risk of falling branches or trees damaging the system. To assure effective operation, the energized fence should:

- *Have a proper-sized energizer. Generally one-joule output per mile of fence is sufficient.*
- *Be properly grounded with a minimum of three feet of ground rod per joule output.*
- *Be protected from lightning by installing a surge protector at the power source, a lightning choke at the fence, and an additional ground rod every 3,000 feet of fence.*
- *High tensile wire is recommended when using energized fences for border areas and is also used for cross fencing. The number of strands depends upon the type of livestock being grazed. Generally, a minimum of four- to six-strands is recommended for border fencing and one to three strands for cross fencing cattle. Other types of livestock often require special considerations such as distance above the ground of the bottom wire, and distance between wires for smaller livestock like goats and sheep.*
- *Polywire or polytape can be used for temporary or portable cross fencing to create smaller paddocks for intensive grazing or to allocate stockpiled pastures for winter grazing. This enhances the manager’s ability to provide optimum, forage recovery periods.*



Fencing, placed approximately 3 feet from tree seedlings, is effective at reducing browsing damage from livestock.

Trampling damage:

The damage livestock do by stepping on (or against) a seedling, as well as rubbing off the bark, is the number one cause of tree seedling death. Generally, trees are most susceptible when less than 16 inches tall, and during the period of rapid growth in early spring. Trampling damage causes deformation and weakening of the stem, and may also provide an entry point for pests and disease.

You can also use obstacle planting to create patterns that will help control livestock movement. When planting trees, it's important to visualize where animals could be encouraged to walk. With that in mind, you can use a tractor to position small logs or logging debris in rough lines to guide the livestock and keep them away from seedlings. Unlike a standard planting grid pattern, obstacle planting in a row creates a 'fence' that steers animals on pasture pathways between and around tree seedlings.

Levels of Management for Livestock

- *Optimal: Timing livestock access to the area to maximize positive interactions with the forages and minimize negative interactions with tree seedlings. Frequent rotation to optimize forage health.*
- *Improved: Moving livestock when forage supply is starting to decline and seedling trees have minimal damage.*
- *Poor: "Dumping" livestock on an area and leaving for extended periods of time, causing overgrazing of forages and damage to trees.*

You can also use obstacle planting to create patterns that will help control livestock movement. When planting trees, it's important to visualize where animals could be encouraged to walk. With that in mind, you can use a tractor to position small logs or logging debris in rough lines to guide the livestock and keep them away from seedlings. Unlike a standard planting grid pattern,

obstacle planting in a row creates a 'fence' that steers animals on pasture pathways between and around tree seedlings.

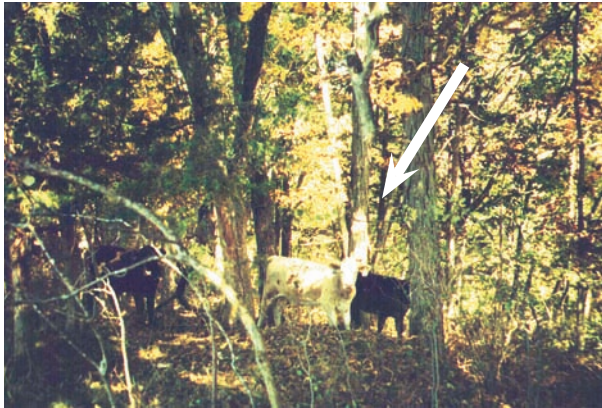
Grazing in the Shelter of a Tree



- Heat and cold stress can adversely affect performance of livestock. Trees, and the climate modification they create, can provide multiple benefits to livestock that reduces their stress and result in gains to the landowner.

- Shade produced by the canopy can reduce stress on cattle during summer months. Cattle grazing in shaded conditions have been shown to have improved weight gains. Shade is also beneficial in husbandry of dairy cattle where milk production and reproductive efficiency need to be maintained.

- Trees can provide protection from wind and winter weather. Trees and shrubs can reduce the effect of wind chill and help manage blowing snow, both of which may be a concern for winter/spring calving operations. Additionally, research has shown that cattle on winter ranges require an additional 20 % increase in feed energy to offset the effects of exposure.



Cattle in unmanaged wooded areas: NOT a silvopasture practice.

B. Trees

Typically, reforestation is designed to produce quality trees for wood production. Consequently, initial planting densities do not often coincide with producing good livestock forage. Even where good forage is available, supply decreases dramatically once the canopy closes past 50 percent. If trees are planted at 12-foot intervals, then, depending on site condition, that may happen after only 5 to 10 years. However, with the selection of appropriate tree species and changes in planting design, it is possible to grow more than 300 trees per acre while maintaining good forage for a longer period. As an example, this can be accomplished by planting at a 8-foot intervals between trees with 18 feet between rows.

Conventional planting is done on a grid pattern. However, by using different configurations, such as the planting scheme mentioned above, or by establishing tree clusters across a paddock, the time between required thinnings may be increased and the area available for forage growth may be maximized. Much wider spacing between tree rows is feasible and depends upon the landowner's objectives. In all but the most widely spaced initial plantings, such as 40 feet by 40 feet, thinnings will at some point be necessary in order to maintain light levels sufficient for forage production.

Desirable characteristics of an agroforestry tree species:

- Marketable -- this includes both the wood itself and other products such as nuts or fruit, which would provide another source of income.
- Compatible with the companion crops or forage you choose. Some trees produce growth-inhibiting chemicals which may affect what you can grow.
- High quality.
- Fast growing or of such a high value that a species of medium growth rate is acceptable.
- Deep-rooted so the trees do not compete with the crops or forage for moisture.
- Have rapidly decomposing foliage.
- Be properly matched to the site. Site tolerant, suited to either a wet or dry site.
- The leaves should produce a light, rather than a heavy shade. This will be especially important as the trees mature and the canopy closes. The lighter the shade that is produced, the longer you can grow crops or forages.
- Make sure that the trees are capable of producing the products you desire.



Tree arrangement on the land

The proper design plan of any silvopasture practice should consider the spacing between select trees and shrubs, both within a tree/shrub row and between tree/shrub rows. Tree arrangement, either during tree establishment in pastures or as a result of thinning trees within managed forested

stands, can vary greatly among trees in single, double or multiple rows; individual widely spaced trees; and/or clustered or grouped trees.

Advantages of single and multiple row plantings:

Single Row

- *Better crown space for nut production*
- *Maintenance is simplified (such as mowing)*
- *Diversified landscape is created*
- *Farm production is enhanced*

Multiple Row

- *Enhanced erosion control*
- *Better growth of trees for timber*
- *Improved wildlife value*
- *Greater diversification of farm products*



An aerial view of the Horticulture and Agroforestry Research Center shows a silvopasture research area pattern. Double rows of tree plantings are shown on the left; triple rows are on the right. Multiple rows provide large volumes of wood without overly sacrificing forage production.

Differences exist between the results that can be expected from each tree arrangement. Landowner objectives will determine the best arrangement of trees and the forages to be used, and it must be remembered that silvopasture management is intensive and dynamic over time.

There are several key factors to keep in mind when establishing the practice on a given site and determining the width of the alley between rows of trees. Key factors include equipment size,

forage, changes through time and thinning and pruning.

Factor 1: Equipment Size

A silvopasture design that plans for occasional forage removal by mechanical means, must provide space between the trees so that equipment can move freely. The alley between tree rows should be wide enough to allow clear passage of the widest piece of equipment and should be organized so that full passes of the equipment are utilized. Ultimately, the design should recognize the branch and crown development which will occur over time for a given tree species and that may be associated with products desired from those trees. For example, when planting trees for nut production, where large crowns are desirable, wider space between tree rows should be planned.

Factor 2: Forage

Closer tree spacings may be designed for forages which are more shade tolerant, keeping in mind equipment requirements. However, most forages need a minimum of 50% light, so plan to manage tree densities to produce adequate light for forage growth.

Factor 3: Changes through time

Increased shading occurs as trees mature. As this happens, a change toward a more shade tolerant forage will be necessary to maintain suitable yields. These changes can also be offset by timely thinning of lower quality trees and through pruning that reduce branch density in a tree's crown.

Factor 4: Thinning and pruning

Timely thinning can be used to maintain semi-open crown conditions. While used as a tool to manage the light available for forage production, thinning also serves to increase the resources (light, water, and nutrients) available to the remaining higher value trees and therefore, should enhance their growth rate.

Another dual purpose management practice is pruning. Proper pruning of the lower branches, to develop a high-value butt log, can increase log value and increase the space available for opera-

Special Considerations for tree spacing:

Within a Row

- Federal/State subsidy program requirements
- Production vs. conservation objectives
- Wood production vs. other tree products
- Grafted vs. seedling planted stock
- Markets for small-diameter material

Between a Row

- Production vs. conservation benefits
- Wood production vs. other tree products
- Light requirement of forage
- Duration of grazing regime
- Width of farm equipment

tion of equipment. At the same time, this also increases sunlight available to the forage. Finally, crown management through pruning may be beneficial if the desired tree product is nuts. An open crown not only allows more light to reach interior branch tips (necessary for flowering and fruiting), but also will allow increased light to filter through to the forage.



A single row of pine and fencing allows for managed paddock grazing based on forage response to grazing.

all influence understory forage production. Typically, combined canopy coverage must equal or exceed 35 percent before it significantly impacts forage production. However, many cool season grasses and legumes perform well in 50 percent shade. Recognize that shade produced by the canopy will increase over time as the trees mature.

Establishing pastures in the forest:

- 1. Prepare your site for seeding as soon as possible** after thinning (crop tree) or harvesting (selection cutting or improvement harvest) from the forest, so native vegetation doesn't have a chance to respond to canopy removal and invade the site.
- 2. Seed immediately after site preparation** (light fire or disking, and necessary soil amendments like lime or fertilizer) to give domestic forage the jump on native competitors.
- 3. Lay out pastures and fencing** for rotational grazing.
- 4. Install water supply** to meet livestock requirements.

C. Forage

As feed for livestock, forage is a vital component of silvopasture practices. Choose forage(s) that will do well in the level of shade produced by the tree cover and meet the nutritional needs of the chosen livestock. Tree size, density, and pattern



Annual rye and timothy grass grow well in shaded environments, as shown here under 8-year-old walnut grown between rows of pine.

Forage Growth and Interaction:

The forage component of a silvopastoral practice can be either competitive or complimentary with your trees. Your management decisions will influence which way the practice develops. As the select forage begins to develop and fill an area, it may be beneficial for tree growth to eliminate the forage that would otherwise grow directly adjacent to the tree. It is desirable to use a weed mat, herbicide or some other form of control to eliminate grass growing within two to three feet of seedlings for up to five years. Tree growth will greatly benefit.

Cool season forages have their peak production in the spring when temperatures are cool. Later they are harvested or allowed to become dormant during the summer. These forages should be grazed no shorter than three inches and should be six inches in height at the end of the growing season.

Cool season plants tend to:

- *Be competitive for spring soil moisture.*
- *Be less competitive for water in the summer months when moisture may be limiting to tree growth.*
- *Many perform reasonably well under partial shade.*

Warm season grasses should be grazed no shorter than 8 inches during the growing season and by the end of the growing season, the last grazing rotation should leave the forage with a height of 10 inches. These grasses achieve most of their

growth in the summer months.

Warm season plants tend to:

- *Be less competitive in the early spring when many trees are beginning their annual growth.*
- *Be more competitive for water during the summer months when trees are putting on the majority of their diameter growth.*
- *Most warm-season grasses native to Missouri do not perform well under partial shade.*

Can forage be grown in the shade?

Research at the UMCA has shown that many cool-season grasses and legumes, when planted under 50 percent shade, will perform equally to or better than open grown plants. Better performance means overall growth will improve (better yields) and often means that quality will improve, as well as digestibility.

Why?

Tree canopies modify the ground level climate. The combination of modified climate and change in light levels, causes many grasses and legumes to both, increase growth (due to modified climate and moisture), and have less lignin in their leaves (improved quality).

Summary

Always use managed grazing principles with the silvopasture practice. As a part of grazing considerations, do not forget to supply adequate water for the livestock. As a rule, keep livestock within 800 feet of water.

As a part of a farms grazing system, the silvopasture practice can be a nice addition. It offers many opportunities to enhance livestock productivity through both the modified climate it provides and the improved forage it is capable of producing.

Major Factors influencing forage production:

- *Tree species*
- *Tree spacing*
- *Tree age*
- *Forage shade tolerance*
- *Forage selection*

If you live where it's dry...

Forage can compete with trees for scarce moisture. Seed at lower rates and have livestock available to graze before the forage becomes competitive. By taking these precautions, and matching tree and forage selections, your results should be:

- *More palatable forage*
- *More efficient grazing*
- *More vegetation removal*

Success Story: Jim Wilson

Pecan and walnut silvopasture practice near Nevada, Mo.



“Ever since we've been in nut production we've used cattle to control the height of the grass. We also benefit from the value of the beef that we sell in the fall, in addition to the nuts that we harvest.

We chose cattle to run in here because we fertilize these trees with nitrogen and it causes the grass to grow. By grazing, it gives us extra profit from the beef. And it also helps where we don't have to mow as much.”

“Another thing that we like about the trees is that it's cooler on a hot summer day. It's at least ten degrees cooler down here, and the cattle are just scattered out everywhere grazing.”

2003 SARE Highlights

Good Bedfellows: Cattle, pecan trees in an environmentally sound mix, Haydon Farm, Okemah, Okla.

Oklahoma ranks second in the nation for native pecan production and third for its forage-based beef industry, so it's no surprise that cattle and pecans co-exist on about 50,000 acres. They make good companions. Cattle gain weight on grass that otherwise would require mowing, return nutrients through manure, and prune the lower limbs of pecan trees. In return, orchard shade encourages cattle to graze and gain weight in hot weather. There's room for improvement in that symbiotic relationship, however, says Oklahoma State University (OSU) extension horticulturist Dean McCraw, who is using a SARE grant to refine the system. While most pecan/beef cattle operations use commercial fertilizer and follow a “typical” orchard spray program, “research has shown that profits and environmental impacts can be improved by replacing the purchased nitrogen with legume pastures and developing a customized pest management system based on scouting and weather monitoring,” he said. “We are looking at how all these components interact on real farms.”

Legume pastures planted in the orchards increased daily weight gain for the steers, improved soil health by reducing grazing compaction, reduced nitrogen runoff and increased habitat for beneficial insects. Over the three-year project, native pecan trees in plots with legume pastures averaged nearly 700 pounds of pecans per acre and over 250 pounds of beef gain per acre without any

added nitrogen fertilizer. The result: a savings of nearly \$30 per acre in fertilizer cost while essentially eliminating fertilizer runoff potential. The benefit of legumes was most dramatic in flood-prone plots, where legumes prove tough enough to withstand excessive water and out-compete other vegetation.

While the orchard/beef combo proves useful in eastern Oklahoma, with its 100,000 acres of native pecan trees, another SARE project is helping ranchers find the system that best suits their own resources. Damona Doye, OSU extension economist, used case studies of cow/calf operations to identify management strengths and weaknesses in animal science, forages, financial management, and herd health. During the course of the multi-state project, more than 100 ranchers in three states identified potential cost-saving measures of about \$3,000 annually each. Doye shared case study findings with other producers during information exchange forums and offered training to veterinarians and accountants so they can better assist their farm clients to improve resource management practices.

Frequently Asked Questions:

Does the silvopasture practice have any long-term effects on soil compaction?

Soil compaction is a valid concern, both from the standpoint of optimizing tree growth, and from the potentially negative influence compaction can have on forage productivity. Any pasture may have problems from soil compaction. And, while it may be more challenging to see the effects of compaction on tree growth, it is visible in forage productivity. Therefore, one of the best ways to gauge whether or not the soil is being overly compacted is by the stand of forage being produced. If a forage stand is thin and does not grow back following removal of the livestock, then soil compaction may be a problem (this assumes that drought or lack of nutrients is not the factor limiting production). Always strive to not overuse pasture. Sound management, such as management intensive grazing, is the best method for limiting soil compaction, and will be evidenced by good forage development. Another way to say this is that if the forage in a silvopasture practice is maintaining growth and productivity, then compaction is not likely a problem.

Will rows of trees planted to a pasture develop an open growth form?

There is the potential that trees established in pastures will develop a more open-grown form. This form, wide crowns and increased branching, while not desirable if trees are grown for timber, is more desirable for trees grown to produce a nut crop. However, in either case pruning will likely be necessary to enhance productivity and often quality. Nut trees require pruning in order to ensure that light reaches flowers and results in nut development. Timber trees will likely require pruning for correction to their form and to enhance their quality. If trees are grown for timber, another option may include planting shrubs/trees adjacent to the timber tree in order to shade its trunk and encourage upright growth. Trainer trees will help reduce side branch development and cause the tree to grow up towards better light.

Is the silvopasture practice sustainable?

Sustainability refers to the long-term potential of a practice to continue through multiple harvests. And, yes the silvopasture practice “trees in the pasture” is sustainable. However, it becomes sustainable through proper planning and management. Planning should include an activities schedule that predicts when certain management will need to take place in the life of the practice. For instance, as newly established trees develop and produce increasing levels of shade, when will thinnings need to take place to maintain light levels adequate for forage production? Is it possible to predict this time? I would say yes, at least within a range. You can do this by looking at the forest site-index from the soil survey and judging the trees height development over time, and of course this will also be dependant on the initial planting density. This is just one example, but it illustrates the importance of planning and management (really the thought process of looking out to the future) on creating a reasonably sustainable practice.

Is “pasture in the forest” a proven silvopasture practice?

No. Experimental trials are underway and show promise. However, long-term impacts of cattle on existing trees in a forest stand, potential for cost-effective regeneration of trees and long-term maintenance of forage under forest canopies are under investigation. Finally, landowner willingness to use management-intensive grazing -- essential for “pasture in the forest” -- is critical.

Additional Resources

Silvopasture

- Clason, T.R. and S.H. Sharrow. 2000. Silvopasture Practices. In: Garrett, H.E., W.J. Rietveld and R.F. Fisher (eds.) 2000. *North American Agroforestry: An Integrated Science and Practice*. American Society of Agronomy. pp. 119 - 147.
- Garrett, H.E., M.S. Kerley, K.P. Ladyman, W.D. Ladyman, L.D. Godsey, J.W. VanSambeek and D. K. Brauer. 2004. Hardwood silvopasture management in North America. *Agroforestry Systems* 61: 21-33.
- USDA National Agroforestry Center: www.unl.edu/nac/silvopasture.html (information on a broad range of silvopasture topics)
- Fike, J. H., Buergler, A. L., Burger, J. A., and Kallenbach, R. L. 2004. Considerations for establishing and managing silvopastures. Online. Forage and Grazinglands. doi:10.1094/FG-2004-1209-01-RV. <http://www.plantmanagementnetwork.org/sub/fg/review/2004/silvo/Silvopastures.pdf>
- University of Florida: <http://edis.ifas.ufl.edu/pdffiles/FR/FR13900.pdf>
<http://nfrec.ifas.ufl.edu/sodrotation/Conf%20PDF%20files/PDF%20FILES/jareknowak.pdf>
- Mississippi State University Extension: A Financial Analysis of a Silvopasture System
<http://msucares.com/forestry/special/silvo.html>
- The Illinois Virtual Forest: A number of links to silvopasture information -
http://ilvirtualforest.nres.uiuc.edu/forestry/af_silvopast.htm

Grazing Systems

- University of Missouri Extension (Grazing and Watering):
<http://muextension.missouri.edu/explorepdf/envqual/EQ0379.pdf>
<http://muextension.missouri.edu/explorepdf/envqual/eq0380.pdf>
- The Conservation Technology Information Center (CTIC):
<http://www.ctic.purdue.edu/Core4/nutrient/ManureMgmt/Paper40.html>
- Managed Grazing around Riparian Areas: <http://www.attra.org/attra-pub/PDF/managedgraze.pdf>
- ATTRA: <http://www.attra.org/attra-pub/PDF/matchl&f.pdf>
<http://www.attra.org/attra-pub/PDF/rotgraze.pdf>

General Grazing Information

- ATTRA: <http://attra.ncat.org/attra-pub/PDF/grazingcontracts.pdf>
<http://attra.ncat.org/attra-pub/PDF/grazingnetworks.pdf>
www.attra.org/attra-pub/PDF/multispecies.pdf

NRCS:

- Information Sheet:
http://efotg.nrcs.usda.gov/references/public/mo/silvopasture_info_sheet_final1205.pdf
- Practice Standards:
http://efotg.nrcs.usda.gov/references/public/mo/381final1_05.pdf
- Statement of Work:
<http://efotg.nrcs.usda.gov/references/public/mo/sow381modified.pdf>

EXERCISE: REVIEW OF THE SILVOPASTURE PRACTICE

What considerations need to be taken into account in order to develop a successful silvopasture practice?

1. *Identify the top three landowner objectives related to creating a silvopasture practice.*
 - i.
 - ii.
 - iii.

2. *What are the three interactive components to consider in design of a successful silvopasture practice?*
 - i.
 - ii.
 - iii.

3. *What cost-share or incentive programs are available to assist with the silvopasture practice (don't forget to include assistance that might be available to establish managed grazing systems or watering systems)?*
 - i.
 - ii.
 - iii.

4. *Do you have any major concerns related to integrating the silvopasture practice with the current farm layout (such as access and movement of the livestock)?*

EXERCISE: REVIEW OF THE SILVOPASTURE PRACTICE (cont.)

5. *Are there any conservation agencies or groups that could assist in designing integrated habitat that works with your current farming practices?*

i.

ii.

iii.

6. *What are the two primary ways that livestock can damage trees? And, is there a plan in place to minimize damage should it occur?*

i.

ii.

7. *What are the four factors that go into planning alley widths for the silvopasture practice?*

i.

ii.

iii.

iv.

8. *What other considerations are needed in order to reach the landowner objectives identified in question # 1?*

EXERCISE KEY

- 1. Identify the top three landowner objectives related to creating a silvopasture practice.**
Increase acreage available for grazing, Better production from paddocks,
Reduced stress on livestock for increased productivity
- 2. What are the three interactive components to consider in design of a successful silvopasture practice?**
Forage, Livestock, Trees
- 3. What cost-share or incentive programs are available to assist with the silvopasture practice (don't forget to include assistance that might be available to establish managed grazing systems or watering systems)?**
EQIP, SWCD Watering, USDA Rotational Grazing/Fence and Watering Systems
- 4. Do you have any major concerns related to integrating the silvopasture practice with the current farm layout (such as access and movement of the livestock)?**
Limiting access to streams and providing alternative watering systems. Protection of young, newly established trees.
- 5. Are there any conservation agencies or groups that could assist in designing integrated habitat that works with your current farming practices?**
USDA NRCS, MDC, MU Extension
- 6. What are the two primary ways that livestock can damage trees? And, is there a plan in place to minimize damage should it occur?**
Trampling, Browsing, use single strand of electric fence spaced 3 feet from seedlings.
- 7. What are the four factors that go into planning alley widths for the silvopasture practice?**
Equipment size, Forage, Changes through time, Thinning and Pruning
- 8. What other considerations are needed in order to reach the landowner objectives identified in question # 1?**
Create a good activities schedule that outlines the process of implementing forest thinning, fencing, forage establishment, creating watering access, etc...

UMCA Research: Silvopasture Grazing

Since 2001, UMCA has been supported by and managed three significant USDA - ARS programs, representing more than 50 individual projects. Our research efforts have been organized into eleven research “clusters” to enhance creativity and productivity among a range of investigators from many disciplines, including a silvopasture cluster. Research findings from this cluster are included here.

Project Team: Robert Kallenbach and Monty Kerley

The Center for Agroforestry is working to reduce hay costs and extend the livestock grazing season through silvopasture practices. Winter hay costs for feeding one steer can reach \$91; the managed grazing practice of silvopasture can reduce this amount significantly. Well managed silvopastures can reduce winter feed costs by approximately 20% (Kallenbach et.al., 2006).

With more than 13 million acres of pasture lands dedicated almost entirely to beef production, Missouri is in a position to greatly benefit from the economic and environmental benefits of silvopasture.

In this study, researchers tested the value of silvopasture in late fall/early spring forage production in a beef cattle operation. The forage production and performance of beef calves grazing annual ryegrass/cereal rye pastures in a silvopastoral system was compared to a pasture system without trees.

A mixture of annual ryegrass and cereal rye were planted into an established pine/walnut alley cropping study (tree pasture), and the same forages were planted into pastures without trees (open grazing pasture). Silvopasture is best thought of as a component of an overall integrated grazing system. Animals were rotationally grazed between sub-pastures with a 1-3 day grazing period based on forage availability. Average daily gain (0.75

kg hd⁻¹ d⁻¹), animal days (607 d ha⁻¹), and beef production (456 kg ha⁻¹) for heifers was equal for both treatments.



Cattle graze in a pine silvopasture practice, which demonstrated economic benefits to land-owners in this study.

Importance of Silvopasture Research with Ryegrass and Cereal Rye:

- Annual ryegrass/cereal rye pastures are becoming popular with beef producers wanting to extend the grazing season.
- These forages have the advantages of rapid autumn growth rates and the ability to produce and maintain high quality forage when most other forages are dormant.
- Annual ryegrass/cereal rye pastures are of interest to small scale farmers who wish to retain ownership of stocker calves through the backgrounding stage as calf gains often exceed 0.6 kg hd⁻¹ d⁻¹ in winter.
- Annual ryegrass/cereal rye pastures fit well into a silvopasture system.
- These forages grow primarily when most tree species are either dormant or not under heat or drought stress. As a result, they would be expected to compete only minimally with the trees.

Key Findings:

Seasonal forage production was greatest from the tree treatment in early spring, while the open pastures produced more forage in late spring.

The microclimate effect of the trees stimulated early spring growth in the tree treatment and would help livestock producers get cattle on pastures earlier in spring.

Silvopastures can be as productive as conventional pastures and beef producers could expect similar livestock weight gain using either system. However, because the silvopastures have the added benefit of producing wood products for future revenue, they show higher economic returns in the long term.

Source: Kallenbach, R.L., M.S. Kerley, and G.J. Bishop-Hurley. 2006. Cumulative forage production, forage quality and livestock performance from an annual ryegrass and cereal rye mixture in a pine-walnut silvopasture. Agroforestry Systems. 66: 43-53.



Cattle graze in an open pasture setting at the Horticulture and Agroforestry Research Center.

Notes

Notes

Section 5: Riparian Forest Buffers

In this Section:

- **Defining Riparian Forest Buffers**
- **Planning and Design**
- **Management and Maintenance**
- **Marketing Value-Added Products from Buffers**
- **Financial Considerations**
- **Success Stories**



Properly applied on a landscape, the riparian forest buffer can enhance and diversify farm income opportunities, improve the environment and create wildlife habitat. By developing an understanding of the interactions between the buffer (trees, shrubs and grasses), the stream or bank, and the adjacent upland area, its layout can effectively meet the goals for which it has been established. By understanding the requirements of each of the components of the buffer, it can be managed to maintain effectiveness over time, and also sustain its contributions to the farm as an integrated agroforestry practice.

What is a Riparian Forest Buffer?

Riparian forest buffers are planned combinations

of trees, shrubs, grasses, forbs and bioengineered structures adjacent to, or within, a stream designed to mitigate the impact of land use on the stream or creek. At the landscape level, riparian forest buffers link the land and aquatic environment, and perform vital ecological functions as a part of the network of watersheds that connect forest, agricultural and urban lands. By establishing, or managing, trees, shrubs and grasses in the zone adjacent to streams or creeks, water quality can be sustained or enhanced. However, to be effective, buffer management and design must include plants that are adapted to the specific riparian environment (flood regime, soils and topography), as well as management guidelines the landowner is willing to follow to keep the buffer healthy and effective.

When considering riparian forest buffer implementation, it is important to understand the benefits associated with riparian buffers, think about planning and design considerations, know the key management requirements necessary for successful riparian buffer use, and understand the market opportunities and cost-share options.

Advantages Offered by a Riparian Forest Buffer:

- *Protection of water quality,*
- *Stabilization of eroding banks,*
- *Increased supply of diverse food and cover for upland wildlife,*
- *Improved aquatic habitats for fish and other organisms, and*
- *Enhanced opportunities to generate farm income through products harvested from the buffer.*

Disadvantages of a Riparian Forest Buffer:

- *Management intensive*
- *Loss of land farmed*
- *Challenges with drainage tile*

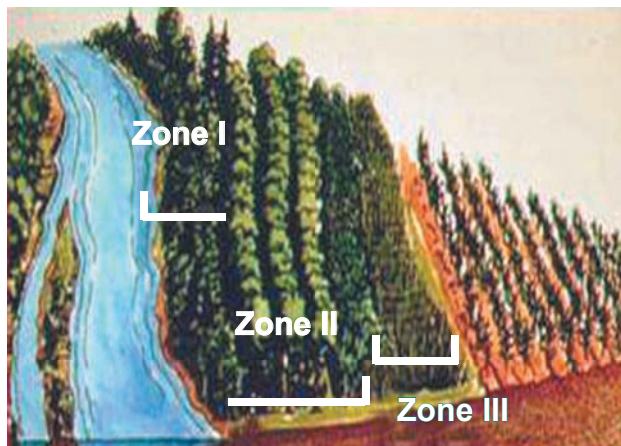
Riparian Forest Buffer Zones and Benefits

A Riparian forest buffer is typically composed of three management Zones.

Zone I – A narrow area closest to the stream bank that often includes a mixture of native trees, shrubs and forbs that are adapted to floodplain hydrology. The principle effect of Zone I is to stabilize the bank and provide woody debris for aquatic habitat.

Zone II – A much wider area adjacent to Zone I consisting of fast-growing trees and shrubs that can tolerate periodic flooding. Their primary water quality purpose is nutrient uptake and storage. Woody stems also slow floodwater. This zone can be managed for additional income from nuts, berries or woody floral products.

Zone III – Area adjacent to crop fields or grazing lands that provides high infiltration, sediment filtering, nutrient uptake and can help disperse concentrated runoff. Native grasses and forbs, such as wildflowers, are normally preferred for their multiple benefits and adaptability, but dense, stiff-stemmed introduced grasses may also be effective.



The three distinct zones of a riparian buffer require individual management decisions to optimize their benefits. For Zone I, seek plants that help stabilize the bank and support aquatic habitat. For Zone II, decorative woody florals and fast-growing trees are an excellent choice for additional income. Zone III is well-suited for native grasses, forbs and wildflowers.

Riparian Forest Buffers and Market Opportunities

In addition to slowing water runoff, enhancing infiltration of nutrients, reducing erosion and stabilizing stream banks, riparian forest buffers provide a landowner with value-added market opportunities and enhanced wildlife habitat.

Edible berries and decorative woody florals, such as Red Osier Dogwood and Curly Willow, may be planted in Zone II of the riparian buffer. These are valuable components of the floral and decorating industries. Nut bearing trees planted in Zone II also contribute to income opportunities from buffers. Wildlife habitat is significantly enhanced with the implementation of a riparian forest buffer (especially pheasant, quail and waterfowl), and lease hunting may be another economic opportunity gained through a riparian buffer system.

Planning for a Riparian Forest Buffer

Establishing a buffer for specific goals

The challenge to design and maintain a buffer system is to achieve your desired goals while also retaining the buffer's critical environmental benefits. For example, buffers established for reducing stream bank erosion require designs which incorporate plant materials both on, and adjacent to, the eroding bank that have deep and fibrous roots that better stabilize soil. Buffers created for the filtering of by-products from agricultural practices work best by filtering sediment and water as it moves through plant root zones, and before it can enter the adjacent body of water. This function of a buffer often utilizes stiff stem grasses and multi-stem shrubs to slow water moving over the soil surface, allowing it to infiltrate the soil. Once in the soil, plant roots are then able to capture, transform and store non-point source pollutants that would otherwise end up in aquatic systems. Considering your desired outcomes for a buffer is an excellent first step in creating a design that is functional. Landowners are strongly encouraged to make a sketch of the buffer on an aerial photo and identify major problem areas, such as severe bank erosion, gullies, drainage tiles, etc., and then

place trees, shrubs, and grasses in their appropriate zones to accommodate any unique problem areas, according to your design. For example, trees, shrubs and deep-rooted native grasses should not be planted directly above field drainage tile lines.

■ **Dick Schultz**, professor, Department of Natural Resource Ecology and Management, Iowa State University, offers suggestions for preparing to establish a buffer.

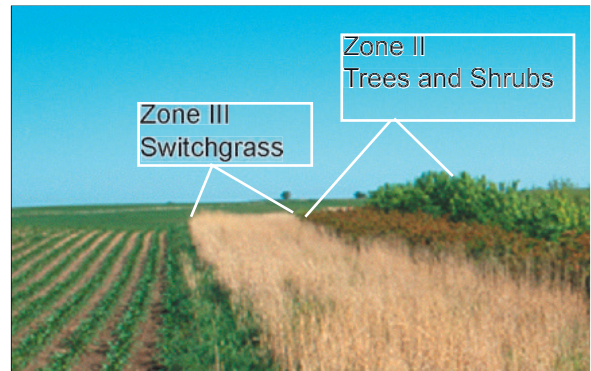
“Before you select the kind of buffer to install along your stream, think of what you would like the stream and riparian zone to look like, and what you would like the site to accomplish. Once you have identified your objectives, walk the site with natural resource professionals and explain your objectives and desires to them. They may use the Natural Resources Conservation Service ‘Stream Visual Assessment Protocol’ or a similar tool to help you identify the functional problems of the riparian zone. Once the site problems and objectives have been identified, select the buffer type that addresses your specific site’s needs.”

Keep in mind that riparian forest buffers and grass filter strips may not solve all of the identified problems along your stream corridor. They are primarily designed to reduce surface runoff of sediment and agricultural chemicals, bank erosion, subsurface movement of agricultural chemicals in the shallow groundwater, and degradation of aquatic or upland habitat. They are not designed to stop bank erosion along deep channels with vertical banks or stabilize the channel bed. They have no impact on groundwater moving through drainage tile networks, and they are not usually designed to accommodate livestock grazing. To solve these problems, one or more other riparian management practices may be needed. These include stream bank stabilizing bioengineering techniques, small wetlands to intercept field drainage tiles, stream channel stabilizing boulder weirs, and controlled grazing practices.”

A list of the different plant species, their planting location and spacing are a critical part of the design sketch. In addition, identify the need for other riparian management practices such as stream bank bioengineering, in-stream boulder weirs or constructed wetlands to filter water from field drainage tiles. **Remember, a totally functional riparian zone will require combinations of riparian and upland management practices.**

Key areas for consideration:

In Stream – This involves an assessment of the stream bed and the stream banks. You may want to consider the channel bed material, and whether or not the stream is down-cutting. This can be addressed by in-stream structures. Consider points of erosion on the stream bank, such as sloughing or bank undercutting. These areas may need to have their bank mechanically regraded, and then proper stabilization implemented to deter future bank erosion.



Adjacent to the Stream – Plants growing on land in direct contact with the upper edge of the stream bank can both stabilize erosion and serve as a living filter. This area can also function to filter flood debris, slow flood waters and run-off from adjacent land activities. A landowner should consider the question, “what is the problem?” Species choice, and planting density, will be influenced by the problem being addressed and size of the stream. Trees, shrubs and grasses (even within a species) will likely vary in their tolerance to flooding. The establishment of trees/shrubs/grasses in this area should also take into account the soils and flood regimes. Choose species that are

adapted to this environment. Trees and shrubs are often selected due to the deeper rooting structure and the shade they provide. Shade lowers water temperatures, reducing algal growth and improving the oxygen content of the water.

Outer Edge – This area provides the initial defense from direct runoff from adjacent land uses. Most often grasses are used in this area. Warm season grasses with stiff stems are desirable; however, it is again advisable to check soil types and flood frequencies/duration to ensure that the grass of choice will do well and persist. These grasses should provide good soil coverage that serves to slow water, allowing it to infiltrate the soil and for sediments to drop out of the flow. Warm-season grasses are often used because they have both stiff stems and deep roots.

All vegetation planted with the intended function to slow and filter water, and/or stabilize soil, should be kept actively growing and healthy. In many cases, especially with grasses, it is necessary to harvest, or otherwise remove, accumulated vegetative growth to prevent the build-up of a mat of dead material. This material results in areas of open ground where erosion may develop as water channels through.

Additional Considerations:

Width: When determining the width of your buffer, it is a good rule of thumb that “wider is better.” For surface erosion control, buffers between 30 to 50 feet will work, but filtering subsurface flow may require significantly wider buffers. Keep in mind that the width of the buffer does not need to be the same throughout its length. Widths may vary to accommodate runoff hot spots or to smooth out field borders next to a meandering stream and create straight runs for operating equipment.

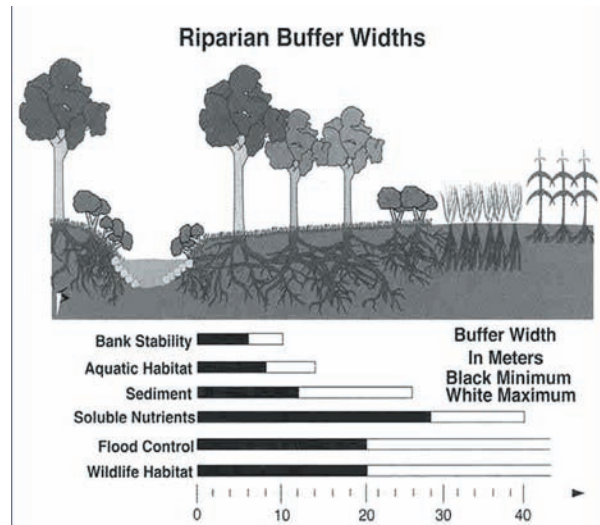


Figure 2: Riparian forest buffer widths by various sections. Source: “North American Agroforestry: An Integrated Science and Practice.” American Society of Agronomy (ASA), 2000. Eds.: Garrett, Rietveld and Fisher. Chapter 7.

Length: Length of buffers will vary. However, it would be best if streams were protected along their full length. Is this practical or feasible? That is a decision each landowner must make. One additional important consideration is that whatever the length, buffers must be designed and placed to prevent all sources of concentrated flow from entering streams or creeks.

Interaction between plant species: Recognize that buffers are constantly changing. Also, remember that buffer effectiveness is best maintained by keeping it healthy and growing vigorously. Over time, trees produce shade that causes a reduction in the density and vigor of neighboring grasses. By introducing a zone of shrubs between trees and grasses, for example, the impacts of competition for light on the growth and vigor of the grass zone are minimized.

Impacts on wildlife habitat: Depending on the choice of plant materials used, wildlife may use buffers for food, cover and/or nesting and raising their young. Additionally, the buffer can serve to provide a connective corridor between various features on the landscape (to connect upland woods and bottomland fields, for example).

How to Design a Buffer Strip: General Requirements

(Adapted from Iowa State University Extension guide, "Stewards of our Streams: Buffer Strip Design, Establishment and Maintenance." Visit www.extension.iastate.edu/ for complete publication.)

The most effective riparian buffer strip has three zones of vegetation, each planted parallel to the stream (see Figure 1, page 4). Adjacent to streamside vegetation (Zone I) lies Zone II, a minimum 30 ft.-wide strip of trees (four to five rows). Upslope from the trees is an area that is a minimum 12 ft.-wide zone of shrubs (one or two rows). Farthest from the stream, next to cropland, Zone III is a minimum 20-24 ft.-wide strip of native warm-season grasses.

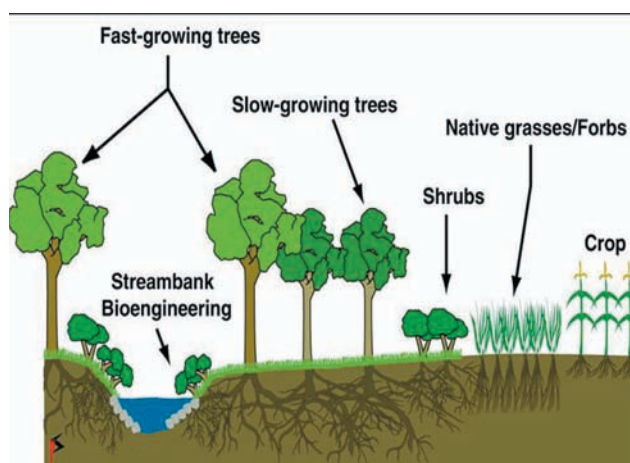
This combination of trees, shrubs, and grasses helps protect the stream more than planting a single species. Trees and shrubs provide perennial root systems and long-term nutrient storage close to the stream. The warm season grass provides the highest density of stems to slow surface runoff from adjacent fields. The design can be modified to fit the landscape and the landowner's needs, for example, by replacing shrubs with more trees, substituting some of the trees with shrubs, or expanding the grass zone. When the width of the tree zone is less than 30 ft., the buffer strip is less effective than one with a wide tree zone. The width of the buffer strip also can be adapted to straighten tillage boundaries along meandering streams or waterways.

Zone I: (Adjacent to the stream)

Zone 1 contains a mixture of native trees, shrubs and forbs adapted to floodplains.

Zone II: (Fast growing riparian trees, higher-value hardwoods and shrubs)

Four or five rows of trees are recommended in this zone. Trees nearest the stream in this zone (rows one and two and possibly three) are selected for their ability to quickly develop deep roots that can increase bank stability. The best choices are bottom land species adapted to the area that have a rapid growth rate such as silver maple, willow, cottonwood, green ash, and box elder. The species must be tolerant of wet conditions.



Selecting the appropriate species for a riparian buffer will help ensure its success and longevity. (Source: ASA, "North American Agroforestry: An Integrated Science and Practice," Chapter 7.)

In the outer area of the tree zone (Zone II), hardwoods such as black walnut, red and white oak, and white ash can be planted to produce high-value timber. If the water table is at least three feet below ground for most of the growing season, plant hardwood species that require good drainage. If the site has poor drainage, select hardwood species more tolerant of wet conditions.

Shrubs also develop a perennial root system, add diversity and wildlife habitat to the ecosystem, and help slow floodwater when the stream leaves its channel. One or two rows of shrubs are recommended. Select species adapted to the soil site conditions in the area. Use a mix of species either by planting a different kind of shrub in each row or by block planting. A mixture also prevents loss of benefits if one species fails.

Zone III: Grass zone (Next to cropland)

The warm-season prairie grass zone is located on the outside of the buffer strip nearest the field crop. Where surface runoff is a problem, a minimum 20-24 ft. width is recommended. Switchgrass is often preferred because its dense, stiff stems slow the overland flow of water, allowing water to infiltrate and sediment carried by water to be deposited in the buffer area. In addition, switchgrass produces an extensive and deep root

Understanding the Buffer Zone: Function and Management

Comprised of two or three zones, these zones become areas where specific plants and management are combined in order to create a forested riparian buffer that is highly effective at improving and maintaining water quality.

ZONE (Location, species choice)	FUNCTION	MANAGEMENT
Zone 1 (Beginning near the edge of the stream) (fast growing trees/shrub species)	<ul style="list-style-type: none"> • Shade the stream and moderate water temperature • Provide bank stabilization • Enhance aquatic habitat with organic matter • Final filter of material moving through the buffer • Reduce velocity of over-the-bank flood waters 	<ul style="list-style-type: none"> • Selective timber harvest, with replacement • Logging equipment excluded • Large woody debris should not be allowed to fall into the channel • Grazing is excluded, or limited to a specific point of access
Zone 2 (Beginning at the edge of Zone 1) (fast and slower growing trees and shrub species)	<ul style="list-style-type: none"> • Provide maximum infiltration • Uptake of Non-Point Source (NPS) pollutants • Storage of NPS pollutants • Breakdown NPS pollutants • Provide forest-grown products • Enhanced wildlife habitat 	<ul style="list-style-type: none"> • Active management encouraged • Harvest should stimulate new growth • Grazing excluded • Avoid soil compacting activities • Wildlife activities such as bird watching or lease hunting
Zone 3 (Beginning at the edge of Zone 2) (grass and forb species)	<ul style="list-style-type: none"> • Converting concentrated flow to sheet flow • Filter sediment • Uptake of nutrients and chemicals 	<ul style="list-style-type: none"> • Maintain vigorous vegetative growth • Remove biomass – mow • Remove biomass – graze carefully • Remove biomass – burn • Work accumulated sediments away from the buffer, back to the field

On streams where damage to soils and banks is of little concern, Zones I and II are often combined, and management becomes more closely aligned to that of Zone II alone. In each of the zones it is important to recognize the role that buffer health plays in maintaining function. Healthy and actively growing vegetation provides the best uptake and utilization of problem nutrients and chemicals prior to their entering waterways.

system, much of which is replaced annually, providing large amounts of organic matter to the soil. Organic matter improves soil quality by increasing infiltration rates and microbial activity.

Where surface runoff is not a major problem, other permanent native warm-season grasses such as Indian grass, big bluestem, and little bluestem can be used. Always maintain a 10-ft. switchgrass strip at the edge of a crop field. Black-eyed susan

and purple- and gray-headed coneflower also might be planted with grass to intercept surface runoff that might occur. Mixing other warm-season grasses with switchgrass hybrids is not a good idea because the switchgrass will usually out-compete other grasses.

Native forbs also may be part of the mix, especially if they are seeded in clumps with other native grasses. Cool-season grasses, such as brome and

fescue, are not appropriate for the grass zone because they do not tend to remain upright under the flow of water. They also produce only one-eighth of the root mass of native grasses and are not deeply rooted. Therefore, they do not improve soil quality as quickly or as much as the same planting of warm-season grasses.

(End: Iowa State Univ. Extension Contribution)

Planting Tips and Species Selection

The selection of appropriate tree, shrub, forb and grass species is essential for the success of the buffer. When possible, select species of plants that are adapted to the site conditions. Often this is best accomplished by using native plants. Native plants - with proper management - will spread energetically through underground rhizomes, bulbs or other vegetative means and are an excellent choice for the zones of a riparian forest buffer.

Compared with the roots of most non-native, cool-season grasses, warm-season grasses and flowers have a deep, extensive root system that helps absorb moisture and prevent erosion. The native plants can withstand long periods of dry weather, and do not require watering unless the buffer is established in a small residential or business park setting and is less than one-year old. The main considerations are: 1) selecting species that grow on potentially moist sites; 2) choosing species based on the severity of surface runoff from adjacent crop fields or grazed lands; and 3) making certain that seed of desired natives is both available and affordable. Most nursery information includes a description of sites suited for different species.

Many forest nurseries carry one to two-year old seedlings of most tree species for planting in Zone II of the buffer, the managed forest area. Use high quality stock with good root systems. Quality hardwood seedlings should have a minimum of four to five large lateral roots. Trees and shrubs should be planted in early spring, and make sure the planting holes are completely closed so the roots do not dry out.

Consider as wide a variety of species as possible to develop diverse wildlife habitat and to reduce potential diseases and insect infestations. If you plan to sell products from your buffer, identify markets prior to purchasing seeds or plants. Non-natives may also have good market value, but take care to avoid establishing invasive exotics.

To determine the most suitable species for your design needs, ask the following:

- 1. What are my objectives?**
- 2. What are the problems?**
- 3. Which species will do well on my site?**
- 4. Which species are available from local nursery sources?**

Resource professionals at your local NRCS, MDC or University Extension office can assist you with species selection.

Planting a Riparian Forest Buffer

Most buffers are large enough to require seeding to be cost effective. Plants or plant plugs can be used, but add to the cost of the buffer. Prairie grasses and wildflowers (forbs) are usually started from seed, but wetlands are often planted with plugs. Trees and shrubs can be planted as 1-2 year old bare-root seedlings. If a buffer area is prone to flooding, additional measures will need to be taken (such as erosion control blankets, etc.) to ensure the success of the planting. Cover crops can be planted to help control weeds while the natives are becoming established. Site preparation for planting the grasses and forbs in a filter strip can take numerous forms. If the site was previously in pasture, burning down the existing pasture vegetation with glyphosate in the fall and spring, and then using a prairie seed drill will result in a good stand of plants. If the site was previously in row crops, light tilling of the surface to kill early weed species, followed by surface packing with a cultipacker and then using a seed drill will provide a good stand. For woody plant establishment, site preparation should begin in the fall, followed by spring planting.

Species Combinations: *Here are species combination possibilities that could provide riparian buffer protection, although they have not been thoroughly tested throughout the region.*

- Replace shrub rows with trees, or tree rows with shrubs, to increase timber or wildlife habitat. In either case, permanent woody roots are maintained, but use a mixture of species.
- Plant the entire buffer area to warm-season prairie grass. The area closest to the stream could include a mixture of grasses and forbs, but always maintain a 24-ft. strip of switchgrass along the edge of a crop field. Some bank stabilization may be needed (i.e., willow planted in the streambank) to provide long-term stability. This system is best suited where stream banks are not very high or steep.
- Where grazing is desired and adjacent crop fields are more than several hundred feet from the stream, plant warm-season prairie grass in a 15- to 20-ft. strip along the stream and completely fence that area. Fencing regulates stream crossings; watering sites must be provided away from the stream. A portion of the buffer strip could be planted with a dense, cool-season grass such as fescue and orchard grass, which might be a more palatable forage and could be harvested.
- Broadcast or randomly plant a mixture of tree and shrub seeds in both tree and shrub zones to naturalize the planting and avoid rows. This might reduce the cost of planting seedlings.

(Source: Iowa State University Extension, "Stewards of our Streams" series, www.extension.iastate.edu/)

If the site has been in pasture, eliminate competing perennial vegetation in 3-foot or 4-foot wide strips or circles where trees or shrubs will be planted. Fall tillage and/or herbicide application (ex. glyphosate) can be used. If the area has been used for row crops, it is desirable to disk the ground in the spring and seed the area where trees and shrubs will be planted with a mixture of perennial rye and timothy grass. These cool-season grasses are less competitive with trees and shrubs than other species, such as tall fescue. Additional ground cover recommendations are available at your local NRCS or Missouri Department of Conservation office.

Brad Riphagen is a Field Coordinator for Trees Forever, a non-profit organization founded in 1989 dedicated to planting and caring for trees and forests. He offers suggestions for planting trees, shrubs and grasses.

"When seeding grass and forbs, a firm seedbed is needed to ensure that the small seeds are in contact with the soil yet remain close to the surface. You can drill directly into soybean stubble and into sod that has been killed with glyphosate. When planting trees and shrubs into a crop field, it is a good idea to drill grasses, like timothy or perennial rye, which won't out compete the trees and help to prevent erosion during the first 5 years of buffer establishment.

Order trees and shrubs early, up to four months before scheduled planting time to assure receiving the desired species. For direct seeding of most trees or shrubs, collect or purchase seed and plant in the fall. Direct seeding in the spring is possible if you can purchase seed from a dealer. Plant tree and shrub seedlings as early in the spring as site conditions allow. Grasses and forbs should also be planted in the spring."

Management of Riparian Forest Buffers

Managing an Existing Streamside Forest for a Buffer System

Buffer function should be a primary consideration in management. Therefore, management of existing buffers should focus on either maintaining or enhancing buffer function. Although plant materials may be alive and growing, they may not be growing vigorously and be in the best of health. Plants with vigorous growth will have enhanced uptake and use of nutrients. This also equals greater storage of materials that would otherwise travel into the water system. Management strategies need to look toward creating stronger plants, resulting in plants that are more likely to survive environmental stress, such as seasonal flood events.

Maintenance of Existing Streamside Forests

Function is maintained when the buffer zones are maximizing their potential for plant growth. For

grasses, this may mean mowing or selectively applying rotational grazing at appropriate times of the year (such as dry and not wet periods). This can assist in minimizing the accumulation of dead grass material, and enhance overall grass growth and vigor. However, it is crucial that access to the stream or creek be limited. One method of limiting access is to only have fenced access available in a small, planned area (Figure 3). Additionally, grass zones adjacent to crop fields may occasionally need to have accumulated soils pulled back into the field. This can be accomplished by directionally discing such that soil is moved away from the grasses edge.

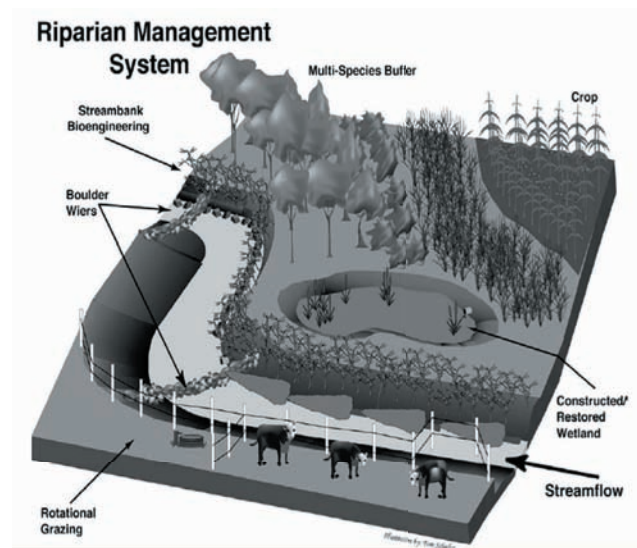


Figure 3: Riparian management system with livestock access restricted by fencing. Source: Tom Schultz, Iowa State University.

In the shrub zones, management may include such practices as cutting the shrub back, pruning and control of invading grasses (weed control). In the timbered zone, thinnings and selective harvest may be used to keep the remaining trees in a state of health and vigorous growth. Also, your management plan in the timbered zone should take into account the need for regeneration and the establishment of new seedlings. This can either be natural or artificial, such as when planting new seedlings. It is important to remember that as trees age, slower growth rates and death are natural. One management tool then, is to harvest mature trees prior to their death, degradation, or break-

down, when they may otherwise become debris in the waterway that inhibits proper flow.

Enhancement

From time to time, in spite of any maintenance that may be completed, it may also be necessary to enhance or enrich the buffer to maintain the desired functionality. This may be as simple as planting additions (overseeding grass zones, putting in a new shrub, or planting trees in openings created by harvest or loss from flood damage). Remember, the goal is to have a healthy and vigorously growing buffer, and one without gaps that would allow water to channel through.

Maintenance of a Riparian Forest Buffer

The primary maintenance activities include mulching, mowing, herbicide application and weed control, until trees and shrubs are large enough to compete on their own. Mow the grass/prairie zone (Zone III) as high as possible to remove annual weed seed heads, but not young grasses and forbs. Prescribed burning during the first 4 to 5 years can also aid establishment. Once established, the grasses and forbs need to be hayed, grazed or burned regularly to maintain vigorous growth.

You can increase the filtering capacity and potential economic returns of Zones II and III by trimming, cutting back, mowing, or harvesting the shrub, grass, wildflower and forb species. By keeping the plants in a state of vigorous growth, they will actively filter more soluble nutrients from the water. Additional income can be generated by planting products to sell locally.

Replace significant losses of tree and shrub seedlings during the first three years to ensure the desired plant density of the mature buffer. Protecting young trees and shrubs from deer, rabbits and beaver can be expensive, but is necessary to the health and vitality of the buffer.

Finally, inspect the buffer annually and after significant storm events to determine the need to remove excess sediment at the cropland edge of

the buffer that can prevent shallow runoff from flowing evenly through the buffer, or to repair concentrated-flow cuts through the buffer.

Replanting and reseeding:

(Following replanting and prescribed burning sections reprinted with permission from Iowa State University Extension; “Stewards of our Streams: Maintenance of Riparian Buffers.” For more information visit www.extension.iastate.edu)

Replanting and reseeding are important maintenance practices during the first few years following establishment of a riparian buffer and can be done in the spring or fall. Woody plants should be replanted within a row if more than three or four consecutive seedlings have died. Spot planting can be done quickly with just a bucket full of water, seedlings and a shovel.



Applying a chemical barrier helps seedlings get off to a good start.

Replanting in the native grass/forb zone may be a bit more involved, depending on the density and quality of grass and establishment. If there is poor establishment, a herbicide like Glyphosate can be used, followed by redrilling. If there is some establishment, but not as dense as desired, the site can be directly redrilled. If the areas needing reseeding are small, handspreading the seed and raking it into the ground is acceptable.

During the life of a riparian buffer, trees will begin to compete with each other as they do in a natural forest, and without pruning and thinning they will not maintain an optimal growth rate. Depending on spacing, fast-growing trees such

as cottonwoods and poplars will be competing with each other within 10 years of planting. After 8 to 9 years, every second or third tree may have to be harvested to increase water availability and growth space for remaining trees.

Prescribed burning:

Fire is a good maintenance tool for native grasses and forb plantings in riparian buffers and filter strips. To reduce weed competition during the year, prescribed burns are usually performed early in the spring. During this time, many of the competing cool-season grasses, weeds and woody plants begin growing while the native prairie plants are still dormant. Always develop a prescribed burn plan prior to burning. (Note: Assistance is available through the Missouri Department of Conservation Private Lands Division).

While different burning frequencies may be used, an annual spring-burn for the first three or four years is recommended. Following establishment of a good stand of desired grasses and forbs, a burning cycle of once every three to four years can be used. The burning cycle is usually defined by the accumulation of dead plant material on the ground, weed species invasion and general vigor of the plant community. Fall burns also can be used to stimulate forb growth more than the grass growth. However, they may be problematic if adjacent crops are not harvested.

Burning the riparian grass/prairie component of a riparian buffer can be tricky due to the close proximity of shrubs and trees. Such a burn requires numerous people, careful planning, attention to fuel sources and amounts, and attention to wind. Using a small, slow backfire (a fire that burns into the wind) helps to keep the fire more controlled while it is close to neighboring shrubs and trees. A fire break is often mowed or raked between the shrubs and/or trees and the native prairie component. The fire break can be wetted if the fuel is dry.

A good strategy is to burn when steady wind (10-15 mph) is blowing into the buffer toward the stream. This way, a backfire can be started with a drip torch along the mowed break and allowed

to burn into the prairie grass filter. The fire moves slowly because it is burning into a prevailing wind. Once the backfire has burned a strip of 10 - 15 feet in width, a head fire (burning with the wind) can be lit along the crop field and allowed to burn rapidly with the wind. If there is heavy corn stover left along the crop edge, care must be taken to keep the fire out of the field. This can be done by raking or wetting the stover just before the fire is lit. The crew, equipped with fire rakes, fire swatters, and backpack sprayers, should patrol the burn to keep it contained. Fires should be kept small and well controlled (start small to test the wind, moisture conditions, and train your crew). A water tank in a pickup truck fitted with a small pump and garden hose can be very useful for wetting down the fire break and corn stover. If you have not performed a controlled burn before, you should ask for assistance from a local natural resource professional with experience dealing with controlled burns. Consideration should be given to the influence of burning on nesting birds.

Ideally, you should burn in sections; burn only one side of the creek or break a prairie stand into three or four sections and burn one each year. Fall burns eliminate winter cover and late spring burns can destroy nests. However, fire helps to maintain native plant health. Most native prairie plants will grow more vigorously, produce more flowers and produce more seed after a fire. The active growing points of most prairie plants are below the soil surface, and are therefore unaffected as the fire rapidly passes over. After the fire, these plants are stimulated by warmth of the blackened ground and the nutrients that were released from burned plant material. (End: Iowa State University Extension contribution)

Specific Considerations for Stability: Stream Bank Structures

In some cases, erosion caused by runoff and/or sloughing of stream banks is too excessive to be stabilized by a Forested Riparian Buffer alone. Therefore, to quickly stop erosion, it may be necessary to use bioengineering at the trouble spot.

Bioengineering can:

- Be used to change the steep angle on actively eroding banks to a more gradual slope upon which plants may then become established,
- Slow water movement and reduce erosion by adding frictional material to stream banks,
- Reduce undercutting,
- Reduce stream sediment loads,
- Improve water quality,
- Improve aquatic habitat and wildlife habitat.

The following bioengineering practices and structures can be used singly, or in combination, to create a more stable stream channel and bank.

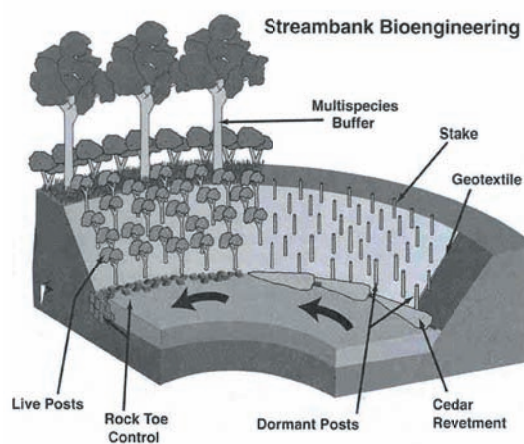


Figure 4: A combination of live and dead materials used in the streambank bioengineering practice. Source: ASA, "North American Agroforestry: An Integrated Science and Practice." Chapter 7.

Rock rip-rap — Rocks anchored to the stream bank. This type of stabilization is useful in areas of severe undercutting. Size of the rock is directly related to stream size, volume, and velocity. Larger streams with increased water velocity will require larger rock. In order to avoid undercutting of the anchored rock, the rip-rap should extend to stable material in the channel bottom. In some cases, it may be necessary to reshape the stream bank prior to rock placement.

Geotextile fabrics — Fabrics of jute, coconut, or other fibers may be used in conjunction with any of the living structures. This fiber mat will hold soil in place while the live plant material becomes

established. The fabric can be held in place with stakes and/or placed in the trench with fascines and covered with a shallow layer of soil.

Tree Revetments — By staking dead trees and logs along eroded stream banks, protection is provided and sedimentation allowed to collect, which in turn provides a medium for new vegetation to become established. Logs and branches can also serve as shade, creating better aquatic environments.

Live post and stakes — By using dormant plant material, stream banks can be quickly stabilized. Dormant material (cuttings) of a few selected tree and shrub species will quickly develop root structures below ground and produce live shoots above. Stakes of one-half inch and larger are driven into an eroding bank. The longer the stake, the better stability that is provided. Lengths may range from 2 to 3 feet for stakes, up to 10 feet for posts. Installation should begin with the larger stakes being placed at the base, along the water line, and the smaller stakes planted into the upper stream bank.

Live fascines — Also known as wattles, these are bundles of live, dormant branches (whips). Individual whips should be at least 4 feet in length. These branches are then overlapped, with all butts and buds pointed in the same direction, to form bundles of up to 8 inches diameter and 10 to 20 feet in length. As with live stakes it is desirable to use species which will quickly root. Place the fascines in shallow trenches, leaving the upper live buds exposed. Soil should be tamped into place around the bundles and a dead stake used to anchor them in place. By placing fascines along the contour, small branch dams are formed against soil movement. This will create a terraced effect on stream banks. Bundles should be spaced from 3 to 6 feet apart with narrower spacings used on steeper banks.

In-Stream structures — Where channel incision is still actively occurring and stream banks are unstable, or where there is a lack of in-stream habitat, rock structures, such as boulder-weirs can

be constructed. These structures are constructed of properly sized rock and no more than 1.5 to 2 ft high at their center. They are usually constructed with a slight V in the center to direct flow down the center of the channel. They have an upstream rock apron with a 4:1 slope and a down-stream apron with a 20:1 slope. These aprons reduce the turbulence of the water, while allowing enough to improve oxygenation. Use these structures in series, allowing enough distance between so that a pool develops. This placement reduces channel bed erosion. Providing pools that are 1.5 to 2 ft high reduces the critical bank height at low flow, thus reducing bank erosion. (See Figure 3, page 8).

Considerations for Wildlife:

One of the most notable benefits of using natives in a buffer is the creation of effective wildlife habitat. Native grasses and forbs provide different heights, densities, shapes of stems and leaves, different flowering times, and different flowers and fruits to attract several different species of wildlife. The key is to plant as wide a mix of species as possible to achieve the maximum wildlife benefit. Planting pure native warm-season grass strips with one or two species is more effective than just one species of low growing cool season grass, but planting 5 or 6 species of native grass and 25 forbs provides much more habitat potential. Similarly, planting mixtures of trees and shrubs will provide more diverse structural habitat, but if a landowner is mainly concerned with upland bird habitat, trees provide perches for predator raptors that may prey on the prairie birds.



Lease hunting is another opportunity for income from the wildlife habitat created by your riparian buffer. (MDC photo)

Jim Wooley is a Regional Wildlife Biologist with Pheasants Forever, a non-profit organization dedicated to the protection and enhancement of pheasant and other upland wildlife population through habitat improvement.

"Pheasants Forever is interested in riparian buffers and other buffer systems because of the habitat that these types of practices provide for pheasants and other wildlife, including non-game wildlife. Beyond that, establishing a buffer offers an exceptionally good economic benefit for a landowner. He's taking ground that in a lot of cases is productive, but may have some problems associated with it. In some cases, we're looking at cash rentals and incentives that approach two hundred dollars per acre. That's an excellent return on the ground, and the buffer is providing many benefits, not only to the landowners, but to society in general."



Improved wildlife habitat, such as ducks and quail, are another benefit of riparian buffers.

Market Opportunities with Riparian Forest Buffers

Many products grown in the buffer have monetary value in addition to their conservation benefits. A trip to a local florist or craft store will give you an idea of the diverse uses of plants and plant stems. It may also be helpful to ask if local stores are interested in purchasing locally and sustainably grown materials. At that time, inquire how they would like to receive the material (condition and packaging).



Willow and dogwood branches are bundled for sale to retail and wholesale florists, bringing as much as 50-75 cents per branch in some markets.



Markets for nut crops like black walnut (background) and pecan (inset) include farmers' markets and retail/specialty grocers.

Decorative woody florals and craft products:

Decorative woody florals can be planted in Zone II of a riparian forest buffer for additional income. This category includes any woody plant species that has a colorful or unusually shaped stem, bud, flower, fruit or leaf. Common examples include pussy and curly willows and red- and yellow-stemmed dogwoods. These plants, and many others, are regularly used in the floral industry to add height and breadth, enhance line and form, and add a splash of color. They retain their bright colors for a long time, extending an arrangement's usable life. Woody florals accent cut-floral arrangements and enhance consumer perceptions of size and value, and can make a statement even when used alone in a vase design. They can be sold to retail or wholesale florists by the stem or the bundle at competitive prices.

Learn more about decorative woody florals through research conducted by the University of

Nebraska Extension Forestry Program, including a list of additional species of woody plants commonly used in the floral industry and retail and wholesale nursery stock sources online at http://snrs.unl.edu/forestry/woody_florals.htm.

Market Opportunities	
Examples of 'marketable' products	Timeframe to reach market potential
Floral and Craft Products	Beginning approximately 2 years after establishment, and if done correctly (i.e. plants resprout), continuing for many years
Berries and nuts	From 2 to 15 years, depending on the crop
Biomass	10 to 20 year rotation, market dependent
Timber Trees	In most cases, 40+ years

Berries and nursery stock:

Various species of edible berries, including blackberries and raspberries, can be grown in the shrub zone of a riparian buffer for additional income. Markets for fresh berries can be found by contacting local farmers' markets, grocers and specialty health food stores.

Harvesting nut crops:

Planting nut trees including pecan and black walnut in Zone II can provide income from nut harvests. Fresh pecans are readily sold at farmers' markets, roadside stands or to retail and wholesale grocers. The Center for Agroforestry is conducting extensive research to identify outstanding cultivars of pecan and black walnut. Informational guides and research updates are available at www.centerforagroforestry.org.

Timber trees:

Planting trees into Zone II of your riparian buffer for a future timber harvest requires a management

plan and patience, but can be very profitable over the long-term. In Missouri, when the market is right, Silver Maple brings almost as much as oak species (price per board feet).

Integrating riparian buffers into your current land practices can maintain the integrity of stream channels, reduce the impact of upland sources of pollution, generate income and optimize performance for environmental protection and economic production. With thoughtful consideration to site characteristics, landowner goals, species selection and environmental and wildlife benefits, riparian buffers provide an additional source of sustainable production with multiple conservation benefits.

Financial Resources:

There are many agencies offering programs that can be used to establish and maintain agroforestry practices on private land. One of the most significant of these agencies is the USDA Farm Service Agency (FSA), offering three distinct programs that may be utilized toward agroforestry systems like riparian forest buffers: the Conservation Reserve Program (CRP), the Continuous Conservation Reserve Program (CCRP), and the Conservation Reserve Enhancement Program (CREP). Each of these programs is designed to take environmentally sensitive and highly erodible land out of production by offering a soil rental payment, a cost-share for the establishment of various conservation practices and other financial incentives to landowners who offer to set aside their land.

Of these three programs, the CCRP program offers direct benefits to landowners establishing a forested riparian buffer. CCRP is a voluntary program that focuses on funding conservation practices (CP) protecting environmentally sensitive land, including wetlands and riparian areas. Landowners with eligible land who wish to enroll that land in the CCRP may sign-up at any time during the year.

Available funding through the CCRP can include:

- Annual soil rental rate payments that can be up to 120 percent of the average soil rental

rate for the area.

- Annual maintenance payments of \$5 to \$10 per acre.
- Cost share payments up to 50 percent of the establishment cost.

Along with these three payments, CCRP also has two one-time incentive payments available for certain CP's, including:

- A signing incentive payment (SIP) equal to \$10 per acre per number of contract years.
- A practice incentive payment (PIP) equal to 40 percent of the establishment costs.

There are 16 practices that are eligible for the CCRP. However, out of the 16, eight allow for tree planting, including:

- CP16A Shelterbelts
- CP22 Riparian buffers
- CP23 Wetland Restoration

Riparian buffers have become a priority for most USDA agencies. Under the requirements of the CCRP's riparian forest buffer practice (CP22), landowners must establish at least a two-zone buffer. The total width of the riparian forest buffer will vary depending on the size of the stream and landowner objectives. For first and second order streams, the buffer must be at least 50 feet wide and cannot exceed 180 feet. Buffers along third order streams must be at least 100 feet wide. Riparian forest buffers along the Missouri and Mississippi Rivers may be increased to 300 feet. Buffers may be extended beyond 180 feet or 300 feet for the purpose of improving water quality benefits.

NRCS Standard 391 identifies the guidelines for establishing a riparian forest buffer for the CCRP. For more information, contact your local USDA/ FSA office.

Additional USDA programs to establish and maintain riparian forest buffers are offered through the Natural Resources Conservation Service (NRCS); the Forest Service (FS); and the Sustainable Agriculture Research and Education (SARE) program. The United States Fish and

Wildlife Service (USFWS) also offers assistance; see chart below for a listing of incentives offered by these federal agencies or consult the UMCA publication "Funding Incentives for Agroforestry in Missouri."

Riparian Forest Buffer (CP22)	
♦	10- to 15-year contracts
♦	Continuous CRP
♦	Eligible for the following CRP financial incentives
	120 percent SRR
	50 percent regular cost share
	SIP
	PIP
	\$7-\$10 maintenance
♦	Width requirements -
	(1st and 2nd order streams)
	Grass zone: 25 feet maximum
	Minimum buffer width: 50 feet
	Maximum buffer width: 180 feet
♦	Width requirements (3rd order streams)
	Grass zone: 25 feet maximum
	Minimum buffer width: 100 feet
	Maximum buffer width: 180 feet

Brief description of the CCRP funding and design characteristics that support the establishment of riparian forest buffers.

Summary

When incorporated on the farm landscape, forested riparian buffers can effectively improve water quality and limit soil loss. A buffer can be established and become productive in a relatively short time period.

One of the keys to the successful buffer is the choice of materials and plant species that are suitable for the selected site. The next step is to understand the dynamics of the stream with respect to adjacent land-use issues so that the buffer design will adequately address the problem. Finally, be clear on the management needed in order to maintain the effective functioning of the buffer over time.

Working from these three points of reference will best ensure the success of a riparian buffer for years to come.

Success Stories:

Lon Strum

Story County, Iowa



Lon Strum rotates corn and soybeans on his 1,000-acre operation in Story County, Iowa. Before installing a riparian buffer, his tractor would occasionally get stuck on the banks of Bear Creek. While he no longer produces corn or soybeans from the buffered land, he no longer loses his crops during wet years, doesn't have to worry about getting his tractor stuck, and enjoys the benefits of a healthy stream with a significant amount of habitat.

“When I was on the edges, I was constantly getting stuck as I was working close to the creek. It was just more hassle than what I wanted. Since putting in the riparian buffer, I don't notice any difference in the yields, but now I just go in straight rows.

“The buffer has also added to our wildlife habitat. This is the hunting paradise of Story County right here, especially for pheasant hunting. People have come from Alaska, Michigan, and all over Iowa. The demand is very large.”

Ron Risdal

Story County, Iowa

Ron Risdal has experienced similar success with the riparian buffer he installed more than 12 years ago. Risdal rotates corn, soybeans, and alfalfa on his farm.

“There's always something new. We can go fishing, or we can go out here and kick up a deer or pheasant or partridge.”



“I don't think we've lost hardly any stream bank since 1993, but before we were moving fences almost every year. Yesterday morning when it was flooding, it stopped at the buffer strip instead of washing all over the bank. We don't have to haul rocks in the gullies like we used to do years ago.”

Additional Resources

In Print:

- Schultz, R.C., J.P. Colletti, T.M. Isenhardt, C.O. Marquez, W.W. Simpkins and C.J. Ball. "Riparian Forest Buffer Practices." *North American Agroforestry: An Integrated Science and Practice*. Garrett, H.E., W.J. Rietveld and R.F. Fisher (eds.) 2000. American Society of Agronomy. pp. 189-281.

University Resources:

- **The University of Missouri Center for Agroforestry** -- www.centerforagroforestry.org
- **Iowa State University Extension** (See publications list for "Stewards of our Streams" series on riparian buffers. Listed under Water Resources and Water Quality section) www.extension.iastate.edu/
- **Healthy Land, Clean Water: Riparian Management Systems** (A resource web site from the Iowa State Agroecology Issue Team of the Leopold Center for Sustainable Agriculture) www.buffer.forestry.iastate.edu/
- **The University of Nebraska Forestry Extension** (Resources about decorative woody florals and other specialty forest products) <http://snrs.unl.edu/forestry/educationalopportunities.htm>
- **University of Missouri Extension** (Use subject search for publications and links to newsletter articles for riparian buffers) <http://extension.missouri.edu>

State-Based Resources:

- **Missouri Department of Natural Resources** (Perform a search for "buffers" to see current bulletins and information.) www.dnr.state.mo.us/
- **Missouri Department of Conservation, Resource Forester** (Find the Resource Forester for your county through this online listing.) www.conservations.state.mo.us/forest/myforester-search.html
- **Grow Native!** (A joint program of the Missouri Department of Conservation and the Missouri Department of Agriculture to increase awareness of Missouri's native plants and their effective use.) www.grownative.org

Federal Resources:

- **USDA Agricultural Research Service (ARS)** (Search for "buffers" to find research projects and publications) www.ars.usda.gov
- **Natural Resources Conservation Service** (Use subject search to view nationwide guides and publications on riparian buffers.) www.nrcs.usda.gov/
- **The USDA National Agroforestry Center** -- www.unl.edu/nac/

Non-Profit Organizations:

- **Trees Forever** (An organization dedicated to natural resources stewardship and addressing the challenges facing communities and the environment, including water quality.) www.treesforever.org/

Five Practices of Agroforestry DVD: Produced by the University of Missouri Center for Agroforestry

- Includes the basics of establishing a riparian buffer practice.

EXERCISE: REVIEW OF RIPARIAN FOREST BUFFERS

1. *Why are warm season grasses viewed as an essential component of a well designed riparian forest buffer?*

2. *Due to the effectiveness of warm season grasses at slowing the movement of water headed towards streams and waterways, sediments accumulate at the up slope side of the buffer.*

Is this a problem in the long run and can it be managed?

3. *If I manage my grass/shrub/tree buffer for the first 3 to 5 years and it has become well established, can it be left alone to take care of itself from that point?*

4. *As their name implies, warm season grasses do not begin active growth until late spring. However, fertilizers and other soil amendments are applied early in the spring. Also, while crops are being planted and getting established, the soil is relatively unprotected from rainfall and prone to serious erosion. Given this situation, how effective are warm season grasses as buffers?*

5. *How wide should my buffer be?*

6. *What cost share programs are available to help offset the costs of RFB establishment?*

EXERCISE KEY

1. Why are warm season grasses viewed as an essential component of a well designed riparian forest buffer?

Warm season grasses are typically stiff stemmed clump grasses. Once established, warm season grasses roots penetrate deeply into the root zone. These two attributes contribute two essential functions to the buffer. First, the stiff stems hold up against water movement and forces water to slow down as it moves through the grasses. Second, coupled with the well developed, deep root profile and well aerated soil, flowing water will have adequate residence time to percolate into the soil. Sediments and phosphate fall out of solution, soluble nutrients enter the root zone, while atrazine can be detoxified by plant roots and microorganisms.

2. Due to the effectiveness of warm season grasses at slowing the movement of water headed towards streams and waterways, sediments accumulate at the up slope side of the buffer. Is this a problem in the long run and can it be managed? Yes, this can become a problem if the warm season grass buffer is not managed. Riparian forest buffers are living filters, and like all filters, they need to be “cleaned” periodically to function properly. In the case of a RFB, cleaning refers to periodic maintenance.

3. If I manage my grass/shrub/tree buffer for the first 3 to 5 years and it has become well established, can it be left alone to take care of itself from that point? RFBs must be managed on a continued basis to maximize their buffer function. To maintain active growth and out-compete fescue and other invasive woody species, warm season grasses and forbs must be burned periodically. Trees must be thinned periodically to maintain active growth rates and not stagnate. Similarly, many shrubs selected for RFBs must be coppiced (cut back close to the ground) to maintain vigorous root and shoot growth.

4. As their name implies, warm season grasses do not begin active growth until late spring. However, fertilizers and other soil amendments are applied early in the spring. Also, while crops are being planted and getting established, the soil is relatively unprotected from rainfall and prone to serious erosion. Given this situation, how effective are warm season grasses as buffers? For a buffer to be truly effective, warm season grasses are an essential component. The above stated problem is their biggest weakness. Therefore, warm season grasses need to be used in combination with both cool season grasses and woody perennials for a RFB to be effective on a year-round basis. Cool season grasses begin growth early in the spring, and even though they are relatively shallow rooted and lack stiff stems (so that water will knock them down and flow right over the top) they are active and a first line of defense against water, soil and nutrient movement early in the growing season. Combined with shrubs and trees, some of which also become active early in the growing season (e.g., willow species), RFBs are fully functional.

5. How wide should my buffer be? The general rule of thumb is that wider is better. However, that is a very broad generalization. Buffer width depends on many factors including the purpose(s) for the buffer, the associated cropping pattern and related conservation practices being employed upslope, the specific soil and slope conditions, and whether or not government cost share programs are involved which require certain minimum widths. Buffers may be designed for bank stability, aquatic habitat protection and improvement, sediment control, removal of soluble nutrients from adjacent crop fields, flood control or wildlife habitat. To stabilize stream-banks and protect aquatic habitat, effective buffers can vary from 30 to 90 feet wide. For sediment and flood control or to improve wildlife habitat, buffers must be wider, ranging from 60 feet to well beyond 150 feet.

6. What cost share programs are available to help offset the costs of RFB establishment?

USDA FSA offers a variety of cost share programs including the Conservation Reserve Program (CRP), Continuous Conservation Reserve Program (CCRP), and the Conservation Reserve Enhancement Program (CREP). Each of these programs contains approved practices that support RFB establishment. Further details on cost share programs are found in the UMCA Publication “Funding Incentives for Agroforestry in Missouri” (changes to these programs may occur after passage of the 2007 Farm Bill).

UMCA Research: Riparian Forest Buffers

Ongoing USDA-ARS projects on riparian buffers and water quality are conducted at University of Missouri research farm sites and private landowner farm sites across the state. A primary goal is to determine the most suitable tree, shrub and grass species for removing agricultural chemicals from runoff water, as demonstrated in the following projects.

Bioremediation of Herbicides in Grass and Agroforestry Buffers

Project Team:

C.H. Lin, M.F. George, and H.E. Garrett, University of Missouri Center for Agroforestry; R.N. Lerch, USDA-ARS, Columbia, Mo.

Herbicides are among the non-point source pollutants of greatest health concern in the Midwestern United States. More than 70% of the herbicides used in the U.S. are applied in the Midwest for corn and soybean production. Many herbicides, such as atrazine, are relatively persistent in soils with an average half-life ranging from 4 to 57 weeks. Not surprisingly, herbicides and their metabolites are commonly found in the wells, surface runoff, shallow aquifers, and surface drinking water supply throughout Missouri.

A well-designed tree-shrub-grass riparian buffer strip is recognized as one of the most cost-effective approaches to alleviate non-point source pollution from adjacent crop lands. Current UMCA research involves four projects with the goals of optimizing riparian buffer designs in agroforestry systems to: 1) reduce herbicide transport to nearby agricultural lands before they reach riparian areas (streams and lakes) and 2) to enhance the degradation process of the herbicides trapped within the buffers.

This research will provide valuable tools for government agencies and landowners to optimize a cost-effective buffer strip design and improve the effectiveness of buffer strips for the bioremediation of herbicides derived from agricultural operations.

A well-designed riparian forest buffer will not only minimize the amount of herbicide and their metabolites transported into the shallow aquifers or surface water, which are used for private and public drinking water sources, but also minimize the amount of land required to be taken out of crop production to reduce pollutants to acceptable levels. Other benefits may include significantly reduced operation and maintenance costs at local water treatment facilities. Findings from the research may also encourage local governments to implement more extensive cost-share, annual incentive or rental payment programs for landowners for the adoption of tree-shrub-grass riparian buffers.

Key Findings, Bioremediation Study

- Grass buffers significantly reduced herbicide transport in surface runoff.
- Grass buffers with native species displayed the best season-long effectiveness to reduce herbicide transport.
- An experimental filter strip of native warm season grasses approximately 27 feet wide removes about 75-80% of atrazine, metolochlor and glyphosate from surface runoff.
- The placement of switchgrass hedges situated at the beginning of the tall fescue buffers enhanced the reduction rates of atrazine and metolochlor transport by 13% and 9%, respectively, at a distance of approximately 3 feet from the herbicide application source.
- Warm-season switchgrass is shown to have the highest capacity to degrade and immobilize atrazine in soils, degrading more than 80% of applied atrazine to less toxic metabolites within 25 days of application.

Sources:

Lin, C.H., Lerch, R.N., Jordan, D., Garrett, H.E., and George, M.F. 2004. *The effects of herbicides (Atrazine and Balance) and ground covers on microbial biomass carbon and nitrate reduction. Proceedings of the 8th North American Agroforestry Conference, June 22-25, 2003 Corvallis, Oregon. p. 182-195.*

Lin, C.H., Lerch, R.N., Garrett H.E. and George, M.F. 2004. *Incorporation of selected forage grasses in riparian buffers designed for the bioremediation of atrazine, isoxafutole (Balance) and nitrate. Agroforestry Systems. 63: 91-99.*

Agroforestry Practices, Runoff, and Nutrient Loss: A Paired Watershed Comparison

Project Team:

R.P. Udawatta, H.E. Garrett, Stephen Anderson and Peter Motavalli, University of Missouri Center for Agroforestry; Tshepiso Seobi and Neil Bailey, M.S. graduates

Pollution of surface and ground waters linked to agricultural practices remains a serious concern in the United States. Excess nitrogen and phosphorus runoff have resulted in the “dead zone” in the Gulf of Mexico, and through

Key Findings, Paired Watershed Research:

- Incorporation of agroforestry practices into rowcrop agriculture has been shown to reduce runoff by 16% compared to a conservation-tilled, row-cropped watershed.
- Soil erosion was reduced by 28% during the past five years, due to the treatments.
- Treatments reduced total phosphorus loss by 24 and 22% on grass buffer and agroforestry buffer watersheds, compared to the control watershed.
- The grass buffer and agroforestry buffer treatments reduced total nitrogen loss by 6%.
- During the last five years of treatments, nitrate N loss was reduced by 9% by grass buffer and agroforestry buffer treatments.

water runoff and soil erosion, agrochemicals from herbicides and other soil amendments may generate millions of dollars in water treatment costs each year. States are required to implement water quality standards based on U.S. Environmental Protection Guidelines or other scientific methods, resulting in an increasing need for economically and environmentally suitable practices to reduce non-point source pollution from agricultural watersheds. UMCA researchers continue to investigate agroforestry practices, including alley cropping and riparian forest buffers, as environmentally beneficial solutions to non-point source pollution that also provide economic benefits to landowners.

A long-term experiment of national significance in the science of agroforestry is the paired watershed at the University of Missouri Greenley Memorial Research Center, Novelty, Mo., consisting of:

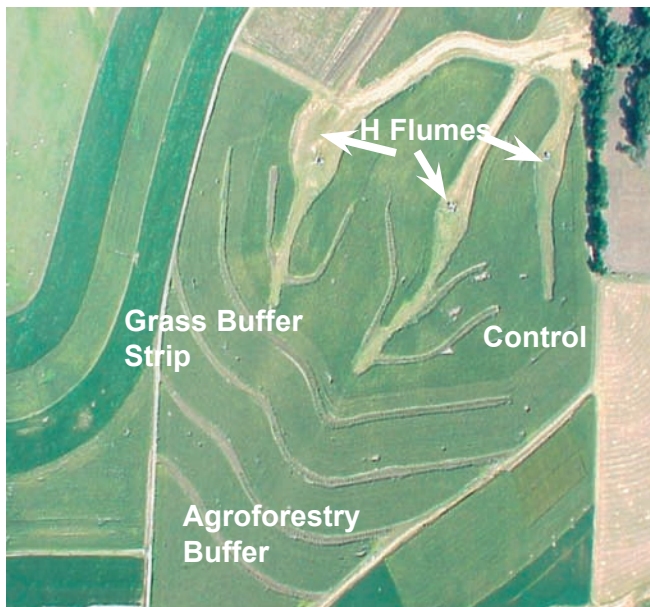
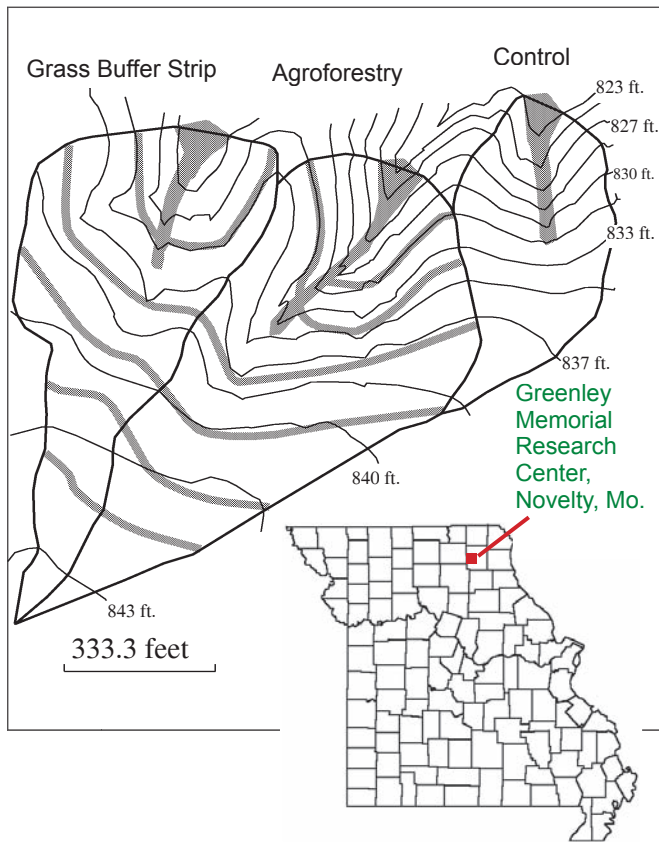
- 1) a corn-soybean/tree-grass buffer (agroforestry)
- 2) a corn-soybean/ grass buffer, and
- 3) a control treatment with a corn-soybean rotation

The paired watershed study is being evaluated to determine the effect of buffers and topographic factors on herbicide degradation, sediment, runoff and fertilizer reduction.

Sources:

Udawatta, R.P., J.J. Krstansky, G.S. Henderson, and H.E. Garrett. 2002. *Agroforestry practices, runoff, and nutrient loss: A paired watershed comparison. Journal of Environmental Quality. 31:1214-1225*

Udawatta, R.J., P.P. Motavalli and H.E. Garrett. 2004. *Phosphorus loss and runoff characteristics in three adjacent agricultural watersheds with claypan soils. Journal of Environmental Quality. 33:1709-1719.*



Top: Study site location and 1.5-foot interval topographic maps of grass buffer, agroforestry buffer and control watersheds. Broad gray areas represent grass strips (contour strip) and tree and grass strips (agroforestry). Grass waterways are visible from H Flumes in all watersheds. Bottom: Study site, aerial view.

Effectiveness of Riparian Forest Buffers in Headwater Watersheds of the Western Corn Belt Plains Ecoregion

Project Team:

Tom Isenhardt and Dick Schultz, Iowa State University (ISU) Dept. of Natural Resource Ecology & Management; Bill Simpkins, ISU Dept. of Geologic & Atm. Sciences; ISU Research Associates/Scientists Leigh Ann Long, Jin-Kie Yeo

The water quality - riparian project cluster, combining expertise from the ISU Agroecology Issue Team, MU and UMCA researchers and researchers at the National Agroforestry Center, Lincoln, Neb., and ARS Dale Bumpers Small Farm Research Center, Booneville, Ark., continues to work on the design, management and efficacy of the riparian forest buffer agroforestry practice in reducing the input of NPS pollution from upland practices into surface waters. A major goal of the cluster is to create flexible buffer designs that are maximally effective across the agricultural region of the Midwest. Researchers and natural resource managers generally agree that, given appropriate site conditions, a well-planned and properly maintained riparian forest buffer can have remarkable effects on sediment trapping and nutrient processing for overland and shallow ground water entering and within the riparian zone (Simpkins et al., 2002; Schultz et al., 2004). They not only provide buffer functions for surface and subsurface pollutants but also provide stream bank stabilization, diverse wildlife habitat and a potential income source for landowners (Schultz et al., 2000).

UMCA and researchers at Iowa State University are studying the impact of riparian forest buffers in the headwaters of the Crooked Creek watershed (in Missouri's Mark Twain Watershed) by monitoring associated groundwater wells. Results of these tests indicate that riparian forest buffers composed of combinations of warm or cool season grasses, shrubs and trees remove significant amounts of nitrates from the groundwater moving toward the stream.

Conclusions from Mark Twain Watershed Research:

- Groundwater moving below crop fields contains significantly higher levels of nitrates from fertilizers than groundwater moving below lightly used stream side pastures.
- Properly designed riparian buffers containing trees, shrubs and native warm or cool-season grasses can effectively intercept sediment and surface chemicals before they enter a stream.
- 42% of the forested strips along first order streams in the Crooked Creek watershed, and 10% of the higher order forested strips, are narrower than the NRCS recommended widths. Efforts to establish riparian buffers should be targeted toward first and second order headwater streams, as these are in closest contact with agricultural activities.

Sources:

Schultz, R.C., J.P. Colletti, T.M. Isenhardt, C.O. Marquez, W.W. Simpkins and C.J. Ball. 2000. Riparian forest buffer practices. Chapter 7 pp 189-282; in: Garrett, H.E., W.J. Rietveld and R.F. Fisher (eds.) *North American Agroforestry: An integrated science and practice*. American Society of Agronomy, Madison, WI. 402 pp.

Schultz, R.C., T.M. Isenhardt, W.W. Simpkins, and J.P. Colletti. 2004. Riparian forest buffers in agroecosystems – lessons learned from the Bear Creek Watershed, central Iowa, USA. *Agroforestry Systems* 61:35-50.

Simpkins, W.W., T.R. Wineland, R.J. Andress, D.A. Johnston, G.C. Caron, T.M. Isenhardt, and R.C. Schultz. 2002. *Hydrogeological Constraints on Riparian Buffers for Reduction of Diffuse Pollution: Examples From the Bear Creek Watershed in Iowa, USA*. *Water Science and Technology* 45 (9): 61-68

Zaimes, G.N., R.C. Schultz, and T. M. Isenhardt. 2004. *Stream Bank Erosion Adjacent to Riparian Forest Buffers, Row-cropped Fields, and Continuously-grazed Pastures along Bear Creek in Central Iowa*. *Journal of Soil and Water Conservation* 59:19-27.

UMCA Research: Flood Tolerance

Since 2001, UMCA has been supported by and managed three significant USDA - ARS programs, representing more than 50 individual projects. The Center seeks to develop the scientific basis for designing and prescribing agroforestry practices within a "systems context," which allows technology to be used most effectively. To achieve this goal, our research efforts have been organized into eleven research "clusters" to enhance creativity and productivity among a range of investigators from many disciplines -- including the Flood Tolerance cluster, from which a selection of research findings are included in this section.

Project Team:

Bob McGraw, James Houx

Flood Tolerance Research:

A Flood Tolerance Laboratory was constructed along Sulphur Creek in the Missouri River floodplain at the Horticulture and Agroforestry Research Center, New Franklin, Mo. This facility provides a unique field laboratory for studying the response of plant species to the periodic flooding common to mid-western floodplains. The laboratory has 12 channels, each approximately 20-ft wide by 600-ft long. Each channel can be independently adjusted for water depth, standing or flowing water, and duration of flooding.

Selected grasses, legumes, and tree species are being evaluated for flood tolerance. The flood tolerance of hardwood planting stock and genetic variation in ecotypes from seed collected from bottomland and upland stands is also being evaluated. The focus is to study the effects of short- and long-term flooding on woody and non





12-channel flood tolerance laboratory, New Franklin, Mo.

woody plants. Results link directly to the ongoing, EPA-funded "green infrastructure" project in Kansas City with the Mid-America Regional Council and National Agroforestry Center.

The following grass and legume species are ranked for flood performance, from very flood tolerant to flood intolerant:

Flood tolerance ratings of selected grasses and legumes tested at 3 and 5 week flood durations in 2004 and 2005. (These are 3 and 5 week flood events. Survivorship at shorter flood intervals may be quite different.)

	Grasses	Legumes
 <p>Very Flood Tolerant</p>	<p>Reed canarygrass (<i>Phalaris arundinacea</i>) Switchgrass (<i>Phalaris arundinacea</i>)</p>	<p>False wild indigo (<i>Amorpha fruticosa</i>)</p>
<p>Moderately Flood Tolerant</p>	<p>Redtop (<i>Agrostis gigantea</i>) Virginia wild rye (<i>Elymus virginicus</i>)</p>	
<p>Slightly Flood Tolerant</p>	<p>Kentucky bluegrass (<i>Poa pratensis</i>) Smooth bromegrass (<i>Bromus inermis</i>)</p>	<p>Birdsfoot trefoil (<i>Lotus corniculatus</i>)</p>
 <p>Not Flood Tolerant</p>	<p>Tall fescue (<i>Festuca arundinacea</i>) Orchardgrass (<i>Dactylis glomerata</i>) Timothy (<i>Phleum pratense</i>) Perennial ryegrass (<i>Lolium perenne</i>)</p>	<p>White clover (<i>Trifolium repens</i>) Kura clover (<i>Trifolium ambiguum</i>) Roundhead lespedeza (<i>Lespedeza capitata</i>) Alfalfa (<i>Medicago sativa</i>) Illinois bundleflower (<i>Desmanthus illinoensis</i>) Alsike clover (<i>Trifolium hybridum</i>) Panicled tick clover (<i>Desmodium paniculatum</i>) Slender lespedeza (<i>Lespedeza virginica</i>) Narrowleaf trefoil (<i>Lotus glaber</i>) Red clover (<i>Trifolium pratense</i>) Sainfoin (<i>Onobrychis viciaefolia</i>) Crownvetch (<i>Coronilla varia</i>) Big trefoil (<i>Lotus uliginosus</i>)</p>

Notes

SECTION 6: Windbreaks

In this chapter:

- Defining a Windbreak
 - How they Function
 - Advantages and Disadvantages of Windbreaks
 - Understanding Windbreak Properties
 - Designing a Windbreak
 - Windbreaks and Livestock
 - Windbreaks and Wildlife
- Windbreak Applications:**
- Living Snow Fences
 - Windbreaks and Urban Areas
 - Success Stories



This guide is intended to help you design and manage the interactive agroforestry practice of windbreaks. Properly applied on a landscape, a windbreak can enhance and diversify farm income opportunities, improve the environment and create wildlife habitat. By developing an understanding of the interactions between the windbreak (trees, shrubs and grasses) and the adjacent land area, its layout can be most effective at meeting the goals for which it is, or has been, established. By understanding the needs of each of the windbreaks component parts, the windbreak can be managed

Agricultural practices benefiting from properly applied windbreaks include:

- Livestock and dairy cattle husbandry
- Crop production
- Soil conservation
- Nut, fruit, and berry crops
- Livestock containment facilities.

Crops that can be produced from actively managed windbreaks include:

- Timber, fencepost, firewood
- Christmas trees
- Boughs, cones, wreaths
- Nuts, fruits, berries
- Landscape plants
- Shade-tolerant plants such as those grown in the forest farming practice
- Lease hunting opportunities when managed for wildlife benefits.

to best maintain its effectiveness over time, and also sustain its contributions to the farm.

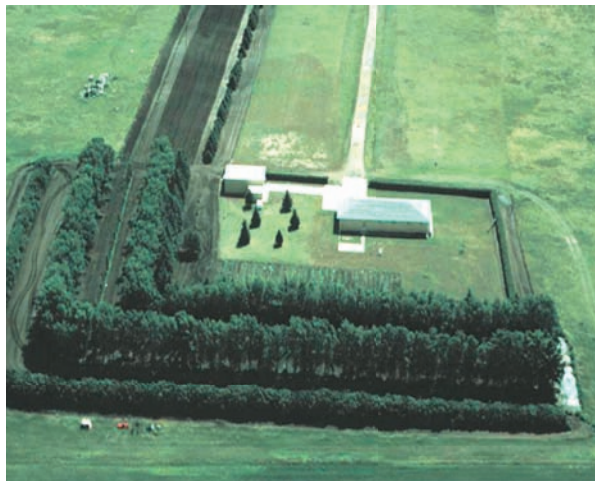
What is a windbreak?

A windbreak is defined as any barrier (natural or artificial) that reduces troublesome winds by creating a wind shadow to the leeward (down-wind) side. Its major function is to reduce the velocity of the wind. A windbreak must be 2.5 feet or higher to have a significant effect. The kinds of materials that can be used for a windbreak include trees, shrubs, tall perennial or annual plants such as sunflowers or grass that can be stacked to a sufficient height to create the desired wind shadow.

Windbreak / Shelterbelt / Timberbelt

Definition: The windbreak practice, also commonly referred to as shelterbelt or timberbelt, uses intensive management for growing trees, shrubs and/or grasses adjacent to other agricultural prac-

tices, and consists of one or more rows of closely spaced trees and/or shrubs planted at right angles to the prevailing winds. A windbreak becomes important to the agricultural system by enhancing production, or conservation, as it modifies air movement and windspeeds. The terms windbreak and shelterbelt can be used interchangeably. Timberbelts add an economic product from the linear tree rows.



Advantages of Windbreaks

Wind erosion can rob land of precious topsoil, nutrients and organic matter. Windbreaks offer a variety of potential benefits to a farm or ranch enterprise and the rural community, both environmental and financial.

Windbreaks protect light, erodible soils from wind erosion in seasons when the ground is bare. Windbreaks reduce energy consumption by reducing air infiltration into buildings resulting in less heat loss and by reducing the amount of snow removal from roads and around buildings. They provide living screens to separate incompatible uses (i.e., livestock facilities from suburban residences) and reduce noise levels between different land uses (i.e., highway noise and a rural residence). Windbreaks improve air quality through wind speed reductions and the physical capture of airborne particulates including dust, smoke, pesticide droplets and odors; provide aesthetic diversity by adding trees in an agricultural landscape and enhance wildlife habitats and corridors through the addition of tree, shrub and herbaceous

cover.

Windbreaks improve crop production and quality by modifying the microclimate and reducing wind erosion. They protect crops from insect pests by reduced crop visibility, dilution of pest hosts due to plant diversity, interference with pest movement, creation of environments less favorable to pests and more favorable to beneficial insects. They can be designed to manage snow drifting to either maximize use of the moisture in the snow for crops or minimize snow blockages across roads or around buildings and livestock areas. Windbreaks improve irrigation efficiency by reducing evaporation losses; improve livestock production by increasing feed efficiency and weight gains, improving survival of newborns and increasing milk production; and improve water quality through interception of sediment and interception, sequestration and decomposition of agricultural chemicals in the tree, shrub and herbaceous rhizosphere.

Advantages of Windbreaks:

- *Enhance crop yields*
- *Protect soil from wind erosion*
- *Shelter livestock and crops*
- *Protect structures (homes, outbuildings, roads)*
- *Capture water runoff and nutrients*
- *Improve irrigation efficiency*
- *Visual screen*
- *Filter and reduce dust*
- *Help control odors*
- *Provide wildlife travel corridors and habitat*
- *Noise abatement*
- *Improve aesthetics*

Disadvantages of Windbreaks

Although there are a number of potential benefits from windbreaks, there are also some limitations. They require a more intensive management system that includes specialized equipment for the long-term tree and/or shrub management

to maintain their protective values; remove land from annual crop production and may not provide a financial return from the protection provided by the trees for several years; and serve as a potential source of harmful pests including insects and weeds.

Field Windbreaks - Benefits to Crops

When field windbreaks are suggested to landowners, they often have a mental image of crop reduction and/or loss adjacent to the windbreak and from the space occupied by the windbreak. What is often not recognized is the potential for increased crop quality and quantity on the leeward (downwind) side of the windbreak. Many years of field research have shown there is a yield advantage for many crops when protected by a windbreak. This yield increase generally occurs from 1.5/2H to 10-12H on the leeward side of the windbreak. The amount of yield increase will vary from year to year due to different weather conditions. There will also be some variation due to soils and the types of trees used in the windbreak (i.e., less competitive trees result in greater gains). The yield advantage is normally more than enough to offset the decrease in yield immediately adjacent to the windbreak and the land occupied by the windbreak. Some landown-

ers will plant a deep rooted crop such as alfalfa adjacent to the windbreak in the area impacted the most from competition and are able to gain good quality forage.

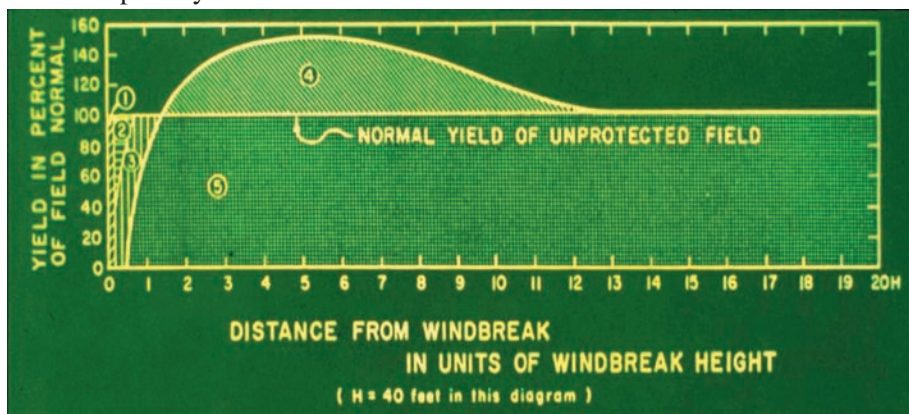


This field windbreak is designed to provide year-round protection by incorporating cedar and pine outer rows with an interior row of deciduous shrubs.

Field Windbreaks - Benefits to Orchards

In addition to the traditional commodity crops, windbreaks are also used to protect a variety of horticultural crops including many fruit and vegetable crops. Some of the key benefits of

protecting these types of crops include: improved crop quality from reduced bruising, better pollination from insects due to less wind, and early maturing of the crops resulting in possible marketing advantages. Windbreaks around orchards are also being examined for their use in preventing off-site drifting of pesticides. Many orchards and other farms are being engulfed by housing developments. Windbreaks can help buffer potential land-use conflicts.



Crop Windbreaks: Weighted Average Crop Yield Increase			
Corn	12%	Soybeans	13%
Barley	25%	Winter Wheat	23%
Hay	20%	Spring Wheat	8%

Designing a windbreak

Designing windbreaks requires the planner to be able to manipulate the different structural components of a windbreak in order to achieve the desired buffering effect. Climatic and physical effects such as wind speed, apparent air temperature, snow deposition and evapotranspiration are modified as a result of the structural characteristics of the windbreak.

Windbreak Design - Ask Yourself:

What needs to be protected?

- Crops/orchards
- Soil
- Livestock
- Roads
- Buildings
- Wildlife

1) Determining the Windbreak Purpose

As noted previously, a windbreak can have a variety of purposes ranging from crop protection to snow management. The design of the windbreak is dependent upon the purpose(s) desired. To determine the purpose(s) requires understanding the desired objectives of the landowner and the physical site characteristics.

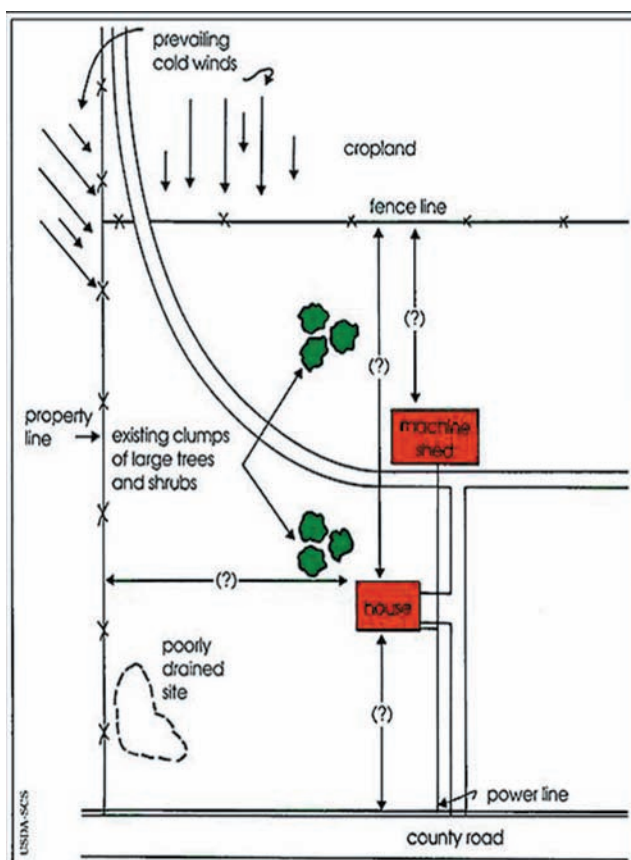
The first step in design is to interview the landowner to ascertain his/her objectives or purposes for the windbreak. A probing **questioning strategy** can be effective:

- *Have you had any crop damage or loss from the wind or blowing soil? If so, when did it occur? From which direction(s) does the wind cause the most problem(s)?*
- *When do your livestock need the most wind protection?*
- *Do we need to be concerned with summer air movement in the livestock area?*
- *Which access roads need to be kept clear of snow?*
- *Are there any potential drainage problems associated with snowmelt?*
- *What structures need wind protection?*
- *Are you interested in selecting species and a*

design that will add beauty to your home?

- *If so, do have any favorite plants?*
- *Are you interested in providing wildlife habitat with the windbreak?*
- *If so, what kinds of wildlife do you want to favor?*

2) Site Evaluation



The next step is to evaluate the site conditions which may affect windbreak design and application.

Evaluating Site Conditions:

- Identify all areas needing protection based on the troublesome wind direction(s).
- Inventory the soils. Begin a starter list of species adapted to the soils.
- Observe the topography to determine any drainage concerns either into or away from the windbreak (especially snowmelt and feed-

- lot runoff)
- Locate property lines, overhead and underground utilities (electric, telephone, gas, and/or sewer), and existing trees or shrubs which may be within or adjacent to the proposed windbreak.
- Identify any access roads or lanes that could cause breaks in the windbreak.
- Locate the windbreak to avoid obstructing the winter sun, picturesque views, or oncoming traffic near driveways.
- Identify protection needs for the windbreak, such as fencing to keep out livestock. Observe any existing plant species which may be alternate hosts for pathogens, e.g., cedar-apple rust.
- Inventory existing wildlife habitat and wildlife species in the area so the windbreak may complement.

3) Key Features of Windbreak Design

Effective windbreaks contain 7 key features:

- *Height*
- *Density*
- *Orientation*
- *Length*
- *Width*
- *Continuity/uniformity*
- *Cross-sectional shape*

Windbreak Design - Height

- **Height** - Windbreak height (referred to as 'H') is the most important factor determining the downwind area of protection. The windbreak 'H' is the height of the tallest row of trees in the windbreak. The windbreak will reduce wind speed for 2 to 5 times the height of the windbreak (2H to 5H) on the upwind side and up to 30H on the downwind side of the barrier. The area protected is a direct result of the height and density.

Windbreak Design - Density


- **Density** - Windbreak density is the ratio of


the solid portion of the barrier to the total area of the barrier. Wind flows through the open portions of a windbreak, thus the more solid the windbreak, the less wind passes through. By adjusting windbreak density, different wind flow patterns and areas of protection are established.


Density level is manipulated by choice of plant materials (e.g., deciduous vs. conifer); and plant arrangement. By combining low growing shrubs with medium and tall deciduous trees, dense plant material is provided at three levels (low, middle and upper) of the windbreak during the growing season. However, during the winter, the density would decrease due to the loss of foliage. Consequently, a conifer component would be desirable for year-round protection.


- **Dense (60-80%)** = *Maximum wind reduction but short wind shadow*
- **Moderately Dense (40-60%)** = *Less wind reduction but longer wind shadow*
- **Under 40%** = *Effective for snow distribution across a field*



 Open Wind Speed 20 mph Deciduous 25-35% density					
H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	10	13	16	17	20
% of open wind speed	50%	65%	80%	85%	100%

 Open Wind Speed 20 mph Conifer 40-60% density					
H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	6	10	12	15	19
% of open wind speed	30%	50%	60%	75%	95%

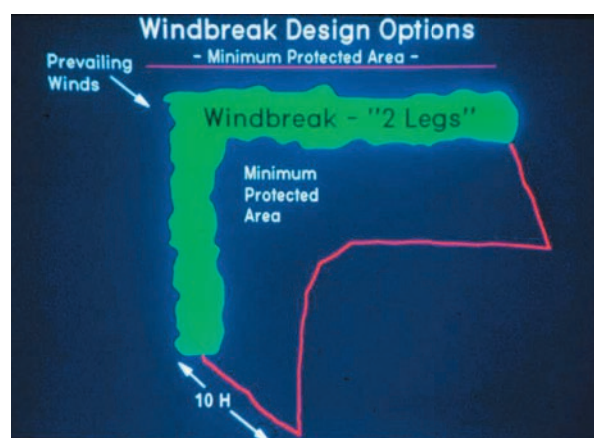
 Open Wind Speed 20 mph Multi Row 60-80% density					
H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	5	7	13	17	19
% of open wind speed	25%	35%	65%	85%	95%

 Open Wind Speed 20 mph Solid Fence 100% density					
H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	5	14	18	19	20
% of open wind speed	25%	70%	90%	95%	100%

The degree of density will impact the extent of the area being protected and the magnitude of protection as shown in the diagram. A solid fence (100% density) provides maximum wind reduction, but the area of wind reduction is shorter than with a dense tree windbreak. The dense windbreak (60-80%), provides a greater area of protection, and the magnitude of wind reduction is as good as the solid structural fence or wall. For the moderately dense windbreak (40-60%), the magnitude of wind reduction is somewhat less but the wind shadow is at its maximum. Once the density drops below 40%, the effectiveness of the windbreak begins to decline. However, the 25-35% density level is very effective for even distribution of snow across a field for moisture management. This density level is not as good for stopping wind erosion.

Windbreak Design - Orientation

- Windbreaks are most effective when oriented at right angles to prevailing or troublesome winds. The best orientation for each windbreak depends on the objectives for the windbreak. A key point to remember is that although the troublesome wind may occur primarily from one direction, it rarely blows exclusively from that direction. As the wind changes direction and is no longer blowing directly against the windbreak, the protected area decreases.



Windbreak Design - Length

- Although the height of the windbreak determines the extent of the protected area downwind, the length of a windbreak determines the amount of total area receiving protection. For maximum efficiency, the uninterrupted length of a windbreak should exceed the height by at least 10:1. This ratio reduces the influence of end-turbulence on the total protected area.

Windbreak Design - Width

- To protect structures, the windbreak should have a density ranging from 60 to 80 percent during the period requiring maximum protection. To achieve the minimum level of this density range, plant at least three rows of trees and shrubs with at least one row being a conifer.

Windbreak Design - To Protect Homes and Outbuildings

Windbreaks for protecting structures such as the farmstead, the feedlot, roads and buildings:

- *Position the windbreak as close to perpendicular to the most troublesome wind direction.*
- *“One-leg” windbreaks are sufficient if winds come from one direction only, but a “two-leg” or network of windbreak(s) provides greater protection for variable wind directions.*
- *Plan for 60-80 % density for maximum protection. Locate windward row 100 - 200 feet from area needing protection. In areas with variable winds, multiple-leg windbreaks provide greater protection to the field or farmstead than single-leg windbreaks.*

Windbreak Design - Continuity

- For wind protection only, the tallest row needs to be 2-5H (H = planned height of the tallest row) from the primary area needing protection. However, for wind and snow protection, the most windward row needs to be 100 to 200 feet from the windward edge of the primary protection area. Once this critical distance is met, check to see if the area needing protection is still in the 2-5H zone, i.e. a livestock feedbunk. Areas and objects more than 10H from the windbreak will receive reduced wind protection

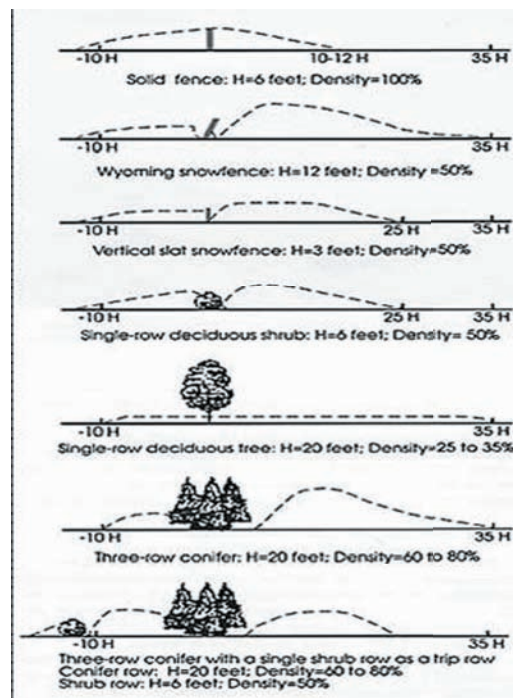
Windbreaks for Structures

The distance between the area needing protection and the windward row varies with the amount of space needed for snow storage. Care must also be taken to accommodate the drainage both from the clean water runoff from the windbreak (i.e. snowmelt) and drainage from the livestock feeding area. Effluent from the feeding area can harm and sometimes kill trees and shrubs.

Two designs for protecting a structure from snow

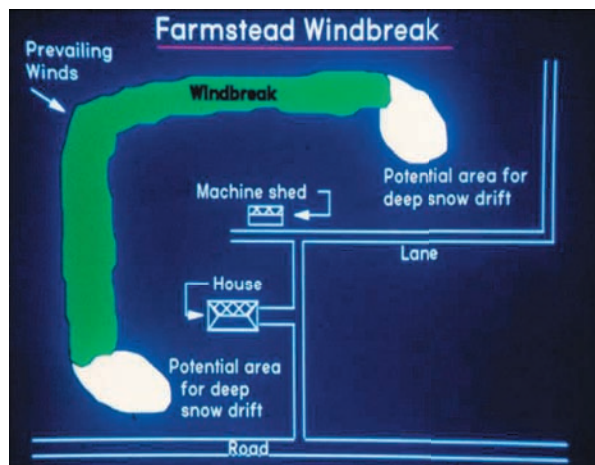
Traditional multi-row windbreak with a trip-row of shrubs on the windward side to help filter out snow. A basic farmstead windbreak consists of three to eight rows of both conifers and deciduous trees and shrubs. Conifers or shrubs should be located on the windward side with tall deciduous species in the center. A row of shrubs on the interior or leeward side completes the design.

Modified twin-row, high density windbreak.: In areas with frequent heavy snows consider adding a row or two of shrubs 50 feet to the windward side to trip snow before it reaches the main windbreak. An auxiliary planting of shrubs on the leeward side of the windbreak can also add good emergency cover for wildlife. This can be supplemented with a food plot between the main windbreak and the auxiliary planting.



Windbreak design for snow.

Extend the windbreak a minimum of 100 feet past structures needing protection to accommodate wind turbulence at the end of the windbreak and end-drifts of snow. Locate access roads from 100 to 500 feet from the ends of the windbreak. If a lane must cut a windbreak, it should cut through the windbreak at an angle to prevailing winds to prevent funneling of wind and snow drifting.



Windbreak Design - Consider Specific Purposes

Use conservation plan map or photo to ID fields in need of protection, existing windbreaks, soil problems, utilities, direction of prevailing erosive winds, property lines, roads and access lanes. Plan for 40-60 % density for crop and soil protection. Plan for 25 - 35% density for snow distribution.

For crop protection/production and/or uniform snow distribution, windbreak-to-windbreak intervals should be 15 to 20H. For crops highly susceptible to damage from wind or small amounts of wind-blown soil during some portion of the growing season, a spacing interval of 6-10H provides a high degree of protection .

For erosion control purposes, the Natural Resources Conservation Service uses a rule-of-thumb of “no erosion out to 10H leeward” -- this would lead to a windbreak-to-windbreak interval of 10H plus the distance protected by the agromonic system (i.e., standing crop, crop residues,

cropping pattern, ridging) being used.

Windbreak Design - Livestock

Greatest wind protection occurs from 2H to 5H leeward of the tallest tree row. Allow room for snow deposition outside of feeding area. Critical temperatures for beef cattle are determined in part by the condition of the coat. Below the critical temperature, livestock must expend more energy to keep warm.



Livestock Critical Temperatures:

Coat Description	Critical Temperature
Summer coat or wet	59°F
Fall coat	45°F
Winter coat	32°F
Heavy winter coat	18°F

Adapted from D.R. Ames, Kansas State University

Community Windbreaks

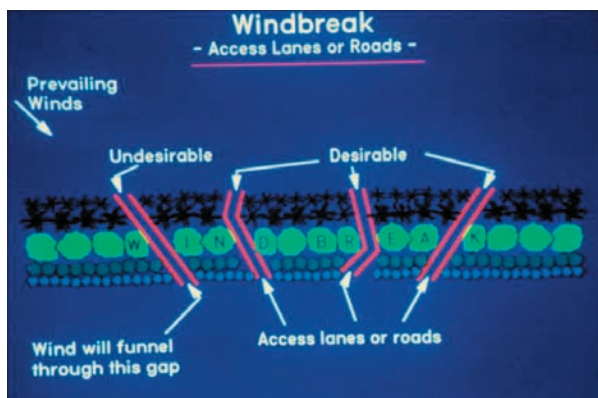
Planned community windbreaks can provide extra protection for the entire development and be an economic gain for the developer and homeowner from increased property values. Windbreaks in the rural-urban interface can also reduce potential conflicts, such as blowing dust, privacy, odors or noise, between land uses.



General Design Considerations

- Stay away from subsurface drain fields and overhead utilities.
- Locate new rows of trees 50 feet from existing trees.
- Avoid locating windbreaks within 200 feet of road intersections to prevent poor driver visibility.

Avoid cutting through a windbreak with an access road. Where needed put at an angle to prevailing winds. Wind flow increases through gaps in a windbreak decreasing their effectiveness. Lanes or roads through single-row barriers should be avoided; where necessary, locate them 100 to 500 feet from the ends of the windbreak.



A) Windbreak Design for Snow

Design the density of your windbreak to manipulate snow drifting to meet landowner objectives. Different design densities and heights for the

structural or living snow fences results in different snow drift patterns.

Snow Management to Supplement Crop Moisture

To achieve even snow distribution across a field resulting in maximum water infiltration into the soil, the windbreak density should range from 25 to 35 percent. This would be roughly equivalent to a single row of deciduous trees without leaves at a wide spacing (15 to 20 feet). If soil erosion is a potential problem during the time the windbreak is at this density level, additional conservation measures will be needed.

Snow Capture: Living Snow Fences

To achieve maximum snow accumulation, the windbreak density should range from 60 to 80 percent. The most windward row should be a minimum of 100 feet from the area being protected to prevent inappropriate snowdrifts. This distance will vary (100 to 300 feet) depending on the location and severity of winters. A trip row of shrubs or dense conifer can be located 50 to 100 feet windward of the main windbreak to create a snow trap. When protecting roads, allow plenty of room for the leeward drift by locating the windward row of the windbreak 200 to 300 feet from the center of the road. (See *Windbreak Design for Snow* figure)

B) Windbreak Design for Wildlife Consider:

- *Connecting habitats*
- *Herbaceous cover*
- *Winter cover needs*
- *Food needs*

Windbreaks can be given a more natural look and still provide excellent wildlife habitat and wind protection. Planting food plots or fruit-bearing shrubs on the lee side of windbreaks provides food in an area protected from wind and possibly warmed by the sun, points that are particularly important in cold months. Where appropriate, select the windbreak site that connects to a larger habitat block such as a river corridor, woodlot, wetland, woody draw, or similar area. Consider

planting or leaving herbaceous vegetation such as a mixture of grasses and legumes, standing grain, or crop residues as a border (20 to 50 feet wide) along the edges of the windbreak. If grasses or legumes are used, they should be separated from the new tree planting to avoid competition. This strip of cover can provide nesting, loafing, and foraging cover for a number of species. Adding a shrub row 50 to 100 feet windward of the main windbreak as a snow trap results in greater wildlife protection on the leeward side of the main windbreak. Use species that will provide good thermal protection in the winter such as cedar and spruce. Select species that may have high food value for a variety of wildlife.



Quail find excellent habitat in field windbreaks.

C) Windbreak Design - Screening in Rural/Urban Areas

High quality windbreaks between agriculture and communities can prevent windblown soil and snow. Sediment in the yard, dust in homes and pesticide drift can be great aggravation to both rural and urban homeowners.

Selecting Tree and Shrub Species

All species of trees and shrubs do not grow at the same rate nor do they grow to the same mature height. Likewise, adapted species vary in their growth on different soils within a geographical area. The amount of available soil moisture during the growing season and soil aeration are two important factors affecting tree and shrub growth. These factors are largely determined by soil texture and depth and by climate.

Conservation tree and shrub suitability groups have been developed as a guide for selecting species best suited to different kinds of soils, and climate, predicting height growth at 20 years, and measuring effectiveness. These guides should be available in the NRCS Field Office Technical Guide. Information about different plants can also be obtained from PLANTS and VEGSPEC located on the internet at www.plants.usda.gov.



Integrate windbreaks into an overall landscape design to achieve multiple objectives.

Windbreak Plant Materials

Select plants adapted to:

- Climate
- Soils

Select to meet objectives:

- Foliage density characteristics
- Height potential
- Wildlife needs

In addition to selecting plants adapted to the climate and soil, plants need to be selected that have the greatest potential for meeting landowner objectives. The primary objective is to select plants that will provide the desired level of wind protection in a reasonable length of time (within 10 years). This means selecting species that will give the appropriate level of density and optimum height for the site. For example, conifers need to be considered if optimum year-round wind protection is desired. If wildlife is desired, select appropriate plants for the desired animals or birds.

Windbreak Planting: Site Preparation

Site preparation is an important first step to ensure successful survival of the trees and shrubs in the windbreak. The goal is to maximize the amount of moisture at the site and to minimize the potential for weed competition. The type of site preparation used depends on the soil and existing vegetation at the site. With sandy soils, care must be given to avoid wind erosion problems. On sloping sites, precautions must be taken to prevent water erosion. Site preparation can be accomplished either mechanically (e.g., tillage equipment including chiselpow, disc, rototiller, or scalper), chemically (pre and/or postemergent herbicides) or a combination of both.

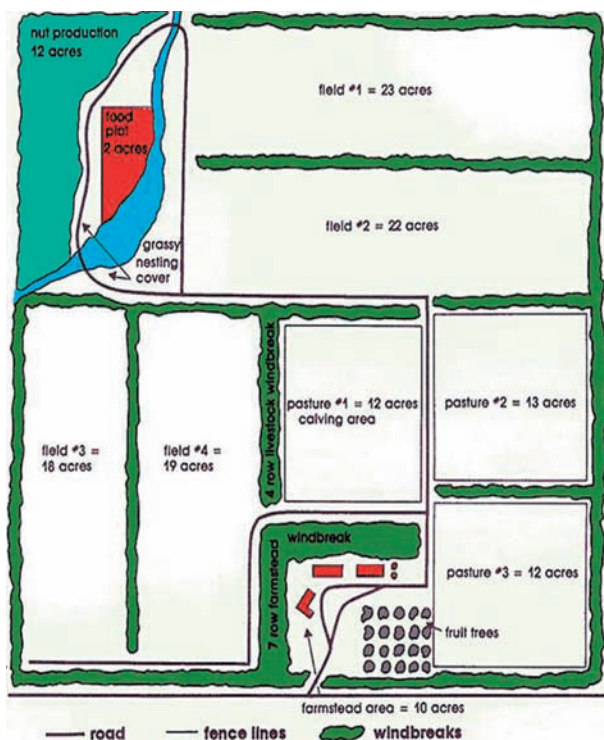
Site preparation:

Maximize moisture
Minimize competition
Match the site
Be timely
Care for plants
Plant at correct depth

Tree planting methods include using either a tree planting machine or hand planting tools. For both methods, some key techniques need to be followed:

- *Do not plant on hot, windy days.*
- *Prevent roots from drying out.*
- *Do not plant when the temperature is freezing or below.*
- *Plant seedlings in a vertical position with root collar 1" below soil surface.*
- *Prepare a trench or hole deep and wide enough to permit roots to spread out naturally; avoid "J rooting" - prune roots as needed to prevent J roots.*
- *Pack soil firmly around roots to eliminate air pockets.*

In arid areas where trees are difficult to grow shrubs or tall native grasses may be used to provide crop protection, to control wind erosion, and to capture snow for crop production.



An example of a 160 acre farm designed to take full advantage of windbreaks and other woody plantings. With a little imagination and careful planning, landowners can enhance both wildlife benefits and economic returns from their land.

Windbreak Maintenance

- Weed/grass control for the first 3 to 5 years with an optional cover crop between rows
- Use supplemental water to ensure early survival and development
- Replant to fill gaps
- Protect from animals and pests
- Use corrective thinning and pruning
- Do not fertilize (cost prohibitive)

Weed/grass control - Weeds need to be minimized usually for the first three to five years in a band about three to four feet on each side of the rows of trees or shrubs. The area between the rows can be planted to an annual cover crop (e.g., grain/forage sorghum, oats, corn, millet, wheat, rye, or sunflowers) which can help control weeds, provide wildlife cover, and protect young tree seedlings from soil or wind abrasion.

Supplemental irrigation - Irrigation (e.g., hand,

drip, sprinkler, furrow or flood) is not a substitute for good site preparation and weed/grass control. Irrigation should be used when soil moisture conditions are extremely dry at planting time or during a prolonged drought after planting.

Replanting - Replant all trees and shrubs that have failed, in order to fill in the gaps in the windbreak. Replant annually for at least three years after the initial planting and continue until a full stand of trees is attained.

Animal Protection - Establish appropriate fencing to prevent livestock and large mammal damage. For small mammals use repellents, traps, special fencing, seedling protectors (e.g. photodegradable plastic tubing or mesh netting). Consult with local and state game/wildlife specialists for control measures for your area.

Pest control - Periodic inspection of the crops and trees is recommended to detect and identify possible pests. These inspections and in some cases the use of pheromone traps will help determine when corrective action is warranted.

Pruning - Hail, wind or snow storms often cause breakage of limbs and sometimes the main trunk(s) of the trees and shrubs. Remove broken limbs and tops.

Fertilization - Generally, fertilization of windbreaks is not recommended. It is not practical, economical, or feasible, in most cases. The only situation where fertilization may be justified would be a small, high valued windbreak planted on soils that have obvious soil nutrient deficiencies. Apply fertilizer according to soil test results.

Economic Incentives for Windbreaks

There are many agencies offering programs that can be used to establish and maintain agroforestry practices on private land. One of the most significant of these agencies is the USDA Farm Service Agency (FSA), which offers three distinct programs that may be utilized toward agroforestry

Federal Agency and Programs Offered	Programs available for Windbreaks	Key to programs
USDA/FSA		<ul style="list-style-type: none"> CS = Cost Share (ranges from 50% to 90%, based on a predetermined expected cost structure) LE = Land Easement (Rental payments based on an average rental rate per land use type; easements are typically 5, 10, 15, 30 years or permanent) M = Annual maintenance payments (range from \$5 - \$10 per acre) IP = Additional incentive payments (payments could include sign-up bonuses, additional cost-share, and/or increased land easement rates) G = Grants
Continuous Conservation Reserve Program (CCRP)	CS,LE,IP,M	
USDA/NRCS		
Environmental Quality Incentive Program (EQIP)	IP	
Conservation Security Program (CSP)	CS,LE	
USDA/FS		
Forest Land Enhancement Program (FLEP)	CS	
SARE		
Producer Grants	G	

practices such as windbreaks and shelterbelts: the Conservation Reserve Program (CRP), the Continuous Conservation Reserve Program (CCRP), and the Conservation Reserve Enhancement Program (CREP). Each of these programs is designed to take environmentally sensitive and highly erodible land out of production by offering a soil rental payment, a cost-share for the establishment of various conservation practices and other financial incentives to landowners who offer to set aside their land.

Of these three programs, the CCRP program offers direct benefits to landowners establishing a windbreak/shelterbelt. CCRP is a voluntary program that focuses on funding conservation practices (CP) protecting environmentally sensitive land. Landowners with eligible land who wish to enroll that land in the CCRP may sign-up at any time during the year.

Available funding through the CCRP can include:

- Annual soil rental rate payments that can be up to 120 percent of the average soil rental rate for the area
- Annual maintenance payments of \$7 to \$10 per acre

- Cost share payments up to 50 percent of the establishment cost.

Field Windbreaks (CP5A)

Following is a brief description of Continuous Conservation Reserve Program (CCRP) design and funding characteristics that support windbreaks/shelterbelts:

- 10-15 year contracts
- Continuous Sign-up
- SIP, PIP, and 120 percent SRR
- \$7 per acre per year maintenance payments
- Maximum width of 1 row for Missouri

Along with these three payments, CCRP also has two one-time incentive payments available for certain CP 's, including:

- A signing incentive payment (SIP) equal to \$10 per acre per number of contract years.
- A practice incentive payment (PIP) equal to 40 percent of the establishment costs.
- There are 16 practices that are eligible for the CCRP.

However, out of the 16, eight allow for tree planting, including:

- *CP5A Windbreaks*
- *CP16A Shelterbelts*

NRCS Standard 380 identifies the guidelines for establishing a windbreak for the CCRP. For more information, contact your local USDA/FSA office. Additional USDA programs to establish and maintain windbreaks/shelterbelts are offered through the Natural Resources Conservation Service (NRCS); the Forest Service (FS); and the Sustainable Agriculture Research and Education (SARE) program. The United States Fish and Wildlife Service (USFWS) also offers assistance; see chart below for a listing of incentives offered by these federal agencies or consult the UMCA publication “Funding Incentives for Agroforestry in Missouri.”

Summary

Windbreaks protect crops, soil, livestock and humans while also improving air and water quality, protecting buildings and roads, enhancing fish and wildlife habitat, broadening biodiversity, and beautifying the landscape. One of the keys to the successful windbreak is recognizing what you want to accomplish through its application on the landscape. The next step is to then understand the properties of a successful windbreak. And finally, choose species to plant in the windbreak that will enable it to work for you.

With a little planning upfront, a windbreak can do anything from save energy by reducing heating cost to improve crop production.

Success Stories:

Paul Huenfeld, Nebraska Producer Using Windbreaks with Organic Farming



“Organic farming and trees were just a natural fit, like a hand and a glove, as far as I was concerned. We needed buffers around the farm. We also really value the importance of habitat for the insects and the predators, and we see that along the trees where we can plant grass and legumes is an excellent source of habitat for the different species of wildlife. “

Claud Launius

Retired cotton producer, Malden Plain, Mo.



Claud Launius is a retired cotton farmer in the sandy soil area of “the Bootheel” of Missouri known as Malden Plain. “We were having a lot of trouble with blowing sand in the spring of the year; it was blowing and hurting our cotton pretty bad--killing some of it.” Then, Natural Resources Conservation Service (NRCS) District Conservationist Phil Gurley told Launius about crosswind trap strips, and said he could get switchgrass seed through the Missouri Department of Conservation. Launius installed some on an 80-acre field in 1989. Although some cotton farmers have used wheat and rye to slow the wind, switchgrass grows to 6 or 8 feet and Launius says it keeps the wind up in the air. “In the spring, it’s windy when the cotton plants are babies, and that’s the worst time. If they get up to 6 or 8 inches tall they can defend themselves; but when they’re short, with just two leaves, wind and sand can just cut them off. It’s like a baby that gets sick--they don’t grow like they ought to until they get well again. That’s cotton, it’s like any plant.” When Launius retired he rented his land, and his tenant has kept up the wind strips.

Launius added four rows of switchgrass in strips with 24 rows of cotton. He figures he might have gone with 36 rows of cotton to 4 rows of switchgrass, “but I’d be afraid to tear any of it up.” Besides, he’s doing better with the 68 acres than he did with the original 80 acres. “Our yields have increased a half-bale per acre or more because the plants aren’t getting hurt. They just sit there and grow; the weather doesn’t bother them. We really like it.” Launius is surprised that others aren’t planting switchgrass wind traps, but thinks they just don’t want to give up those 4 rows of cotton ground. He notes that there are other benefits beyond protecting the cotton plants and boosting production. “It’s doing really well for quail and other animals, such as rabbits. By hiding in the switchgrass, the quail run the hunters crazy. The grass is really thick and it keeps getting thicker and thicker.” To maintain it, every other 4-row strip is burned every other year; that makes the switchgrass “stool out” more, and then it has millions of seeds on it--”and that’s what quail and wildlife like.”

Additional Resources

Online:

<http://ianrpubs.unl.edu/forestry/ec1771.htm>

<http://ianrpubs.unl.edu/forestry/ec1772.htm>

<http://www.nhq.nrcs.usda.gov/CCS/misucotn.html>]]

<http://ianrpubs.unl.edu/forestry/ec1763.htm>

National Agroforestry Center

<http://www.unl.edu/nac/windbreaks.html>

Planning Farmstead Windbreaks - Iowa State Extension

<http://www.extension.iastate.edu/Publications/PM1716.pdf>

Farmstead Windbreaks: Establishment, Care and Maintenance - Iowa State Extension

<http://www.extension.iastate.edu/Publications/PM1717.pdf>

NRCS Links to Windbreak Information

<http://www.nrcs.usda.gov/technical/ECS/forest/wind/windbreaks.html>

UMCA DVD

Visit www.centerforagroforestry.org or the University of Missouri Extension web page at <http://extension.missouri.edu/explore/agguides/agroforestry/index.htm> to purchase.

In Print:

Brandle, J.R., L. Hodges, and B. Wight. 2000. IN: North American Agroforestry: An Integrated Science and Practice (H.E. Garrett, W.J. Rietveld and R.F. Fisher, ed's.). Agronomy Society of America, Madison, WI. pp. 79-118.

EXERCISE: REVIEW OF WINDBREAKS

1. *What are the advantages of windbreaks for:*
 - *Cattle*
 - *Soil*
 - *Crops*
2. *How far from the windbreak will crops benefit with increased yields?*
3. *Compare and contrast the uses for single-row and multiple-row windbreaks.*
4. *When considering whether to use single or multiple row windbreaks, what factors should be considered?*
5. *When deciding between deciduous and coniferous species, what factors will also be used when writing out the management plan?*
6. *Putting in a windbreak will cause a farmer to take acres out of production. How can you persuade a farmer that putting a windbreak in will be beneficial in the long run?*
7. *What cost share programs are being funded through state or federal programs to help landowners with the cost of putting windbreaks up on their property?*
8. *A number of features must be analyzed prior to the placement of a windbreak. List four of these features.*

For further thought:

Like any other aspect of agroforestry, windbreaks bring disadvantages to the landowner. How do you work with the landowner to see past the disadvantages and not focus on the negative?

EXERCISE KEY

1. What are the advantages of windbreaks for cattle, soil and crops?

Properly designed windbreaks have been shown to increase crop yield for a wide variety of crops. Decreases in wind speed protect downwind crops, decreasing evapotranspiration and increasing water use efficiency. Decreasing wind speed enhanced soil stability and is the primary basis for the installation of windbreaks dating back to the Dust Bowl of the 1930's. During the winter, cattle use energy to keep warm, increasing their feed requirement. Windbreaks moderate winter temperature extremes, reducing cold stress. Windbreaks also improve calving success rates.

2. How far from the windbreak will crops benefit with increased yields?

The rule of thumb is that crop yields are improved out to 10-15H.

3. Compare and contrast the uses for single-row and multiple-row windbreaks.

Single-row deciduous windbreaks are designed to improve snow distribution across a crop field to improve moisture for early season crop growth. They are also used surrounding orchards to still the air and improve pollination and/or speed up crop maturation. They may also be used as a visual screen along roads.

Other windbreak applications depend on multiple-rows of deciduous and coniferous trees and shrubs, combined and configured for specific purposes (i.e., crop production, animal protection, snow fences).

4. When considering whether to use single or multiple row windbreaks, what factors should be considered?

The purpose of the windbreak dictates the design.

5. When deciding between deciduous and coniferous species, what factors will also be used when writing out the management plan?

Both conifers and deciduous trees bring different attributes to the function of the windbreak. Deciduous trees are more porous to wind movement, and are less effective in slowing wind speeds. Conversely, deciduous windbreaks reduce wind velocity further downwind. Conifers provide much more wind blockage, critical to protect cattle from wind and snow and roads and buildings from snow buildup.

6. Putting in a windbreak will cause a farmer to take acres out of production. How can you persuade a farmer that putting a windbreak in will be beneficial in the long run?

A realistic assessment of the farmers goals and objectives, coupled with a similar assessment of the entire farm and cropping system, will lead to the diagnosis that may include establishment of windbreaks. Evidence of windblown soil erosion and associated crop damage, need for cattle protection or protection of buildings and roads, may all lead to this diagnosis. Once the diagnosis includes windbreaks, the next step is to explore cost share programs that may help to offset establishment costs. Visits to other landowners that have functioning windbreaks, will be very effective in addressing farmer concerns.

7. What cost share programs are being funded through state or federal programs to help landowners with the cost of putting windbreaks up on their property?

EQIP and CCRP both provide cost share for windbreak installation.

(see "Funding Incentives for Agroforestry in Missouri" for a thorough discussion of available cost share programs).

8. A number of features must be analyzed prior to the placement of a windbreak. List four of these features. Height, density, orientation, length, width, uniformity, cross sectional shape.

Notes

Notes

SECTION 7: Forest Farming

In this chapter:

- **Defining Forest Farming**
- **Linking Sustainable Forest Management with Forest Farming**
- **Adjusting Shade Levels**
- **Types of Forest Farming**
- **Market Opportunities**
- **Designing a Forest Farming Practice**
- **Forest Farming and Wildlife**
- **Success Stories**



In this drawing of a forest farming practice, trees are planted with ginseng and other medicinal root plants. Shiitake mushrooms grow on logs nearby, illustrating the diversity of products that may be grown under a forest canopy.

Properly applied to the forest environment, the forest farming practice can enhance and diversify farm income opportunities, while at the same time making significant improvements to the composition and structure of the forest for long-term improvements in overall health, quality and economic value. By developing an understanding of the interactions between the overstory trees and the understory environment, forest manage-

ment activities can be used to create an understory capable of growing profitable shade-loving crops. Both long-term tree crops and short-term understory crops can be grown on the same forested land, while managing for a more healthy forest.

Advantages of Forest Farming

- Improved forest health
- Additional forest income opportunities
- Diversified farm income

Disadvantages

- Requires intensive management
- Markets for some products are not yet fully developed
- Requires a broad knowledge of both trees/forest and plants to properly manage to improve growing environments for both

Forest Farming is Linked to Sustainable Forest Management

The objective of sustainable forest management is to harvest trees for wood products and manage the understory for nontimber forest products (NTFP) while continuously maintaining the health of the forest for watershed protection, recreation, mast production for wildlife and visual and ecological benefits.

Timber crops and forest farming

Use Timber Stand Improvement (TSI) to “invest in your best” and remove other trees to improve species composition, stand structure, wildlife values, regeneration, health, and the quality of the forest stand.

Timber has value. However, not every tree is created equal. For a given tree, size, quality and distance to market are all factors that go into determining its market value. Prior to selling any timber, it is advisable to have an estimate of its market value. Local natural resource conservation departments will likely have foresters on staff, or be able to put landowners in touch with a Con-

sulting Forester, either of whom should be able to break down the volume of standing timber by species and quality, and also estimate its value. In Missouri, two primary organizations exist that can assist landowners with timber sales: the Missouri Department of Conservation and the Missouri Consulting Foresters Association. Additionally, there are two primary sources of information that provide value estimates for Missouri timber: the Missouri Timber Price Trends Report (Missouri Department of Conservation) and Missouri Timber Price Discovery Report (Missouri Department of Agriculture).

Properly managed forests will provide landowners with a greater annual return compared to unmanaged forests. By managing forests for species appropriate to site conditions, and species of the greatest value potential, you maximize growth and future value. In some cases the potential annual return can be doubled. However, in most cases it will be a number of years between timber harvests from a given piece of land. This is where the forest farming practice offers enhanced income opportunities to the forest landowner. With management, the timber value can be enhanced at the same time alternative NTFPs are being grown to generate income in a shorter timeframe. To understand how to manage your timber, see Additional Resources at the end of this section. Also



Shiitake mushrooms grow on upright logs in this forest farming example.

see appendix section four, “The Basics of Selling Timber.”

What happens after TSI, after the timber sale?

We know that lumber has value in various forms: \$ per board foot, \$ per cord, more dollars are paid for higher grades, e.g., veneer, more dollars are paid for preferred species, e.g., walnut, red oak, white oak. The specific value for these species varies with market demand and shifts over time.

What about the residual after harvest? What about those “other” species? What about non-timber forest products? How can you maximize the value of all of the potential products coming from your woodlot? The answers lie in application of the Forest Farming agroforestry practice.

What is Forest Farming?

Forest Farming is defined in many different ways, but the consensus among agroforestry professionals is as follows: “the intentional manipulation, integration, and intensive management of forested lands that capitalize on specific plant interactions to produce specific non-timber products.” The Forest Farming practice intentionally manages the light, or shade, levels in a forest to favor the growth, or enhanced production, of certain shade-loving plants. Shade-loving plants, such as ginseng, specialty mushrooms and goldenseal, that may be grown in the understory of a forest are often termed non-timber forest products (NTFP).

The forest farming practice emphasizes the fact that both timber and other products can be grown simultaneously. However, to accomplish this, forest canopy densities must be controlled by manipulating the structure and/or species composition of the forest; these manipulations then influence light levels available at the forest floor.

Unlike other agroforestry practices such as alley cropping or windbreaking, where trees are introduced into some type of agricultural system, in forest farming agricultural or cropping techniques are intentionally introduced into existing forested systems. The various product options have different forest management requirements. Medicinal

Methods of Forest Farming	Level of Management Required (<i>from most intense to least intense</i>)
1. Forest Gardening Management Level: High Input Cost: Higher	Cultivating the forest, or forest gardening, describes the most intensive of all forest farming methods. In addition to thinning the overstory, this method often involves clearing of the understory of undesirable vegetation and other practices that are more closely related to agronomic type practices (tillage, fertilization, weeding, and control of disease and insects and wildlife management). Due to the input levels applied, this method often produces NTFP of lower value compared to alternative methods.
2. Wild-Simulated	This method seeks to maintain the natural growing environment and yet enriches local populations to create an abundant renewable supply of NTFP. Minimal disturbance and more natural growing conditions ensure that products produced from these plants will be similar in appearance and quality to those from wild plants. Rather than tillage, practitioners often rake leaves to expose soil, seed the ground, and then cover with leaves again. However, because this method produces NTFP that closely resemble wild plants, they often have a better value than plants produced by the forest gardening method.
3. Forest Tending	Forest-tending involves adjusting the tree crown density and (higher value product) subsequent light intensity to favor the growth and natural reproduction of desirable understory plant species. This low management intensity approach does not involve supplemental planting to increase populations of desired understory species.
4. Wildcrafting Management Level: Low Input Cost: Lower	Wildcrafting is the harvesting of naturally existing NTFP. It is not considered agroforestry since there is no human involvement in the plant's establishment and maintenance. Once forest thinnings, or other inputs, are applied in order to sustain or maintain plant populations that might otherwise succumb to successional changes in the forest, it becomes agroforestry and forest tending.

Varying crop values: *These various methods of integrating forest farming each have potential advantages as well as drawbacks to their production levels and income potential. This will vary by NTFP crop. For example, while ginseng production levels will likely increase when comparing forest gardening to wildcrafting, the value of the crop may not. Wildcrafting typically commands a crop price similar to plants grown and collected from the wild. Crop price for ginseng plants produced in the forest gardening method may bring less. This may or may not be true for each NTFP crop. Always do some background research to identify what market factors drive the pricing of the NTFP crop of interest.*

herb production normally involves cultivating the forest floor and possibly thinning the canopy to create the appropriate microclimate. Small diameter hardwoods that are removed for timber stand improvement may be used as logs or chippings for mushroom production.

NTFPs generally fall into four categories:

- medicinals and botanicals
- forest-based food products
- woody decorative florals
- handicraft and specialty woods

Medicinals and Botanicals

Medicinals and botanicals are products derived from parts of existing trees, shrubs or understory plants. The terms are often used interchangeably. Medicinal and botanical plants produce substances that are used in a variety of nutraceutical, herbal health products, cosmetics or other products. Of the quarter million known flowering plants, nearly one quarter of them (approximately 80,000) have been used at some time for medicinal purposes in traditional medicine worldwide. The value of prescription and over-the-counter

plant based drugs in developed countries approached \$43 billion in 1985.

Products are derived from nearly all parts of the plants, including wood (e.g., aromatic oils from cedar), bark (e.g., smooth sumac, slippery elm), buds (e.g. cottonwood), leaves (e.g., catnip, ginseng, ginkgo), roots (sassafras, ginseng, golden-seal), fruit and flowers (e.g., echinacea, partridge-berry, skullcap, St. John's Wort), and pollen (e.g., ash, maples, pines). There is a growing body of knowledge, often held informally by practitioners and harvesters, on the management and cultivation of many of these species.

Forest-Based Food Products

Forest-based food products include nuts, fruits and berries and edible fungi. Many types of nuts are produced throughout Midwestern forests, including black walnuts, pecans, hickory nuts and butternuts. Considerable research has been conducted by plant breeders and hobbyists to develop superior nut cultivars of most of these species. Black walnut and pecan have also received considerable attention, and are major industries in Missouri and the Midwest. Improved cultivars are typically planted in alley cropping practices at wide spacing rather than in light limiting forested settings.

Commonly harvested fruit and berries include chokecherries, highbush cranberries, sand cherries, black, white and red currants, elderberries, saskatoons or juneberries, jostaberries, Nanking cherries, Chokeberry, buffaloberries, pawpaw, and persimmon, among others. All are harvested for home consumption, but many are also gathered for commercial use (be sure to check on local or state regulations pertaining to commercial harvest from public lands). The numerous types of berry species are used in products ranging from fresh fruit to jams, jellies, syrups, juices and wines. The Cornelian cherry (*Cornus mas*), native to eastern Europe, shows considerable potential, not only for jam, but also for the wine industry (as a sparkling wine). Similarly, elderberry (*Sambucus* spp.) is increasingly in demand for wine, jellies and other value added products. Improved varieties are

under development at the University of Missouri Southwest Center, Mt. Vernon, MO.

Some of these species are adapted to conditions across large areas of the Midwest and Great Plains. Others are restricted to the more northerly or southerly zones. For example, pawpaws and persimmons are produced in the southern and central Midwest, while highbush cranberries and saskatoons are largely adapted to colder climates, and grow well into central Canada.

Gathering wild mushrooms from forests is a popular activity across the US, and in some areas (particularly the Pacific Northwest) is a multimillion dollar industry. In forest farming however, native and exotic gourmet mushrooms are intentionally cultivated in the forest setting. Freshly cut logs produced as residual from timber harvest activities or small woodlots provide the medium for growing forest grown cultured mushrooms of high value. Shiitake and oyster mushrooms, two popular edible fungi are cultivated in the Midwest region, and are marketed in supermarkets and high-end restaurants.

Decorative Woody Florals

Any plant species that has a colorful or unusually shaped stem, fruit or even leaf can become a decorative floral product. Examples of woody decorative florals include numerous cultivars of red stemmed and golden twig dogwoods; corkscrew, pussy, flame and scarlet curls willows; several species of holly; witch hazel; bittersweet, and forsythia, apple, cherry, plum and many others. Floral designers increasingly use these materials in creative floral arrangements. For the majority of woody floral species, production is best suited to other agroforestry practices where light is not a limiting factor including riparian forest buffers, alley cropping and windbreaks.

Holly (*Ilex* spp.) valued for its evergreen leaves (in some species) and bright red berries, and witch hazel (*Hamamelis* spp.), redbud, quince, mountain laurel, and rhododendron for their forced flow-

Market Opportunities with Forest Farming

Floral and Craft Products

Grape vine wreaths, small wood products for carving burls, carving bark, dried and mounted fall color leaves, ferns and cuttings from conifers

Food Products: Mushrooms, Berries and Nuts

Pecans, black walnuts, gooseberries, blackberries, mushrooms and fiddle heads

Landscape Plants

Ferns, mayapples, Jack-in-the-pulpit, hostas, dogwoods and azaleas

Herbal Plants

Ginseng, goldenseal and black cohosh

Biomass and small wood

Thinned smaller sized trees, used as chip wood, fire wood, crafts wood and fence post

Timber trees

High quality timber, veneer and sawlog or other mature tree products

ers have similar markets, and command even higher prices per stem. This class of products is both sold directly to floral shops, and to large retailers and wholesalers. Stem material valued for flowers is cut while dormant, and is forced to flower by the wholesale or retail florist. Finally, some materials with leaves are preserved by soaking in glycerin and enhanced with various dyes.

“Floral greens,” a major part of the NTFP market, include salal, ferns and bear grass from the pacific northwest, and cuttings from coniferous trees, such as firs, spruces and pines. Cuttings can be used in wreaths and seasonal decorations. They are produced in native forests, particularly in Minnesota and Wisconsin, as well as on Christmas tree farms across the Midwest. Floral greens in Minnesota is a \$33 million/year industry. They can be produced sustainably in a low intensity forest farming practice.

Woodland wildflowers, also known as spring ephemerals, are ideally suited to



Bottom: Pine straw, a renewable mulch consisting of pine needles harvested into bales, is another possibility for income from agroforestry. **Top:** The market for high-value medicinal herbs, shown in this forest farming practice, is increasing.



forest farming. Woodland wildflowers including celandine poppy, wild geranium, bluebells, Jack-in-the-Pulpit, mayapple and trillium are naturally found growing in deep shade on the forest floor. All of these species can be intentionally propagated under forest shade conditions and sold in yard sales, roadside stands, farmers markets, or wholesaled to landscapers or nurseries. In addition, woodland ferns and some woodland orchids can also be propagated. In all cases it is essential to get to know the plants and how to propagate them. Most take from two to six years to go from seed to blooming plant.



Handicrafts and Specialty Woods

A number of species produce specialty woods and materials for use by local artisans in handicraft products and art. The same basket willow (*Salix purpurea*) used for stream bank stabilization is made into bent willow furniture. “Diamond willow”, which is actually a diseased willow, has cankered stems that are carved and polished by craftsmen to create beautiful walking sticks and other items. These value-added “art objects” often sell for up to \$100 or more. Smooth sumac, hickory, and aspen saplings are converted to walking sticks and mass marketed. Other products include carvings from cottonwood bark, which often grows thicker and denser under harsh climates, such as that existing across the eastern Great Plains.

There are many types of “character” woods that are highly valued by artisans and carvers, and

are especially suited to smaller scale production (e.g., butternut, basswood, figured walnut, catalpa). Highly figured wood products can be sawn from less than perfect logs. Burl wood of many species is a specialty forest product utilized by artisans for many types of decorative furniture and art pieces. Similarly, turning of “spalted,” or partially decayed and stained wood, reveals beautiful grain highly valued by craftsmen. Pine cones, as well as other seed capsules and pods are used in a variety of craft, potpourri and seasonal products, and have consistent markets. These and other products are regionally specific.

Designing a Forest Farming Practice

It is very important to start small when establishing a forest farming practice. The intensity of the practice, and the value of the product being grown, makes it likely that the initial management of small acreages will provide greater encouragement to the landowner. On a very small area (5 acres or less) the vertical, horizontal and below-ground dimensions are managed intensely to produce multiple crops simultaneously. Practices usually focus on a single NTFP plus timber, but can include several products. As previously mentioned, NTFP production should always be coupled with best management practices than maintain forest health.

Adjusting Shade Levels

The key interaction between crops in forest farming practices revolves around the amount of shade required or tolerated by understory crops. In a natural forest, understory plants are tolerant of the conditions present, or they would not grow there. In a managed system, you will need to create and/or maintain the right conditions for your chosen understory crop(s) by managing the overstory trees. For example, if you want to produce floral greens that have a rich, dark green color, you will try to ensure optimum conditions of approximately 60 percent shade. However, if you want to grow ginseng, then it is more appropriate to manage for 70-80 percent shade.

Over time, changes occur in a mature or a developing forest requiring either thinning or new tree establishment to maintain the required shade level.

In managing a forest for shade and forest health, thinnings should focus on tree species that are best adapted to site conditions, and manage those so that their spacing produces the desirable shade level. Site conditions that influence tree growth and health may include soils, position on the slope (hill top vs. creek bottom) and/or aspect (direction the slope is facing). The United States Forest Service web site, www.na.fs.us/spfo/pubr/silvics_manual/, offers information on optimum site conditions for most all North American tree species. Used in conjunction with information on forest soils, the selection of trees for which to manage can be refined.

Within the forest farming practice, shade levels can be adjusted by one of two methods:

- *If there is not enough shade for the understory, more crop trees will have to be planted or retained to produce more shade.*
- *If there is too much shade under trees, trees can be thinned or pruned.*



Ginseng grows well in this mix of alley cropping and forest farming. Walnut trees provide the necessary shade.

Forest Canopy Cover: Examples of Density	
50% Cover	
25% Cover	
10% Cover	

Crop tree management

Crop tree management is one method of managing for trees best suited to specific site conditions. This method focuses on identifying the best suited trees and making sure they have room to grow. Often, this is done by making sure that the branches of one crop tree do not touch, or overlap, with branches from an adjacent tree. This ensures that each crop tree has plenty of room to grow.

When applied, this method of thinning to release crop trees can provide quantities of smaller wood for use in NTFPs. For example, thinned wood

may be used on site for mushroom production.

Mark (or otherwise identify) the trees that are most site appropriate and healthy. Landowner preferences for timber, wildlife, recreation and/or aesthetics influence management and choice of species that are retained. Marked trees are identified to remain in the forest and all other trees surrounding them may then be removed as needed to create a desirable level of shade. The crown of healthy trees should have full leaves (not wilted) and you will not see many dead branches. A tree with more than 30 percent dead branches in its crown indicates the tree is not growing vigorously and may be susceptible to disease and drought. After marking the healthy trees you wish to remain in the forest, you may begin the thinning process. For a detailed explanation of the tree thinning process and methods, print or request a copy of the document “Forest Management for Landowners” from the Missouri Department of Conservation online at mdc.mo.gov/forest/private/forest_manag.pdf. (See additional resources at the end of this section). Regardless of the desired NTFP crop, management of the forest overstory trees is crucial to the forest farming practice and overall forest health.

Summary

As a part of the overall family farm, the forest farming practice can provide income and help encourage management of the forested lands. Management should focus on adjusting light levels through thinnings, prunings and/or adding trees.

However, before investing time and money in growing a particular NTFP, an entrepreneur needs to:

- 1) Obtain production and processing information.
- 2) Locate a source of technical expertise.
- 3) Locate, or develop, potential markets.

Sources of expertise on growing and producing NTFP can be obtained from State Forestry and Conservation Agencies, the Cooperative Extension Service in county offices or State Universities, the Natural Resources Conservation Service,

the USDA Forest Service and the Internet (see additional resources at the end of this section).

A market analysis and business plan will help a producer understand the inputs that are required and should be an essential starting point when beginning an enterprise.

The existence and type of market depend on the NTFP. Markets are often local stores, cooperatives or farmers markets. For example, shiitake, matsutake, morel and chanterelle mushrooms, as well as truffles, may be sold directly to gourmet French and Asian restaurants, Asian and natural food stores, or to a middleman or cooperative for resale to larger more distant markets. Markets for decorative products like grape vine wreaths are often in urban areas and may be very seasonal. Decorative products may be sold through cooperatives or to local buyers. Non-local buyers may also be reached through the Internet. However, by marketing directly to consumers a grower is more likely to retain a greater share of profits than when a middleman is involved.

UMCA Forest Farming Research: Specialty and Gourmet Mushroom Production

Markets for shiitake and other specialty gourmet mushrooms continue to show promising profit potential for Missouri forest land owners. The interest level in preparing fresh mushrooms is rising, from gourmet chefs to farmers' markets and household consumers, as information about their nutritional benefits and rich, versatile taste becomes more abundant.

The University of Missouri Center for Agroforestry (UMCA) supports one of the nation's most comprehensive research programs for shiitake and other gourmet mushrooms in an effort to help establish mushrooms as a profitable agroforestry crop in Missouri and the Midwest.

Current successes indicate that shiitake is a premium, high-dollar mushroom that grows well in Missouri and may be very successful when grown in agroforestry practices. Research is also being conducted to develop morel and other gourmet mushrooms into profitable agroforestry crops for landowners. The first specialty mushroom workshop in Missouri was hosted by UMCA in December of 2004, bringing together researchers, niche-product experts and landowners to explore the outstanding potential of the specialty mushroom market.



Success Stories

Ozark Forest Mushrooms, Timber, Mo.

One of the Midwest's most significant demonstrations of a successful forest farming practice is Ozark Forest Mushrooms near Timber, Mo. Dan Hellmuth and Nicola McPherson established the specialty mushroom operation in 1990 on what was then a timber operation, and together with a small staff, coordinate every step of the value-added process, from the inoculated log to packaged, consumer-friendly, organic mushroom products.



Nicola McPherson, right, talks to field day participants about year-round, sustainable shiitake mushroom production, used to extend mushroom production through the winter months.

A key to their success is developing an agroforestry practice that works within the natural setting of the land. Under the guidelines of the Stewardship Incentive Program, administered by the Missouri Department of Conservation (MDC), the couple harvests a renewable supply of mushroom bed oak logs while simultaneously maintaining their forested acres in a healthy ecological state. Consequently, what began 15 years ago with only 100 oak logs in production has grown to include 12,000 shiitake logs in production. Only five acres of the couple's 2,500 forested acres are utilized for the mushroom business.

A new greenhouse with a wood furnace for burning spent/culled shiitake logs has recently been completed for researching mushroom cultivation

during the cold season and sustainable usage of wood resources.

Ozark Forest Mushrooms gives particular emphasis to targeted marketing of their value-added boxed mixes and products. “The biggest marketing challenge for a rural area is that most of the mushrooms are a fairly high value specialty food, and the largest market is in some of the state’s bigger cities,” said Hellmuth. “We are marketing products to St. Louis and need to deliver them to the city on a weekly basis.”



“It’s hard work that doesn’t stop,” McPherson said, “but when I walk into a restaurant and see my mushrooms on the menu, or walk into a supermarket and see our products on the shelf, that gives me huge pleasure and makes all the work worthwhile.”

Heckemeyer Farms: *Pine Straw Production* *Sikeston, Mo*



The naturally shed needles of pine trees are known as pine straw. It is an excellent landscape mulching material, and a multi-million dollar industry. In the Southeastern U.S, pine straw is the predominant mulching material used in landscape plantings. Many sites in Missouri are suitable for pine straw production, including this example from Heckemeyer Farms in southeast Missouri.

Joe Heckemeyer: “In the bootheel we have big flats of sand. We had an area we used to farm, but put into retirement. Of the 1500 acres of ground, 800 acres of it we planted in pine trees. We were expecting the price of pulpwood to go up -- but the price of pulpwood went down, so we found an alternative in baling the pine needles. It’s a wonderful mulch, because it doesn't hurt the tree and makes it even more interesting.

This has offered us an opportunity to maintain profit on the land until the lumber can be harvested. It bridges a span where we would not have income otherwise. Some people are also planting potted plants like azaleas in the rows -- there are a lot of things you can do to reap a profit from your woods as they’re planted and grow.”

Additional Resources

Internet Sources: Understory Crops

- Non-Timber Forests Products - <http://www.sfp.forprod.vt.edu/>
- National Agroforestry Center (many resources on numerous Forest Farming Products): <http://www.unl.edu/nac/forest-farming.html>
- UM Center for Agroforestry: (publications on a variety of products and practices) <http://www.centerforagroforestry.org/pubs/index.asp#pubs>
- Missouri Alternatives Center: (topics alphabetically organized) <http://agebb.missouri.edu/mac/links/index.htm>
- Association for Temperate Agroforestry: (many topics) <http://www.aftaweb.org/entserv1.php?page=3>
- ATTRA – National Sustainable Agriculture Information Service: (numerous publications) <http://www.attra.org/horticultural.html#Herbs>
- NC State University Cooperative Extension: (numerous publications) <http://www.ces.ncsu.edu/depts/hort/hil/spcrop-index.html>

Finding a Forester (In Missouri):

Department of Conservation – <http://www.mdc.mo.gov/forest/myforester-search.html>

Consulting Foresters Association – <http://www.missouriforesters.com/pages/707248/index.htm>

Pricing Timber

In Missouri: <http://mdc.mo.gov/forest/products/prices/>
<http://www.mda.state.mo.us/Market/timberprice.htm>

Outside of Missouri: <http://www.srs.fs.usda.gov/econ/data/prices/>

Managing Timber

NRCS: Crop Tree Management Information Sheet -

http://efotg.nrcs.usda.gov/references/public/mo/crop_tree_managementfinal_1205.pdf

Forest Stand Improvement job sheet for wildlife -

http://efotg.nrcs.usda.gov/references/public/mo/JSBIOL14FSIWildlife2_05.pdf

Forest Stand Improvement job sheet for forest -

<http://efotg.nrcs.usda.gov/references/public/mo/666JobSheetMay2005.pdf>

Forest Stand Improvement Practice Standard -

<http://efotg.nrcs.usda.gov/references/public/mo/666-July2000.pdf>

MDC: Forest Management for Missouri Landowners –

http://mdc.mo.gov/documents/forest/private/forest_manag.pdf

MU Forestry Extension – (numerous publications on forestry)

<http://muextension.missouri.edu/explore/agguides/forestry/index.htm>

UMCA DVD

Visit www.centerforagroforestry.org or the University of Missouri Extension web page at <http://extension.missouri.edu/explore/agguides/agroforestry/index.htm> to purchase.

In Print:

Hill, D.B., and L.E. Buck. 2000. Forest Farming Practices. IN: North American Agroforestry: An Integrated Science and Practice (H.E. Garrett, W.J. Rietveld and R.F. Fisher, ed's.). Agronomy Society of America, Madison, WI. pp. 283-320.

EXERCISE: REVIEW OF FOREST FARMING

Identify the top three landowner objectives related to creating a forest farming practice.

i. _____

ii. _____

iii. _____

2. What are the four general categories of Non-Timber Forest Products?

i. _____

ii. _____

iii. _____

iv. _____

3. What are the four methods of integrating forest farming with wooded environments? Which are the highest input and cost and which are the lowest?

i. _____

ii. _____

iii. _____

iv. _____

4. Identify three products to be produced from the managed land.

i. _____

ii. _____

iii. _____

5. Identify how the landowner can reach their objectives while producing the desired crops.

EXERCISE KEY

1. Identify the top three landowner objectives related to creating a forest farming practice.

- i. Alternative income from forested land
- ii. Improved forest health
- iii. Improved timber value

2. What are the four general categories of Non-Timber Forest Products?

- i. Medicinal and botanicals
- ii. Forest-based food products
- iii. Woody decorative florals
- iv. Handicraft and specialty woods

3. What are the four methods of integrating forest farming with wooded environments? Which are the highest input and cost and which are the lowest?

- i. Forest Gardening – high input and costs
- ii. Wild- Simulated
- iii. Forest tending
- iv. Wildcrafting – low input and costs

4. Identify three products to be produced from the managed land.

- i. High quality timber
- ii. Shiitake Mushrooms
- iii. Ginseng

5. Identify how the landowner can reach their objectives while producing the desired crops.

First identify certain wooded areas that may be more appropriate than others for growing the desired crop. Choose a northerly aspect and well drained site for ginseng production. A bit more flexible on the mushroom site (but, place it where access is good). And, are there sites that are best for just producing timber (soils, aspect, slope position)? Select crop trees to create appropriate shade levels. Thin. Plant ginseng by planned method. Inoculate mushroom logs in an identified area.

Notes

Section 8: Agroforestry and Wildlife

In this chapter:

- **A Description of Habitat Needs:**
 - Species Addressed:**
 - White-tailed Deer**
 - Bobwhite Quail**
 - Eastern Wild Turkey**
 - Waterfowl**
 - Mourning Doves**
- **Agroforestry Practices as Habitat**
- **Reducing the Costs Associated with Establishing Wildlife Habitat**



Agricultural practices have traditionally involved clearing of the land to facilitate farming. However, everything done on the land influences use by wildlife, some actions both positively and negatively. Current, practice(s) and equipment sizes have led to larger, cleaner (weed free and little waste grain) fields and have resulted in a decrease in the quality and diversity of available wildlife habitat. While agroforestry practices provide many benefits to a farm, such as improved water quality, soil stabilization and income opportunities, agroforestry also offers many benefits and enhancements to wildlife habitat.

Agroforestry provides a means to increase the availability of habitat for certain wildlife without sacrificing the potential to achieve a landowner's agronomic and economic goals and objectives. It can be used to combine agricultural and forestry enterprises that encourage a more diverse, and often more sustainable agricultural system. Generally speaking, agroforestry involves the deliberate integration of trees, shrubs and grasses with agricultural practices (crops and/or livestock). The land-use decisions that result are better able to accommodate the needs of a variety of wildlife species.

When designing land with wildlife objectives in mind, it becomes important to consider the various components that define their habitat, such as food, cover, water and space. Once you have knowledge of the life history, biology and habitat requirements of the species, then you can begin to identify the limiting factors that might exist on your property and conduct management practices that provide the needed food, cover, water or space (i.e., the habitat) that the species requires. To be successful, develop a plan of action (a wildlife management plan) and begin to integrate wildlife considerations (such as habitat management techniques) along with your ongoing land management objectives. Having a plan to work from will help ensure success.

Managing for a diversity of plant communities and habitats (i.e., woodlands, grasslands, wetlands, shrubs, row crops) will also tend to promote a diversity of wildlife on your property. The agroforestry practices including alley cropping, windbreaks, forested riparian buffers, silvopasture and forest farming, will provide opportunities to manage for a diversity of plant communities and habitats that have the potential to benefit the wildlife resource. Agroforestry can also provide the means that enables landowners to improve habitats for wildlife on their property while offering alternative sources of income to the farm.

A general overview on managing habitats for selected wildlife species is provided. In addition, specific plants that can be used to provide food and cover are identified as well as a few suggestions on how to integrate management practices that benefit the desired species. Information is also provided on methods that can be used to reduce management costs as well as on potential income opportunities that can result.

Part 1: A Description of Habitat Needs



- **White-tailed deer**

Habitat:

White-tailed deer have adapted to a variety of habitat conditions across Missouri. Good white-tailed deer habitat contains the right mix of available foods and cover throughout the year. The size and shape of a deer's home range will vary with habitat quality, deer density, sex, time of year and the deer's age. Deer that live in better habitats (ample amounts of food and cover) often are able to satisfy all of their daily requirements in a smaller area, while deer that live in less diverse habitats usually must travel larger distances to find suitable food and cover. An adult buck will usually have a larger home range than does and young bucks; however, this is dependent on the time of year and the overall quality of the habitat. Home range refers to the area used by a deer throughout a given time frame or season. As mentioned earlier, does will often have a smaller

home range than bucks. However, by providing the appropriate mix of cover types on your property you can begin to manage for all the habitat needs of deer throughout the year.

White-tailed deer prefer to use habitats with an abundance of forest edge, as opposed to large, dense areas of forest. Farms with small woodlots, forested riparian areas and woody draws provide excellent habitat for deer, and for this reason deer populations have thrived in agricultural areas.

Water

Water is critical for survival; however it is most often not a limiting factor for deer in Missouri. Deer may acquire water from vegetation or surface water, such as ponds and streams. Good deer habitat contains accessible surface water that is available throughout the year.

Food and Forage

Deer are ruminants and therefore will use a variety of foods including hard and soft mast, fruit, herbs, grasses, twigs, green leaves and agricultural crops. Deer are very selective feeders and will seek out preferred plant species. Most often their preference is for browse material, which may include vines, shrubs, and young trees, and mast production such as acorns. Deer have the ability to select plants that offer the most nutrition at particular times of the year. As fall and winter approach, deer prefer to eat acorns (white and black oak). When acorn production is low, deer will transition to other readily available food sources, including agricultural crops like alfalfa, clover, wheat, corn and soybeans.

As a daily average, deer may consume up to 8 pounds of green food for every 100 pounds of body weight. As a percentage of their body weight, bucks will consume the most food in the spring while does will consume the most food in the fall, just prior to breeding.

Because deer food preference and need changes seasonally, it is important to provide readily available foods throughout the year. Acorns are rich in

carbohydrates and are one of the most important food items during the winter. It is preferable to manage woodlands and wooded edges for a variety of hard mast producers. Oaks will typically produce large mast crops one year out of every 3 years. It is also typical that an oak will not bear acorns until it is 15 – 25 years of age. Forest management for deer habitat should seek to maintain about 15-20 red and white oaks per acre.

Cover

Deer rely on a variety of cover types during each season of the year. When evaluating your property for deer, keep in mind that deer are creatures of the edge. This means that they prefer areas where two or more cover types come together, such as where a shrubby thicket adjoins an agricultural field. Deer utilize both open woods and areas with thick shrubs and brush such as clearcuts for escape cover. In addition, grown up pastures provide concealment cover for does and young fawns as well as nutritious food plants.

Management Guidelines

Evaluating Deer Habitat

Missouri's relatively mild winters, diverse habitat conditions, and good mixture of crop ground and woody cover provide deer with ideal conditions throughout the state. However, there is no doubt that the larger body sizes, more optimal antler growth and higher reproductive rates of north Missouri deer (where soils are more fertile and agriculture predominates) suggests that providing habitats that contain an abundance of high quality foods is important for producing these desirable characteristics. It is important to evaluate your property with a habitat appraisal before making habitat management decisions. In Missouri, most land ownership consists of many small parcels and it becomes important to cooperate with neighbors to help achieve habitat management goals.

Woodland Edge

As mentioned earlier, deer are creatures of the edge and their instincts draw them to woody cover and to the edges of woody cover. Edges can be made more valuable for deer by creating an undulating edge (more edge per area is created when

edges are not in a straight line). This can be accomplished by leaving brushy draws that periodically protrude into fields, or by mowing or disking field edges in an irregular/wavy edge.

A good rule of thumb would be to keep edges of fields and pastures in shrubs or young trees by periodically brush hogging (once every 5-7 years). Allow quality trees that are 50 feet or more from the edge to develop into their full potential as timber and mast producers. This maintains the shrubby component that is important for high quality deer habitat, and minimizes the competition for light and moisture that would otherwise develop from larger trees spaced closer to farm production areas.

Food Plots

In addition to managing field edges, you may have dense pockets of woods that need to be opened up. Small temporary or permanent openings can be created to provide diversity in these woodlands. One popular opening is a "green-browse" food plot. These areas are typically 1 to 5 acres in size and placed at the rate of about 1 per 40 acres of woodland.

"Green-browse" food plots can be planted into wheat and red clover in permanent forest openings. Grain food plots can also be planted. Crops such as corn, milo or soybeans can become hotbeds for deer activity, bringing together multiple habitat requirements.

These "temporary" openings can also serve as regeneration areas for the development of young trees and shrubs, and become valuable for cover and browse. One of the critical components to deer habitat management will be addressed in answering how to integrate quality habitat with existing agricultural practices. Agroforestry provides several practices that offer methods for integrating various woody species with existing crops and/or pastures. The agroforestry practices of alley cropping, forested riparian buffers and windbreaks are especially well suited for creating edges of desirable species for integrating deer habitat management with agricultural production.

Additionally, the practice of forest farming can be used to manage woods for improved timber growth, while also developing favorable understory plants that will attract deer.

Population Management:

Landowners have the opportunity to implement various population management strategies to help accomplish goals and objectives. A high percentage of does have twin fawns so deer reproductive rates in Missouri are high. Predation and farming activities are the primary causes of mortality of fawns less than two months of age. Hunting is the leading cause of deer mortality in most of Missouri and is an important management tool in governing deer abundance in any particular area. Hunting mortality of does is the most important factor determining whether a population increases, decreases or remains stable. One male can mate with many does so bucks can remain at much lower numbers in the population than does without affecting the reproductive rate of the herd. It is extremely important to realize that legal hunting is the most efficient method to keep deer number at or below the cultural carrying capacity (the maximum number of deer that the public will accept before the negative aspects of high deer numbers become intolerable).

When managing for deer, the question of landowner goals and objectives must be answered prior to implementing management practices. Landowners have diverse attitudes toward deer on their property. Some would rather have few deer on their property while others would like to maximize their numbers. Harvest preferences also vary. Some landowners who hunt want to see as many deer as possible while others want to kill only trophy animals. Concepts such as Quality Deer Management (which began in the southern United States) have as their objectives to manage for healthy deer populations and their habitat, and to ensure a quality hunting experience. Groups like QDMA (Quality Deer Management Association: www.QDMA.com) seek to promote a philosophy among hunters and landowners producing deer herds that exist within environmental, biological and social boundaries. By managing

for a more balanced deer herd, problems can often be reduced and goals of interest better achieved.

• Bobwhite quail

Habitat

Bobwhite quail have more complex habitat requirements than many wildlife species, so it is important to begin thinking about how to create habitats that are usable throughout the year. Bobwhites need a mix of early-successional vegetation (grasses, legumes, shrubs and crop fields) all interspersed together. Quail rely on these interspersed habitats for their food and cover needs. They survive largely by continually refueling and minimizing unnecessary energy loss and expenditure. This means that habitats must be managed so that they provide the needs of bobwhites throughout the year, and arranged so that they are accessible and usable by bobwhites.

In his book “The Technology of Bobwhite Management,” Fred Guthery (2002) clarifies the needs of quail: “The goal in habitat development may be seen as creating that which minimizes energy expenditures while maximizing opportunities for replenishing energy. Habitat should recognize the needs associated with cold winters and/or hot summers (climatic variation), and the various activities from laying, nesting, brood rearing and resting (types of cover for stages of their life cycle). The elements of the habitat developed, or maintained, must be combined in a manner that balances both access to that habitat and escape from predation. It is through the proper mixing of habitat types that quail are most likely to benefit.”



Quail are primarily ground dwelling birds and do not have the same degree of mobility as most other game species (i.e., wild turkey, deer, pheasant, dove, and waterfowl). It is generally thought that 20 to 40 acres of area with the right mix of habitats can support a covey of quail. While that amount of area can certainly be managed to support a covey, research suggests that much larger land areas are needed (i.e., 5,000 to 10,000 acres) to successfully restore habitats to support a sustainable quail population.

This means that landowners who may own small acreages (less than 100 acres or so) can manage habitats for quail, however, they will need to work together with their neighbors to really begin to make a difference. An excellent reference for quail management is MU Extension Publication MP902, Missouri Bobwhite Quail Habitat Appraisal Guide, which provides information on habitat appraisal and evaluating your land for bobwhite quail habitat. The appraisal guide can be used as a planning tool to help you identify the habitat components that are in “shortest supply” or limiting on your property and the appropriate management practice(s) required to address deficiencies that need (nesting, brood rearing, roosting and escape cover).

Breeding, nesting, brood rearing

Bobwhite quail have short life spans, rarely living to two years of age. Most often, 80% of the annual population will not survive to see the following year. Although bobwhites have high mortality rates, the species also has the capability to have high reproductive rates.

During the spring, males begin their courtship activity and the familiar “bobwhite” whistle is the earliest sign that the reproductive season is underway. Courting pairs form during April and May and bobwhites may mate and initiate nesting attempts with as many as three different mates.

Some of the best nesting cover are clump grasses that are between one and two feet in height. These grasses are often warm-season grasses, such as broomsedge and little bluestem, but cool-season

grasses, such as timothy and orchardgrass, may also be used. It is important that residual nesting cover exists during the spring, so planning is required during the previous year. Since it is important to have this residual cover each year, the recommendation is to stagger management so that cover is on a given field about every two years. Don’t burn all warm-season fields every year.

Nests are often built on a slight depression in the soil with dead grasses and stems left over from the previous year. They are usually located close to edges of grassy fields or field borders, many times within 10-25 feet of a habitat edge. The importance of proximity to bare ground becomes apparent when you consider the needs and size of newly hatched chicks.

Most nesting in Missouri begins in mid-May, with peak hatching often occurring in mid-June; however, if initial nest attempts are broken up, quail may nest as late as August. Late season nesting will often occur following failed nesting attempts earlier in the year.

As soon as all chicks are hatched, they are led away from the nest to what is referred to as brood-rearing cover. Therefore, mobility at the ground level plays a key role in what areas are selected for nesting. Fescue, and other turf grasses, as well as stagnant warm-season grass stands that form mats of vegetation, are undesirable as quail habitat. Unless an area is prone to erosion, management should favor stands of grass and forbs (weeds) that are open at the ground level, which will allow chicks to move freely and satisfy their high-protein diet requirements.

Year-round cover and food

Early successional stages of plant vegetation are essential habitat for bobwhite quail. The appropriate cover types must be available throughout the year. Bobwhites are often associated with cover that affords a high level of visual obstruction. This protective cover needs to be provided from both above and from the ground level. An optimal agricultural landscape for bobwhites typically contains 15 to 20 percent shrubby cover, 20

to 30 percent grassy areas, and 40 to 60 percent row crops, all interspersed closely together. Embodied in each of these cover types is the desired existence of 20-60% bare ground, with an overhead canopy of shrubs, grasses, legumes and weedy vegetation. These areas of cover provide resting areas for use between feeding periods. They also provide protection from predators and bad weather.



Research has shown that during winter, quail rarely stray further than 70 feet from shrubby cover. Therefore, to make an area suitable for bobwhites, scattered patches of shrubby cover should be spaced every 150 feet, and be located next to other important cover types and available food resources. Woody protective cover is an absolute necessity and a habitat type that is often limiting on many farms. With other food and cover located nearby, little covey movement is necessary, energy is conserved and predation is reduced. The idea is to have these “covey headquarters” located across the property.

Bobwhites are seed eaters; however, insects are also important and comprise approximately 30 percent of the diet during the summer. A variety of foods are found in the diet, from weed and forb seeds (ragweed, annual lespedeza, partridge peas, tick trefoil), grasses and soft mast (fruits and berries) to cultivated crops and hard mast (i.e., acorns). Seed will comprise 70 percent to 95 percent of a quail’s diet depending upon whether it is summer or winter.

Although bobwhite quail will utilize all successional stages of vegetation, from recently disturbed bare ground to mature forest, the early successional stages containing abundant annual forb and weed seeds are the most important. As mentioned earlier, early successional vegetation (grasses, legumes and weedy vegetation) must be integrated with patches of early-successional shrubby cover. Without dense, shrubby patches of cover, it is not possible to restore quail populations on your property.

Water

In the Midwest, water is not a limiting factor for bobwhites. Water requirements are usually met by the intake of green plants, insects, dew, and snow.

Management Guidelines

The question may be asked: Which should I manage for -- nesting, escape, or cover? The answer is to initially manage for the habitat component that is the most limiting on your property. MU Extension publication MP902 provides a process that can help you identify limiting factors and provides management recommendations to assist you in getting habitat on the ground. Many farms lack the diversity of habitats that quail need. The most common limiting factors on many farms are the lack of brood-rearing cover and shrubby escape cover. Another scenario may be that your property has all the habitat components that quail need, but is essentially an “island” of habitat within a landscape that does not have suitable habitat. If this is the case, it becomes extremely important to work together with your neighbors and cooperate in the management of habitat for bobwhite quail.

There are several agroforestry practices that may help connect otherwise isolated islands of habitat on a farm. Alley cropping, forested riparian buffers and windbreaks each provide for the integration of select trees/shrubs/grasses with agriculture practices that might otherwise not provide cover or nesting and brood-rearing areas for quail. Likewise, silvopasture practices can provide a means to intersperse cover with otherwise grassed areas and enhance the areas potential use by quail. A key component to integrating agroforestry

with agricultural production is to identify how best to maximize quail habitat while minimizing production losses. This requires our understanding of the competition that will occur between trees/shrubs/grasses and the agricultural crop. Each of the agroforestry practices, and the amount of competition, will be discussed in more detail in the section entitled: Agroforestry, common habitat characteristics.

- **Eastern wild turkey**

Habitat

Today the eastern wild turkey thrives, but their history is not without a few bumps in the road. Early in our nation's history hunting was unregulated. In addition, settlement practices and farming often resulted in forested lands being cleared, and by 1920 wild turkey remained in only 21 of the 39 original states of its historical range. Habitat management has restored sound populations of the once endangered wild turkey to most of its natural range.



In Missouri, wild turkey restoration programs were initiated in the 1950's when the Missouri Department of Conservation began to restock birds in the Ozarks. Currently, all 114 counties have sufficiently large populations of wild turkey to support hunting. Wild turkeys use different habitats during the various seasons; however, they spend about six months of the year in "winter habitat," which is characterized by having at

least 50 percent of the range in mature hardwood forests. Turkeys also make extensive use of open fields that border these forests. Nesting habitats are varied, but hens will usually nest near the edge of an open field or hay field. Turkeys have a fairly large home range, however, the size of the area will be dependent on the availability of foods and cover. The use of a specific piece of property is related to its ability to meet one or more of a turkey's diverse habitat needs. A diversity of habitat types that provide seasonal food and cover requirements is the key to having large numbers of wild turkeys.

Roosting

Generally speaking, suitable turkey habitat includes a scattering of mature mast hardwoods (for food and roosting sites), understory shrubs that provide soft mast such as dogwood and wild cherry and a variety of open pastures and fields to provide nesting and brood-rearing sites. The importance of having mature timber is highlighted by the roosting preference of turkey. While turkey will roost on the ground, they are most often associated with roosting overnight in trees to avoid predators. When roosting in trees, turkey prefer to use open-crowned, mature timber. Often this timber will be connected to a large area of woods and will have a water source close by.

Water

Turkeys require an open source of water. They will use ponds and lakes, streams and spring seeps.

Food

Turkeys will also make use of crops such as corn, soybeans and milo. Food plots and grain crop residues can provide a high energy food source to sustain turkeys during the winter and early spring when other food sources are in scarce supply.

However, the preferred foods of turkey are found in association with forested lands. While acorns are a primary food source, other seed or fruit from species such as dogwoods, hawthorns, wild grapes, cherry and persimmon, will also be used extensively. In addition to food from trees and

vines, turkey will eat seeds, buds and leaves and insects.



Breeding, nesting, brood rearing

Turkeys do not have specific habitat needs associated with mating. However, field edges adjacent to woody cover are excellent locations to view the spectacular show-and-tell antics that toms use to impress and attract hens.

Turkey nest on the ground. Most often nests will be located where a dense understory or thickets exists, under brush/slash piles, or downed tree tops. Nests will often be found along field edges. Because of the light that reaches vegetation at the ground level (as opposed to darker forested environments) the undergrowth on field edges is usually thicker, and comprised of a number of woody/shrubby species of vegetation.

When broods hatch, access to insects is very important. Like quail, insects provide new poults with a good source of protein. For this reason, patches of legumes that attract insects are excellent habitats for young broods. In association with these areas it is good to have some shrubby escape cover located close by. In large tracts of forest land, small woodland openings, one-half to 3 acres in size, provide a good mix of herbaceous material, and good access to cover as escape from predation.

Management Guidelines

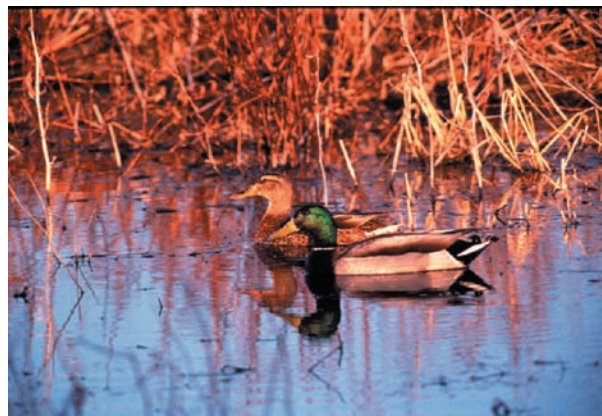
With the large range size required by a wild turkey flock (350 to >1000 acres), it is essential

to provide a mix of habitat requirements if you want to attract and keep turkeys on smaller tracts of land. Maintaining large tracts of timber with a mature tree component is essential. To do this, it is often necessary to stagger management and harvesting practices so that areas of mature timber are left undisturbed. One method might be to harvest timber in blocks. The acreage harvested will need to be spaced so that mature timber is always available next to harvested blocks. Therefore, harvests will also need to be spaced over time. This allows harvested areas to grow back prior to cutting the mature timber that may be adjacent to them.

An alternative method is to harvest single or small groups of trees from within the forest. To properly conduct single or group tree harvests, and sustain the composition of the forest, careful monitoring of the regeneration is necessary. Regeneration of a forest is dependent on available sunlight. Many species, such as oaks, require substantial sunlight for regeneration. Therefore, it may be that a greater number of trees will need to be removed in order to increase the available sunlight for seedlings to become established.

Whether through block or group openings or single tree harvests, it is important to manage forest lands so that all the important habitat components are available - either on your property, or on adjacent lands.

• Waterfowl



Waterfowl are another great wildlife conservation success story. In the early 1900s many waterfowl species were reduced to extremely low population levels as a result of unregulated hunting and loss of wetland habitats. In response to hunting regulations and wetland conservation programs that have been implemented in North America, most waterfowl species have made a dramatic comeback.



Habitat

Missouri is home to a few resident waterfowl species, including giant Canada geese and wood ducks. Most waterfowl that utilize Missouri wetland habitats are migratory. Many of these waterfowl species nest in the prairie pothole region of the northern Great Plains and Canada and then migrate south during the fall and winter. Migrating waterfowl will typically begin moving into Missouri in late August and September (blue and green wing teal), and this movement will steadily increase as winter progresses.

Migratory waterfowl are attracted to wetland habitats. An exception to this might be seen in the use of crop fields by migrating snow geese. However, one of the best methods of attracting and holding migratory waterfowl is to seasonally flood bottomland timber and crop fields during the winter months.

Other options include managing wetlands so that they hold water during select periods of the year. In general, wetlands can be identified as a place where water is at or near the soil surface for an extended period of the year. Often these wetlands may be identified by their vegetation, including trees such as cottonwood, species of maple, and several species of oaks. Many herbaceous plants are also typically found in wet environments, such as smart weed, and many of the sedges. Many of these and other plants that are found in wetlands provide beneficial foods for waterfowl.

The timing of flooding a crop field or a tract of timber to attract waterfowl is critical. Before attempting to develop wetland habitats on your property, you should seek professional assistance from a wildlife biologist that is familiar with managing waterfowl and wetland habitats.

Management Guidelines

For many waterfowl species, seasonally impounded waters that are in the migration flight path will provide excellent habitat. However, in agroforestry we are concerned with improving the habitat through the integration of selected trees and shrubs with grasses or crops. Therefore this management section emphasizes the integration and management of trees.

Two ingredients of extreme importance to developing and managing land that is successful in attracting waterfowl. One is the presence of water and the other is the presence of food. Both work in concert to provide habitat that waterfowl will utilize.

Water and Food

Waterfowl use areas that have shallow water. Standing water does not need to be deep to provide benefits for waterfowl. In fact, water that is from 6 inches to 2 feet in depth is ideal for many waterfowl species. Most food should be no further than 10 inches from the water surface. This means that depth of water should be varied depending on the food crop. If food crops are present, manage water depths so that the foods are available.

In general, water should be put on, or allowed to accumulate, in the fall, and drained down in the spring or early summer. Most areas with integrated crops and trees should not be flooded until mid to late October (October 15th or later). This allows crops to mature and trees to enter the dormant process. It is important that trees are going dormant prior to flooding and that water is drawn-down or taken-off prior to bud break in the spring.

Water draw-down is as important as timing of flooding. Water should be allowed to gradually come off a site before trees enter bud swell (just prior to leaf emergence). This process should begin early in the spring. In north Missouri this is often during mid-March. In southern Missouri it is more likely that draw-down should begin in mid-to-late February. In addition to the effect that the removal of water has on tree survival, it also plays a key role in the establishment of weeds, such as smartweed, which will become a vital food source when the field is flooded again next fall. Landowners wanting to have additional food crops, such as sorghums or millets, may mow the smart weed and seed additional crops in June or July. Draw down of water can play a key role in the establishment of waterfowl food crops; plan accordingly so that different foods, cool season or warm season, will be ready by fall flooding dates.

Integrating Trees for Waterfowl

Many trees, including oaks, ash and maples are important food sources. These and other trees that are allowed to mature may also become important nesting sites for wood ducks. Seasonally flooded areas that contain trees are often termed green tree reservoirs. These areas can be created in a natural manner or, in an intensive and artificial manner.

Natural management of bottomlands with trees includes a process of identifying where water is entering the area, and where it is exiting. Many times wooded streamside corridors can be flooded by simply identifying where a small stream enters a larger stream and constructing a dam or water control structure. Opening and closing these structures allows for the seasonal adjustment of

water depths. Trees should not be flooded when in leaf and actively growing.

Another natural method is to create a pond or water impoundment area above the intended green tree reservoir. Then, when the time is appropriate in the fall, release water to flood the site. Remember, controlling the amount of water on the site is important, and as little as 10 inches of water may be sufficient to accomplish your objectives.

More intensive methods may also be applied. Levees can be created to form a continuous berm/raised bed (2-3 feet in height) that can be used to hold water on an area. Trees can then be planted on these berms. Soil type will play a critical role in determining whether the area will hold water as well as determining the type of tree that should be planted. By spacing these berms on the contour, for example 60 to 120 feet apart, it is feasible to integrate crop fields between the trees. These inner cropped areas can then be seasonally flooded, creating a managed wetland for waterfowl use.

It is also important to manage the woodland during the spring and summer months. Typical management may include planting additional trees, or thinning existing stands of timber. Thinning is important because it can help develop a healthy stand of trees with good timber potential. Thinning is also important to keep the stand as open as possible. Sunlight is necessary for new trees to become established and is essential for the establishment and growth of weedy plants. Properly applied, thinnings can assist in managing for a healthy stand of trees that also are more likely to produce better nut crops for use by waterfowl.

• Mourning Doves

Mourning doves are native migratory bird species in much of the United States. Their range extends from as far north as Canada, to as far south as Mexico and Central America. Although doves are migratory, Missouri offers habitat for doves throughout the year. In any given year, annual harvest of mourning doves has been equal to the harvest of all other migratory birds combined.



Habitat

Mourning doves are highly adaptive and will use a wide range of habitat types. Their preferred habitat includes a combination of wooded edges adjacent to open or semi-open land. They thrive in a variety of agricultural settings and take advantage of the available foods that are provided by various grain crops and weedy fields.

Nesting

Mourning doves begin courtship and nesting activity in the early spring. Nesting pairs will stay together throughout the year. Nests are very flimsy and are built out of just about any available material, and Doves have been known to use a previous year's. Doves prefer to nest in trees, and if a nest is lost, the pair will re-nest. Most often nests will be found along field edges, in shrubs, trees or vines. Both deciduous and coniferous trees are used. Mourning doves will continue to nest throughout the spring and summer. Incubation begins immediately following the completion of the two-egg clutch. If all goes well, the eggs hatch after 14 days and the young birds are fed pigeon milk until they are ready to leave the nest. Soon after they leave the nest, adults begin their preparations for a second brood, frequently using the same nest. As many as three to five broods may be produced each year in Missouri.

Food and Water

Doves have been known to fly several miles to food and water sources. They prefer to walk to the edge of the water and need bare ground conditions adjacent to water sources. They will use just

about any fresh surface water that is available, such as ponds, puddles or streams.

The diet of mourning doves consists almost entirely of seeds from native and farm crops (greater than 99%). However, they are primarily ground feeders, relying on being able to see the food on the soil surface. Also, in order to digest seeds they need grit in their gizzard. Therefore, doves will utilize sources of sand or gravel. There are many native foods used by doves, however, a variety of cultivated crops are also used including corn, millets, and milo. In addition, doves are attracted to sunflowers. Other crops that might be considered include sorghum, hybrid sunflowers (black oil), wheat and sesame. In all cases, the best management practices that serve to attract doves involve agronomic practices that provide waste grains on the soil surface following harvest. Be sure to comply with state and federal regulations to avoid management practices that create conditions that might be classified as baiting.

Roosting and Resting

Roosting and resting areas are essential. The use of perching sites and resting areas are important prior to doves flying down to feed in a field. Trees that are adjacent to row crop fields and to watering sources provide excellent locations for attracting doves.

Part 2: Agroforestry Practices as Habitat

Trees and shrubs can be added to farm landscapes to enhance wildlife habitat. However, it is as important that the managed agroforestry practice provide additional products to a farm in the form of timber, other woody products and a variety of horticultural type crops. Their integration and management will benefit wildlife populations and farm production.

- **Deer and Turkey**

Although deer and turkey both use wooded tracts, they will also make extensive use of woody edges and open fields. Because of the preference

that both species have for a diversity of plant communities for food and cover requirements, agroforestry practices are ideally suited to create a desirable habitat.

Every hunter has observed how a deer uses a woody edge or shrubby fence row as a travel corridor. By planting select trees and shrubs in configurations such as alley cropping or windbreaks, a greater amount of woody edge can be created in or around a given field. Use of oak species can be especially beneficial since acorns provide an important food source. Additionally, combining this planting with species of shrubs provides opportunities to meet both food and cover needs that are beneficial throughout the year.

For wild turkeys, the alley cropping practice can create areas with trees, shrubs and open areas that provide good nesting and brood-rearing locations. In addition, the acorn crops provide turkeys with mast that can be used during the winter.

Windbreaks and riparian forest buffers provide similar benefits as alley cropping with rows of trees and shrubs; however, they are usually not as regularly spaced on an area. Each serves specific functions such as reducing wind speeds or filtering runoff. However, the edges they create can be more diverse than with alley cropping and are more useful to wildlife. Both the riparian buffer and the windbreak practices incorporate the use of multiple rows of trees and shrubs, and also may utilize stiff stemmed grasses. This complexity has the potential to enhance their benefit and use by deer and turkey.



Silvopasture and forest farming practices provide similar types of habitat. Both can be managed so that more sunlight is available to produce a companion crop.

Typically, the silvopasture practice promotes greater sunlight than forest farming (50% for silvopasture as compared to only 20-40% in a typical forest farming practice). Silvopasture can provide habitat for deer and turkey by opening up a natural woodland and allowing for the establishment and growth of forage and browse plants. Forages that can attract deer and turkey include legumes such as ladino and red clover. Turkeys will also use these locations for “bugging” in the spring and early summer.

Comparatively, the forest farming practice promotes a greater level of shade and therefore is more likely to create areas of green browse, vines and shrubs than in a silvopasture practice. This too has benefit for the seasonal use by deer and turkey.

An important point to remember throughout the process of creating a silvopasture or forest farming practice is that these resources can also be managed for timber products. As a part of the overall woods management, thinnings should favor desirable species of trees and shrubs, taking into consideration not only their value for wildlife, but also their potential as a high quality tree for timber production. Then, in the process of managing the overstory trees, suitable understory environments can be maintained and managed to meet the habitat needs of deer and turkey.

• *Agroforestry Practices for Quail*

Weeds, forbs and annual crops each provide sources of high energy foods for quail. However, studies have shown that by far the highest energy values come from agronomic seed, such as corn, soybean, wheat, grain, sorghum and sunflower crops.

Alley cropping configurations that promote the use of shrubs can enhance habitat for quail by providing food and cover in close proximity to one

another. It is important to provide and manage for the habitat components that are in shortest supply, whether this is cover for nesting, brood-rearing areas, or for protection from predators. For the purpose of developing good quail habitat, tree or shrub selection should satisfy two requirements. First, the selection should provide overhead cover and, second, create areas of bare ground.

Most shrubs such as dogwoods, wild plum, sumac, blackberry, and wild indigo are desirable for the food and cover provided, and due to their low height, they compete minimally with adjacent crops for sunlight. Integrating trees and shrubs for quail management should balance landowner objectives for habitat and long-term income needs from farming. Additional benefits that result from alley cropping might be gained by incorporating a 30-foot field border of warm-season grasses and legumes that can provide nesting and brood-rearing cover. Or, in the case of alley cropping, when integrating rows of trees/shrubs place 15-feet of warm-season grass on either side of the tree/shrub row. This will create high diversity directly in the crop field. The benefit to having trees, shrubs and grasses intentionally incorporated adjacent to high energy crops has great potential to enhance habitats for bobwhite quail on your property.



Similarly, properly managed and arranged windbreaks can provide benefits for bobwhites. However, windbreaks that are spaced too far apart become isolated field borders. These isolated borders can create habitats that are linear and used by a variety of mammalian and avian predators during the year. Regardless of whether the open field contains row crops, grasses or livestock, the distance between windbreaks should be carefully considered and based on the conservation benefits that the windbreak is to provide. It would be most beneficial for quail if windbreaks are spaced as close together as possible. Then, the only difference from the alley cropping practice may be that the trees used are selected based on height and/or density that they will ultimately attain. By using

Top 12 Seeds and the Number needed to provide 60 kcalories of useable energy*.

Seed	No./oz.	Useable Energy (kcal/oz.)	Seeds needed each day
Corn	75	109	41
Soybean	188	109	103
Wheat	938	87	648
Grain sorghum	1,188	107	666
Common sunflower	2,000	103	1,160
Black locust	1,500	72	1,257
Hemp	1,719	71	1,448
Partridge pea	4,081	68	3,605
Western ragweed	7,188	110	3,923
Smooth sumac	4,288	42	6,152
German millet	13,750	98	8,396
Korean lespedeza	14,063	89	9,490

* approximate energy needed by bowwhite quail on a cold winter day.

Guthery, F.S. 2002. The Technology Of Bobwhite Management: The Theory Behind The Practice. Iowa State Press: www.iowastatepress.com.

multiple rows of quail-friendly trees, shrubs, and grasses, an effective windbreak can also become prime quail habitat, meeting needs associated with having cover and loafing areas near agronomic crops.

Much of the success or failure of a silvopasture practice to support quail hinges on the selection of methods that combine the silvopasture components (i.e., forages, shrubs and trees). When seeking to develop habitat suitable for quail on the same acreage that is grazed, the challenge is to understand the needs of both livestock and quail and design the plant mixture for use by the quail.

Tall fescue, which is a common pasture grass in Missouri, does not make good habitat for quail because it is a very aggressive grass that produces a dense, matted ground cover. It also out-competes other vegetation. Although tall fescue pastures can be improved by adding legumes, such as red clover and lespedeza, it is unlikely that those pastures will provide many benefits for bobwhites because the pastures lack the bare ground required for quail mobility.

For incorporation into a silvopasture practice, forages must be relatively shade tolerant. It should be noted that we are dealing with a practice that is not static in nature, the growth of trees (not so much in the case of shrub species) will change the amount of shade that exists over time and will influence forage growth on an area. It will therefore be necessary to monitor and adjust the density of trees so that equal parts shade and light are maintained.

The riparian forest buffer and forest farming practices are not as readily useful for quail habitat as alley cropping, windbreaks and silvopasture are. Bobwhites will utilize the woody edges that these practices create; however, quail do not use the areas with large expanses of mature forest that forest farming creates. Yet, the properly designed riparian buffers that contain zones of shrubs and warm-season grass in close proximity to crop fields or pastures can be extremely beneficial as nesting, brood-rearing and escape cover.



A new conservation practice, Habitat Buffers for Upland Birds or CP33, has been designed to help bobwhite quail recover from a dramatic population decline. The goal of this conservation practice is to create 250,000 acres of habitat for northern bobwhite quail by enhancing early successional grass buffers adjacent to agricultural field borders. Plants included in the Bobwhite Buffer program are a variety of native warm-season grasses, legumes, wildflowers, forbs, and some shrub plantings. You should check with your local USDA Natural Resource Conservation Service, Farm Service Agency, or State Conservation Department to determine if your land qualifies.

- ***Agroforestry Practices for Waterfowl***

It is unlikely that waterfowl will benefit greatly from either a silvopasture practice or a windbreak practice. Remember, two of the primary attractants for waterfowl are the presence of water and food. Alley cropping, forest riparian buffers and forest farming (in the right location and under proper management) can each be beneficial in creating or managing waterfowl habitat.

When alley cropping is applied using techniques such as rows of trees planted on raised beds, with cropping in between, it has great potential to enhance waterfowl habitat if flooded. The key will be timing and depth of flooding and availability of the crop to attract waterfowl species. Keep in mind that shallow water is fine. In general, you

only need 10 inches of water, and should not go deeper than 2 feet. If raised beds are not used, then the established rows of trees will need to be treated like a green tree reservoir. The points to remember are: no water until the tree is dormant and water off prior to bud break. Actively growing trees do not typically like wet feet (roots under water).

The bottomland forest can be managed as though it were a forest farming practice. Essentially, the broader riparian forest buffer or bottomland forests are managed to allow light to the forest floor. Sunlight is essential for the growth of plants, many of which waterfowl use for food. Because the two practices manage for appropriate levels of sunlight, they are useful for attracting water fowl. Thinnings reduce overall forest density. The level of thinning will vary by the plants you desire to grow. Most often, agronomic crops will require more sunlight than that needed to grow many seed-producing weed species. Thin to increase the growing room for quality trees, and also for sunlight that encourages the growth of new tree seedlings. With more room to grow, quality trees will more quickly increase in value. Additionally, trees that are free to grow will typically produce better nut and acorn crops.

- ***Agroforestry Practices for Mourning Dove***

There are primarily three agroforestry practices ideally suited for integration with cropped areas intended for mourning doves. The first practice is that of windbreaks, second is alley cropping, and the final is the forested riparian buffer. Each

offers a means to integrate trees and shrubs with farming practices, and thereby create or enhance roosting and resting areas in close proximity to food source areas.



All fields have a border. Sometimes these borders are grassy, other times they are filled with a multitude of unmanaged trees, shrubs and vines.

The more appropriate border, such as in the wind-break practice, is one that is managed. It may be used to create a sheltered field environment that, if properly spaced on the landscape, can also serve to break larger fields up into smaller units, or blocks. These blocks will allow only certain areas to be hunted in conjunction while other areas rest. Managed windbreaks can produce both excellent bird habitat, and at the same time be managed to produce a variety of wood products. Done correctly the windbreak around a dove field can create excellent locations to hunt.

The agroforestry practice of alley cropping can also be used to enhance a field's appeal to mourning doves. By establishing widely spaced rows of trees in existing crop fields, natural resting areas are produced. While these trees and shrubs can also be managed to produce various wood products that futuristically add to overall farm production, they enhance areas for dove hunting. By spacing rows 60 to 120 feet apart (or wider), doves have places to rest and view the field for waste grain. On fields larger than a couple of acres, this potentially translates to greater use of the field by the birds.

The final agroforestry practice that is appropriate for use with cropping practices is that of the riparian forested buffer. The forested buffer, when located adjacent to crop fields, can play a significant

role in reducing sedimentation and nutrient flow into stream waters. At the same time sound water conservation is being practiced, valuable wood products are growing and significant roosting and resting areas are provided. Doves need sources of surface water. By providing roosting sites adjacent to watering sources, you are more likely to retain a greater number of doves in a given area.

Doves will use fields of various sizes. However, for hunting safety, it is desirable to manage for larger fields of 20 to 60 acres in size. It is also wise to limit hunting pressure on any given field to about 2 days per week. Rest periods will give birds time to move back onto a field and settle into a habit of using that field again. Overuse can drive birds away.

When managing a dove field for hunting, it is extremely important to follow Federal regulations that pertain to baiting. Federal regulations specify that any practice not considered a “normal agricultural practice” is considered illegal, especially the top sowing of small grains without covering seeds. It is advisable to contact a Conservation Agent with the Missouri Department of Conservation concerning the legality of various management practices.

Reducing the Cost

Contact your local USDA Natural Resource Conservation Service (NRCS) or State Conservation Department to begin developing a plan for creating wildlife habitat that qualifies for cost-share and/or incentive payments.

Additional sources of information on various cost-sharing programs that can reduce the establishment and maintenance cost associated with agroforestry and other conservation plantings on the farm can be obtained at www.centerforagroforestry.org:

- Economic Budgeting Guide
- Funding Incentives for Agroforestry
- Tax Incentives for Agroforestry

Additional Resources

For additional information on managing for specific wildlife species contact the USDA NRCS, State Conservation Department, University Extension, and/or private groups such as Quail Unlimited, Quail Forever, Quality Deer Management Association, Pheasants Forever, North American Wild Turkey Federation and Ducks Unlimited.

White-tailed Deer

- Missouri Department of Conservation: Missouri Whitetails: A Management Guide For Landowners and Deer Enthusiasts. <http://mdc.mo.gov/nathis/mammals/deer/>
- Quality Deer Management Association. Quality Whitetails; <http://www.qdma.com/>
- University of Missouri Extension: Controlling Deer Damage in Missouri (MP685)
Quality Deer Management in Missouri (in press)
www.ces.purdue.edu/extmedia/FNR/FNR-194.pdf
www.ces.ncsu.edu/nreos/forest/pdf/www/www03.pdf

Wild Turkey

- Missouri Department of Conservation. The Wild Turkey in Missouri. www.mdc.mo.gov
- National Wild Turkey Federation

Bobwhite Quail

- Missouri Department of Conservation. On the Edge: A Guide For Managing Land For Bobwhite Quail. www.mdc.mo.gov/documents/landown/wild/quail/quail_guide.pdf
- Covey Headquarters Newsletter: www.coveyheadquarters.com
- University of Missouri Extension: Missouri Bobwhite Quail Habitat Appraisal Guide (MP 902)
<http://muextension.missouri.edu/explorepdf/miscpubs/mp0902.pdf>
 - Ecology of Northern Bobwhite Quail in Missouri (MU Guide G9431)
 - Habitat Management Practices for Bobwhite Quail (MU Guide G9432)
- Quail Unlimited: www.qu.org
- Quail Forever: www.quailforever.org/
- Guthery, F.S. 2000. On Bobwhites. College Station: Texas A&M University Press

Dove

- www.conservation.state.mo.us/nathis/birds/doves/
- www.ces.ncsu.edu/nreos/forest/pdf/www/www12.pdf
- www.agnr.umd.edu/MCE/Publications/PDFs/FS605.pdf

Waterfowl

- Missouri Department of Conservation: www.mdc.mo.gov
- www.conservation.state.mo.us/landown/wetland/wetmng/index.htm
- www.ducks.org/

General Habitat

- General Management for Wildlife. http://mdc.mo.gov/documents/landown/wild/wmml_2000.pdf

Lease Hunting

- University of Missouri Extension:
<http://muextension.missouri.edu/explorepdf/agguides/wildlife/G09420.pdf>

EXERCISE: AGROFORESTRY AND WILDLIFE

1. Rank the top three wildlife species that you would like to see more of on your property.

i. _____

ii. _____

iii. _____

2. What are the top three components of habitat needed by the top ranked wildlife species?

i. _____

ii. _____

iii. _____

3. What cost-share or incentive programs are available for the number one wildlife species?

i. _____

ii. _____

iii. _____

4. Do you have any major concerns related to integrating habitat with current farm practices?

5. Are there any conservation agencies or groups that could assist in designing integrated habitat that works with your current farming practices?

i. _____

ii. _____

iii. _____

EXERCISE KEY

Rank the top three wildlife species that you would like to see more of on your property.

- i. Quail
- ii. Turkey
- iii. Deer

2. What are the top three components of habitat needed by the top ranked wildlife species?

- i. Nesting Cover
- ii. Brood Rearing
- iii. Escape Cover

3. What cost-share or incentive programs are available for the number one wildlife species?

CP33

4. Do you have any major concerns related to integrating habitat with current farm practices?

Loss of income due to ground lost in habitat development. Weeds associated with the practices.
Loss of income from grain left along field edges.

5. Are there any conservation agencies or groups that could assist in designing integrated habitat that works with your current farming practices?

- i. Missouri Department of Conservation
- ii. NRCS
- iii. Quail Forever and Quail Unlimited

UMCA Research: Effects of agroforestry practices on wildlife species in major alluvial floodplains

Since 2003, UMCA has been supported by and managed three significant USDA - ARS programs, representing more than 50 individual projects. The Center seeks to develop the scientific basis for designing and prescribing agroforestry practices within a “systems context,” which allows technology to be used most effectively. To achieve this goal, our research efforts have been organized into eleven research “clusters” to enhance creativity and productivity among a range of investigators from many disciplines -- including the Forest Bottomland and Wildlife Restoration/biodiversity Research Cluster, from which a selection of research findings are included here.



Agroforestry plantings near remnant bottomland forests greatly enhance abundance and diversity of wildlife communities in large floodplains.

Project Team:

Mickey Heitmeyer, Principal Investigator; Shawn Papon, Shane Pruet, John Vradenburg and Adam Warwick (Graduate Students); Frank Thompson (U.S. Forest Service Co-Advisor and Cooperator)

This study is designed to understand the role agroforestry lands play in supporting wildlife

species and populations in large river floodplains. Specifically, the project is investigating the role of various types, sizes, and locations of forest patches in sustaining wildlife communities in the 100-year floodplain of the Mississippi River in southeast Missouri. Fifteen 4-square mile study sites were randomly selected to represent landscapes containing various amounts and types of forest, including agroforestry patches.*

Historically, these floodplains were mostly bottomland hardwood forests that supported rich biodiversity and abundance of fish and wildlife species. As these floodplains were cleared and drained for agriculture, wildlife populations have been reduced in abundance and distribution.

Agroforestry plantings in floodplains are attractive to landowners because they provide financially and ecologically beneficial options and alternatives to traditional intensive row crop production in flood-prone areas. These agroforestry sites also provide valuable resources to wildlife and provide recreational opportunities to landowners, the potential to reduce exotic agricultural pests and income through hunting and recreational leases.

To date, studies have been completed (or are near completion) on the distribution and abundance of 7 key wildlife species groups (amphibians, reptiles, songbirds, birds-of-prey, swamp rabbits, bats, waterbirds). Collectively, this is the largest and most comprehensive landscape-level study of wildlife communities and agroforestry plantings ever conducted on privately owned forest and agricultural lands in a major alluvial floodplain. Ongoing studies are investigating specific questions about nest success of forest birds in agroforestry sites in floodplains and how flood dynamics affect waterfowl use of

agroforestry areas over long periods.

Until this study, little was known about how the size, configuration, distribution and proximity of agroforestry patches affected resource values and wildlife species. By understanding these landscape ecology issues, future agroforestry plantings can be strategically placed to improve both tree production and wildlife benefits. Scientifically, understanding the values of agroforestry in floodplain ecosystems potentially offers great insight into how wildlife adapt and live in intensively farmed landscapes and how wildlife conservation efforts at many geographical scales can be most effective.

* Note: This is the habitat of the recently rediscovered Ivory Bill Woodpecker.

Wildlife Habitat Restoration: Reforesting Bottomland Crop Fields With Oak to Restore Wildlife Habitat

Project Team: Dan Dey (USFS), John Kabrick (USFS), Josh Millspaugh (MU)

Millions of acres of Missouri bottomland forests have been cleared for agricultural production, producing some of the state's most productive farmland. There are areas that are only marginal for agricultural production due to flooding, but these can still be very productive using agroforestry practices. This project provides landowners with methods to establish oak in floodplains to diversify native forests; combine timber, acorn production and the management of wildlife habitat for recreational operations; and restore waterfowl habitats using agroforestry practices.



Above: Redtop grass is an excellent cover crop for oak.
Right: Rabbit chewing damage to oak seedlings can be extensive if competing vegetation is not controlled.

Key Research Findings: Bottomland Oak Reforestation

- Oak can be established in former bottomland crop fields by planting large container grown oak seedlings with a cover crop of redtop grass, producing a 98 percent survival rate after 4 years.
- Rabbit damage, a major cause of regeneration failure, was greatly reduced in the redtop fields as the wildlife habitat became more open to rabbit predators (raptors).
- **Acorn production in large container seedlings of swamp white oak that were only 18 to 24 months old is phenomenal** compared to production in natural oak stands, which often do not produce acorn crops for 20 to 30 years. This is a major benefit to landowners who want acorn production for wildlife purposes, and it is important in providing a local seed source that makes possible natural regeneration of oak in the future.

Source: Dey, D.C. J. M. Kabrick, J. Grabner and M.A. Gold. 2003. Restoring Oaks in the Missouri River floodplain. IN: Proc. 29th Annual Hardwood Symp. Hardwood silviculture and sustainability: 2001 and beyond. May 17-19, 2001. French Lick, IN. National Hardwood Lumber Assoc. p. 8-20.

Notes

SECTION 9: MARKETING PRINCIPLES FOR AGROFORESTRY - AN INTRODUCTION

In this chapter:

- **Market Research Basics**
- **Conducting Market Research**
- **The Five Forces Model**
- **Developing a Marketing Plan**
- **Real World Examples**



A chestnut producer successfully markets his harvest at the annual Missouri Chestnut Roast.

One of the most beneficial aspects of agroforestry is the potential for a landowner to earn income from a wide range of alternative products. The key to earning income from agroforestry practices is understanding what products to sell and how to successfully sell those products, in other words, understanding the “ins and outs” of marketing.

Marketing is more than just letting a buyer know that you have a product to sell; it is a process that requires planning, research, and creativity.

Marketing is defined as:

The process of planning and implementing a strategy that includes everything from idea development, pricing, promotion, and distribution of what you are offering, right through to the exchange of your product for money.

In most cases, marketing begins before production. It’s best to have a strategy in mind before you have a product to sell. For many landowners, marketing may seem to be outside their area of expertise. However, there are some very basic steps to help simplify the process.

Marketing Agroforestry Products:

Step 1: Market Research - Identifying the “Who, What, When, and Where”

Step 2: Market Research – Identifying the “How and Why”

Step 3: Developing a Marketing Plan

Step 4: Implementing the Plan

Step 5: Reevaluating Your Plan – Learning from Experience

Step 1: Market Research Identifying the “Who, What, When, and Where”

The starting point for all marketing research is identifying what products you can sell and determining who the potential consumers of those products would be. The potential for marketable products from an agroforestry practice can be numerous; however, it may be beneficial for a land

owner just starting out to identify a few products that seem to provide the best market potential. Visiting retail markets such as a farmer’s market, craft store, or even browsing the internet, may provide some ideas about potential products. For example, you may find a craft store selling woody stems for use in floral arrangements, or various types of nuts and berries being sold at a farmer’s market.

Identifying what products are currently being marketed can provide ideas about what products you may want to market and who your potential customers may be. Seeing what is currently being marketed and how it is marketed may also provide ideas on how you can better meet the needs of your potential customers or how you may be able to differentiate your products from other similar products.

Besides retail markets, products can be sold into wholesale markets. Restaurants, floral shops, and secondary manufacturers purchase products that they can use in the production of other marketable products. As an example, shiitake mushrooms are often sold to restaurants as ingredients for items on their menus. Similarly, woody stems are often sold wholesale to floral shops for use in floral arrangements.

In identifying the “who” and the “what”, you should try to answer the following questions:

- **What products are currently being sold?**
Be sure and identify all products and variations of products that are similar to what you may be interested in selling. For example, if you are considering selling walnuts, be sure to take note of any products that are using walnut as an ingredient, such as ice cream and candies; as well as all forms of walnut, such as in the shell, walnut nutmeats, and walnut in mixed nuts.
- **Who buys them?** The consumer may be a specific demographic category (such as age group or ethnic group) or industry segment (such as restaurants or floral shops) or be diverse in nature. Brokers and other types of

buyers who operate in markets to help coordinate product flow may also be potential customers for your products.

In conducting this first step, you should also take note of any “seasonal” aspects of potential products. For example, pine boughs typically sell during the Christmas season. Likewise, some products may have a short “shelf life”. For example, fruit crops will only stay fresh for a short period of time, their form must be modified (such as made into jelly or frozen) in order to extend the marketing period. Perishability and seasonality are two major factors that affect when a product is marketed.

Finally, identifying where a product is sold may provide valuable insight into how the current producers reach their intended customer base. Fruit sold at farmer’s markets is expected to reach a certain target market of customers that not only enjoy fresh fruit but also enjoy the rural atmosphere that a farmer’s market provides. This same customer base may also value other products that add to their “rural” perception.

In this first step, your research should provide a broad analysis about the potential markets and customers. This process should give you some idea of the possibilities but not be so narrowly focused that additional opportunities are overlooked.

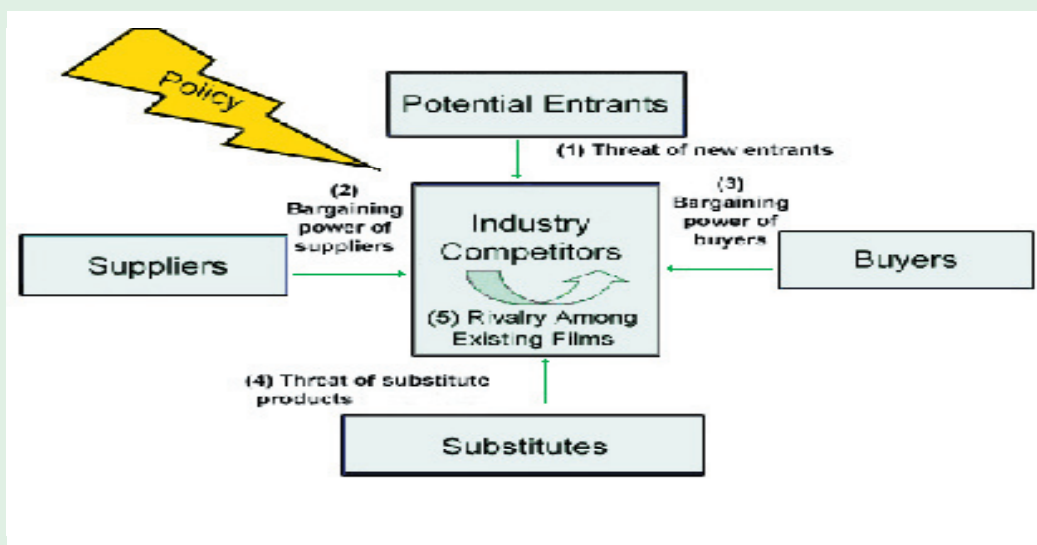


Curly willow can be a profitable crop when sold to local florists. It can be planted in several agroforestry practices, including riparian forest buffers.

Five Areas of Market Coordination and Control: The Five Forces Model

- 1. Barriers to entry** - such as high start-up costs or proprietary knowledge may prevent you or potential competitors from entering the market. On the other hand, a market may not have apparent barriers and the number of potential competitors may be substantial.
- 2. Bargaining power of suppliers** – for some products, for example ginseng, there may be only a few sources of inputs needed to produce a product. Following the ginseng example, there are only a few sources for ginseng seed. This may increase your cost of production or it may limit the availability of the seed.
- 3. Bargaining power of buyers** – in some markets, a low number of high-volume buyers may exist. As a result, the buyer may impose specific requirements on the quality and quantity of products that they buy. These requirements may be difficult for you to meet or they may impose additional costs that you must pay in order to sell your products.
- 4. Threat of substitute products** – the potential for substitute products will impose price restrictions on your products. Close substitutes will have a greater impact on the market for your product. For example, if you are selling Missouri native pecans at a premium, consumers who do not distinguish Missouri native pecans from Georgia or Texas pecans will most likely purchase the non-native pecans if they are offered at a lower price. Therefore, unless you can clearly distinguish your product from all others, your market price will be determined by the price of your closest substitute.
- 5. Rivalry among existing firms** – a market for a particular product may have numerous market participants with a high level of competition between those participants. It would not be advantageous to enter this type of market unless you possess a clear competitive advantage over all the other participants. However, some markets may have a small number of market participants and a high degree of cooperation may exist between those participants. As an example, the elk market in Missouri has a small number of growers who assist each other in marketing elk meat products. The growers have joined together to form the Missouri Elk Farmer’s Association. Analysis of existing firms includes evaluating the way they do business to see what they do right and what they do wrong and understanding trends within the industry.

A sixth force, **governmental policies**, is added to the FFM because of its influence on all of the other forces. Governmental policies and standards can influence many aspects of a market. For example, jams and jellies made from berries and fruit grown in an agroforestry practice will have to meet standards set by the Food and Drug Administration before they can be publicly sold. Some governmental policies act as barriers to entry, such as the ban on harvesting wild ginseng on public property. As a result of this ban, only cultivated (wild simulated, woods cultivated, or commercially cultivated) ginseng can be sold. Other governmental policies open the door to new markets; such is the case with the USDA’s organic labeling standards which opened the door for the marketing of niche organic products.



Step 2: Market Research – Identifying the “how and why”

Once you have an idea of the possible products, customers, seasonal variations, and market locations, a more in-depth study of the market needs to be conducted. During this step a competitive analysis is conducted to open the “black box” and shine light on the current market to see how the market functions and why it functions as it does. Several methods can be used to study a market; however, the Five Forces Model (developed by Dr. Michael Porter of Harvard University) serves as a good framework for examining competition that transcends industries, particular technologies, or management approaches. The underlying fundamentals of competition go beyond the specific ways market participants go about competing.

The Five Forces Model identifies coordination and control aspects of a market and provides a guideline for understanding the resources and relationships needed to be successful in a market. The model looks at five areas of market coordination and control.



A variety of specialty products can be harvested and marketed from agroforestry practices, including syrups, dried mushrooms, baking mixes made with nuts, medicinal herbs and decorative florals.

Gathering information to analyze these market forces can be as simple as talking to current market participants, browsing the web, contact-

ing your local university extension person, or subscribing to a trade journal. On the other hand, gathering some of this information may be quite difficult; for example, you may have to conduct surveys or attend conferences and trade-shows which may be a substantial out-of-pocket expense. However, the greater your understanding of the market, the greater your success.

Understanding Forces that Influence Markets: Sources of Information

- **Primary information sources:**

Personal interviews with consumers, producers, and other person’s involved in the value chain. Observations (visiting farmer’s markets, retail outlets, production facilities, as well as attending farmer field days, trade shows, and marketing conferences).

- **Secondary information sources:**

Published reports and studies; online information sources, such as websites, newsgroups, and electronic bulletin boards. Trade magazines and journals, newspapers, books and literature from competitors. Business directories.

This list is not complete but should give you an idea of some potential sources for market information that will help with analyzing the forces affecting the market for whatever product you may be interested in selling.

Analysis of the five market forces and governmental policies can be useful in understanding how a market works and why it works a certain way. Knowing this information can help prevent you from making costly mistakes starting out and aid in the development of a good marketing strategy for your products.

Step 3: Developing a Marketing Plan

Once you have done your market research homework you should have some idea about what you want to market, how you want to market it, and who you want to market it to. From this formation you can begin to develop a marketing plan. A marketing plan identifies your marketing goals and objectives, lays out a strategy for

distinguishing your product from all others, and provides benchmarks to measure your success or failure.

Developing a Marketing Plan

- 1) *Synopsis of Current Market Situation*
- 2) *Define Objectives and Goals*
- 3) *Build a Marketing Strategy*
- 4) *Build a Promotion Strategy*
- 5) *Set an Action Plan*

1) *Synopsis of Current Market Situation:*

A good marketing plan begins with a good synopsis of the current marketing situation and information about competitors, business trends and policy implications. This synopsis allows you to clearly describe the market that you are preparing to enter.

2) *Define Objectives and Goals:*

After describing the market, you should clearly define your objectives and goals. Your objectives may be to earn a specific level of income or to develop a solid customer base. In either case, your objectives and goals should be challenging but attainable.

3) *Build a Marketing Strategy:*

Next, a marketing plan will lay out a detailed marketing strategy, including your marketing mix. A marketing mix is simply the 4 “P’s”; **price, product, promotion, and place**. This strategy, which is derived from your market research, will be the road map for meeting your marketing objectives. Pricing strategy can be based on your specific costs or the customer’s willingness to pay (market price). Product strategy can include determining the form in which you intend to sell your product, for example you may choose to sell berries fresh or with some level of value added, such as in a jelly. Product strategy also includes packaging, branding, level of quality and any other method for distinguishing your product from all others. Place strategy is determining where the product and customer will meet. You may choose to sell only at farmer’s markets or you may try to get

your product into as many retail establishments as possible.

4) *Build a Promotion Strategy:*

A promotion strategy describes how you intend to inform the customer about your product. Personal propaganda (creating your own brochures, newsletters, and fliers), promotional activities (coupons, give-aways, trade show involvement), and advertising (billboards, newspaper ads, direct mailings) are all methods of informing the public about your product.

5) *Set an Action Plan:*

The last step in developing a marketing plan is to set specific action plans (timelines), budgets, and measurements to identify your progress throughout the marketing plan.

Overall, the marketing plan should help you put the ideas that you develop from the market research steps into a practical, achievable proposal. This plan is just the starting point and will most likely change with experience and time. However, it establishes the direction for exchanging products for income.



Step 4: Implementing the plan

This step is self explanatory; however, this may be

the most difficult step. Just like rappelling, this is the point where you take the first step off the edge of the cliff. As you successfully reach your goals and objectives you will become more comfortable with your marketing plan and your marketing skills.

Step 5: Reevaluating Your Plan – Learning from Experience

Marketing does not end once your product reaches the customer. As you become a participant in the market you may experience aspects of the market that you didn’t realize as you were conducting

your market research. A marketing plan is flexible and may change over time. New opportunities may arise as you become familiar with your markets and consumer preferences may change over time.

Real World Example - Ben's Black Walnuts:

Marketing the Eastern Black Walnut

Ben's Black Walnuts, a small eastern black walnut nutmeat producer located in Iowa, provides an excellent example of strategies for success in the eastern black walnut nutmeat market. Bill and Geri Hanson, owners of Ben's Black Walnuts, successfully linked their unique abilities with an untapped market niche to provide quality black walnut nutmeat.

Step 1: Understanding the "Who, What, When, and Where"

Eastern black walnut (*Juglans nigra L.*) markets are often categorized with other nut markets, such as pecan or English walnut. However, eastern black walnuts are a unique product for many reasons. First, historically there has been only one major processor of nut meat, Hammon's Products Company. Hammon's is located in southwest Missouri, but has contract buyers and hullers located in numerous locations throughout the Midwest. The going market price for black walnuts delivered to these contract buyers and hullers ranges from \$0.10 to \$0.13 per pound. Supply is collected 99% from the wild; there are no large producers using improved cultivated varieties. Producers who are growing improved cultivars have the option of selling directly to Hammon's at a higher price; however, those improved cultivars must be delivered to the processing plant in Stockton, Mo.

Second, the market demand for eastern black walnut nutmeats is small compared to the demand for pecans or other popular nut meats. Black walnut nutmeats are used in ice cream, baking, and candies. However, due to the strong flavor associated with the wild crop, the demand for black walnut nutmeats as a stand alone "snack" is small.

Step 2: Understanding the "How and Why"

Currently, the black walnut market is not structured in a way that allows for segregation of improved cultivars. Hammon's processing requires large quantities of nuts in order to meet their current demands in the ice cream and nutmeat markets. Due to the fact that there are very few plantations of improved cultivars and it may take up to 15 years for a plantation of improved cultivars to reach full production, Hammon's has to rely on the wild nut crop.

Understanding these characteristics and analyzing them from the perspective of the Five Forces reveals a market that currently cannot be approached using the same strategy as in a pecan or English walnut market.

Step 3: Developing a marketing plan

Based on their analysis of the current market for black walnut, the Hanson's developed a marketing plan that emphasized their personal goals, expertise, and passion for black walnut to create a niche market for quality black walnut nutmeats. The Hanson's strategies were to grow their own improved black walnut cultivars; process those nuts on the farm; and sell them directly to retail stores within a close radius of the farm. By controlling the process from the tree to the store, they are able to maintain a higher quality product and capture a larger profit for themselves.

Step 4: Implementing the plan

The Hanson's started planting black walnut trees in 1984 on 10 acres. Since then they have expanded to nearly 18 acres of grafted black walnut trees. Instead of looking to the existing market for nuts which was controlled by Hammon's Products Company, the Hanson's began developing the machinery and equipment needed to process nutmeats.

By modifying equipment designed for other uses, such as a huller/washer that was designed for English walnut, the Hanson's developed a completely vertically integrated production system. Through direct marketing to local grocery stores and other retail outlets, nearly 2000 pounds of nutmeats are sold annually, grossing nearly \$12,000.

Step 5: Reevaluating the plan

Ben's Black Walnuts are successful because of several reasons. First, the Hanson's control the supply and quality of the nut crop by owning their own grafted trees. Yield and quality from their black walnut plantation is predictable. The Hanson's continually work to improve the cultivars that they grow in order to extend the harvest season and improve cracking and nutmeat qualities.

Second, direct marketing to local retail outlets has helped link a person with a product (a face with a place). In other words, Ben's Black Walnuts are not just a product that comes from some distant processor; it is a product that comes from Bill and Geri Hanson. The Hanson's have developed a trust relationship with the retailer and consumer through their personal involvement with those market participants.

Finally, the scale of the operation is designed for the labor and inputs available. The Hanson's operation is designed to handle no more than 10,000 pounds of nuts per year. They currently have enough trees planted to reach this capacity. Labor, the constraining factor in the production system, is provided by Bill and Geri.

While the eastern black walnut market is still faced with a single large buyer, low commodity prices, and wild nuts of variable quality, Ben's Black Walnuts has carved out a niche. Focusing on quality, adding a personal marketing touch, vertical integration and capturing the full value chain, the Hanson's have recognized market forces and developed successful strategies.

Real World Example— Oak Leaf Wood and Supplies “Your Trash is My Cash”



Paul Easley, Moweaqua, Ill., has established a successful business during the past 18 years, utilizing a portable sawmill and a dehumidification dry kiln.

Paul and Kathy Easley have a “stump to store” niche market wood manufacturing business in central Illinois. At its outset 18 years ago, the Easleys’ hardwood business cut exactly what the customer wanted, including fence boards, bridge decking and hog farrowing crates. At the same time, the Easleys began their own primary market research to study the competition by touring numerous hardwood facilities in adjoining states. The entrepreneurs also studied everything these facilities *weren’t* doing, learning they weren’t involved in niche markets, such as the production of bowl, gun stock, pen or flute blanks. After making these market discoveries and focusing on these market opportunities, the Easleys moved their business in a new direction from its original markets.

Paul’s experience with wood enabled him to recognize that highly figured wood products can be sawn from less than perfect logs. Today, he and Kathy saw up the lumber, then run the trees through their sawmill kiln and surfacing operation. They also have their own hardwood retail store (established 1990) in downtown Moweaqua, Ill.

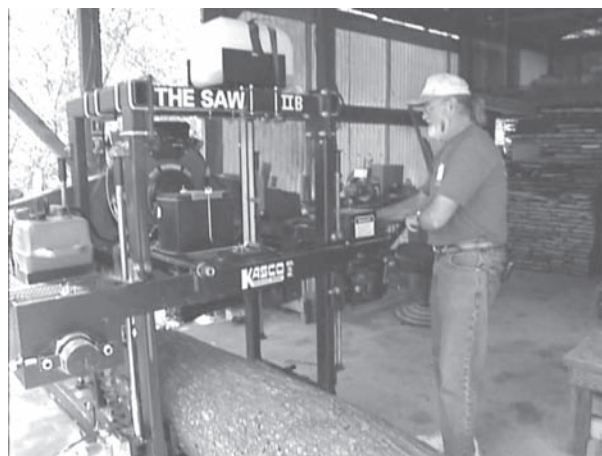
The Easleys maintain a competitive advantage in several ways. First, they have a very low raw material (supply) cost. Tree services bring wood to the business instead of paying landfill dumping fees. Nearly 80% of his product consists of wood that would otherwise have been deposited into landfills, with the remaining 20% coming from their own farm.

Second, their knowledge and ability to turn “junk wood” into high value blanks helps maintain an edge on the competition. Crotch material, from logs often left behind in the woods after timber harvest, contains feathered (figured) grain. By proper slicing, Paul puts the feathered grain into the wood blanks and increases their value as much as 10 fold. He also adds value by using everything -- for example, the pen blank is a byproduct that normally gets burned or thrown away as edging waste. Blanks are put back through the edger to create their shape (¾ of an inch square, and 6 inches long), then put through a chop saw table 6 at a time. Pen blanks alone add up to \$10,000 per year.

Oak Leaf Wood and Supplies combines vision and experience with patience, taking the time to cut the wood to maximize its value. The business puts the needs of the customers, crafters and other high-end users at the center of activity. Recognizing that there are many different facets to wood-working and many market niches to be filled, the Easleys do not actually make any finished products in the retail business. The products they manufacture and sell include cabinet grade stock, carving stock and ballpoint pen blanks. The retail business handles approximately one hundred species of wood.

Paul attributes part of the business success to his involvement in a variety of related activities. He sawmills because people can see for themselves how they benefit his successful entrepreneurship efforts. Because demand for Oak Leaf Wood and Supplies products grew faster than the Easleys’

ability to supply their customers, Paul networks with 25 sawmills in a 50-mile radius of his facility, buying the product that his sawmill customers make and selling it in his retail outlet.



Using a band sawmill, Paul processes wood others might consider trash into value-added products on his farm.

The Easleys’ market area includes the entire United States and seven foreign countries. They attribute this to tremendous high-quality, free publicity, and making a product that people wanted.

“Publicity is free, while advertising costs a lot of money,” said Paul. “Good publicity is easy to do. If you are doing things that are unique and different than everybody else, if you’re having a good time at what you do, tell people about it, and there will be magazines writing articles about you and your business.”

The Easleys’ business has been featured in close to one hundred magazines. Paul does not have a web site, nor does he want one. “We are so busy doing what we do that there is no room to do anything else.

“Keep it small, keep it simple, and don’t buy any more equipment than it takes to get the job done,” suggests Easley. “Then go to work, do the job with a smile on your face and be enthusiastic about your product. If you’re willing to do that, and talk with your customer, you can succeed. We’re living proof.”

Taste of the Kingdom: Value-Added Nut Products



Taste of the Kingdom sauces, jellies and condiments made with Missouri black walnuts, pecans and chestnuts are one of the most popular vendors at the annual Missouri Chestnut roast.

Simply stated, UMCA strives to maintain the success of the family farm and to preserve Missouri's unique and diverse natural resources. This mission is best expressed through the testimonial of landowners and agricultural producers impacted by the Center's activities, like the annual Missouri Chestnut Roast. The Chestnut Roast is quickly becoming one of Missouri's premier agricultural education and outreach events, drawing a crowd of more than 3,000 each year to the Horticulture and Agroforestry Research Center at New Franklin, Mo., to learn about the opportunities agroforestry provides.

Julie Price, CEO of Taste of the Kingdom Missouri-made food products, participated in the Missouri Chestnut Roast during its inaugural event in 2003, incorporating chestnuts into her product line for the first time, and again in 2004 and 2005. Each year, Taste of the Kingdom has sold out of its nut-themed specialty sauces and jellies before the end of the Chestnut Roast event.

Mrs. Price writes:

“In continuing our mission of supporting Missouri niche agriculture through the production and sale of value-added, all natural, kosher certified products, we began work with the MU Center for Agroforestry in February to develop new value-added products using chestnuts.

*Chestnuts began dropping only two weeks ago, which created a tight time line for manufacturing, but the pressure was justified by the consumer response. We were confident our new fruit line (using Missouri grown produce, of course) would sell, but we **had no idea there would be so much interest in chestnuts!***

Not only did our four chestnut sauces sell, but people wanted to buy our display chestnuts as well! We received absolutely no negative reactions to the new concept of chestnuts as a sauce ingredient, but rather were confronted with a myriad of questions (e.g. what is a chestnut?) which opened the door to educate the public on chestnuts as a new Missouri niche crop.”

Credit: the "Forest Landowner's Guide to Evaluating and Choosing a Natural Resource-Based Enterprise," published by the Natural Resource, Agriculture, and Engineering Service (NRAES-151) Cooperative Extension program, based at Cornell University, Ithaca, New York.

MARKETING EXAMPLES FOR FORESTRY, AGROFORESTRY AND NATURAL RESOURCES

Enterprise	Retail or direct market	Wholesale market	Niche market
Firewood	Delivery to homeowner; roadside piles for campers	Broker, garden center, landscape contractors	Convenience store bundles; custom cut/split; select species
Fence posts and/or rails (Black Locust, Cedar or Osage Orange Hedge)	Homeowners	Landscape contractors, garden stores	Nature stores
Wood chips for cooking and smoking (hickory, apple, maple)	Homeowners and businesses	Convenience stores	Fairs and festivals
High-value sawtimber and veneer	-	Sawmills through traditional sale process	Sell harvested logs directly from log deck to buyers; sell to the export market
Custom sawmilling	Craft artisans, hobbyists	Other sawmills	Cut lumber at landowner's property
Drying lumber	Craft artisans, hobbyists, cabinetmakers	Local lumber store, chain stores, planning mill	Unique species or products such as crotch wood, matching panels
Value-added wood products (hardwood and grapevine baskets, bowls, kitchen utensils, and other value-added products)	Craft fair, tourist sites, Internet and catalog sales	Broker	Custom-shaped and custom-sized baskets; gift baskets
Christmas trees	Choose-and cut or parking lot trees	Garden stores; nonprofit organizations that sell trees for fundraising	Super large trees, tabletop trees, and select species; combine with sleigh ride and other activities or onsite sales
Holiday greenery (wreaths and roping from pine trees and grapevines)	Choose-and-cut parking lot sales	Broker; nonprofit organizations that sell greenery for fundraising	Decorated greenery at holiday crafts fair
Native vegetation collection for floral and food markets on a sustainable basis (moss, ferns, colored twigs, mushrooms, ramps, etc.)	Florist shops, craft artisans, fairs	Brokers for floral markets and edibles, stores, restaurants	-

MARKETING EXAMPLES FOR FORESTRY, AGROFORESTRY AND NATURAL RESOURCES (cont.)

Shiitake, oyster, and other mushrooms	Farmers market	Broker, specialty stores, restaurants	Dried mushrooms and other unique products
Ginseng / Goldenseal	-	Broker	Ginseng jams or other products at specialty stores
Walnut, pecan, hazelnut, or other nut production	Farmers market, Internet or catalog sales	Broker	Specialty stores
Recreational natural resource events (forestry, logging, heritage, wildlife, maple syrup festivals or field days; forestry skill competitions)	Individuals, organizations, and groups	-	Combine with value-added forestry products and many other unique offerings
Hunting lease	Hunting clubs and groups	Forester or other outlets to act as your broker	Combining hunting lease with cabin rentals
Vacation cabin	Individuals, families, hunt clubs	Broker	Combine with fee hunting, campground or other recreational access enterprises
Recreational trails (bird watching, hiking, cross-country skiing, horseback riding)	Individuals, nature and conservation groups, church and school groups	Broker	Special arrangements
Hayride/sleigh ride / bonfire combinations	Individuals, nature and conservation groups, church and school groups	Broker	Special holiday programs and promotions (e.g. Halloween, Thanksgiving, Christmas)
Nature-based bed and breakfast	Individuals, couples, small groups	Broker	Special program offerings
All-terrain-vehicle (ATV) and mountain-biking access	Individuals, groups	Broker	Special races, events, and promotions
Hay	Farmers, small-farm owners, horse owners	Auction	Special hay mixes for specific livestock
Vegetables	Farmers markets, roadside stands, pick-your-own, CSAs*	Broker, auction, cooperative, restaurants	Ethnic markets, organic

MARKETING EXAMPLES FOR FORESTRY, AGROFORESTRY AND NATURAL RESOURCES (cont.)

Field crops (corn, soybeans, small grains, etc.)	Livestock farmers	Elevator, cooperative	Popcorn, edible soybeans, fuel for heating stove, organic
Wine and table grapes	Farmers markets, CSAs*	Stores, wineries, restaurants	Organic, special and heirloom varieties for wineries
Bramble fruit crops (raspberries, blackberries, currants, gooseberries)	Farmers markets, roadside stands, pick-your-own, CSAs*	Stores	Organic, heirloom varieties
Fruit trees (apples, pears, peaches, etc.)	Farmers markets, roadside stands, pick-your-own, CSAs*	Broker, stores, restaurants	Unique and heirloom varieties and species, special sizes and quality
Honey	Individuals, roadside stands, farmers markets	Stores, restaurants, cooperative	Organic, honeycomb
Sheep and goats (milk, meat and fiber)	Farmers, 4-H groups, and other individuals and groups	Auction	Ethnic meat markets, organic markets
Exotic livestock (emu, fallow deer, ostrich, etc.)	Farmers, 4-H groups, and other individuals and groups	Auction	Ethnic meat markets, restaurants
Value-added food processing (slaughterhouse, bakery, canning, microdairy processing)	Farmers markets, roadside stands, fairs and festivals	Specialty stores, restaurants, broker	Organic, specialty products
Herbs (Echinacea, basil, etc.)	Farmers markets, roadside stands	Broker, stores, restaurants,	Organic, medicinal, special product combinations, heirloom varieties
Native plant nursery	Homeowners, local businesses	Landscape contractors doing residential and restoration work, garden centers	Specific in-demand species that are difficult to grow
Greenhouse	Homeowners, local businesses	Garden centers, brokers	Specialty plants for a specific market
Recreational agriculture (harvest festivals, corn mazes, petting zoos)	Individuals, organizations and groups	-	Combine with value-added, roadside stand, and many other unique offerings

* CSA indicates community-supported agriculture

Additional Resources

Online Marketing Resources:

- <http://ohioline.osu.edu/ae-fact/0008.html> - Direct Marketing as a Value-Added Opportunity for Agriculture, Ohio State University Fact Sheet
- <http://www.sfp.forprod.vt.edu> – Non-Timber Forest Products, The Center for Forest Products Marketing and Management, Virginia Polytechnic Institute and State University, and The Southern Research Station, USDA Forest Service, Blacksburg, Virginia
- <http://specialforestproducts.com/woods/> - Goods from the Woods, Giziibii Resource Conservation & Development Association.
- <http://www.ibiblio.org/pfaf/database/commonM.html> - Plants For A Future Database, Plants for a Future, Blagdon Cross Plant Research and Demonstration Gardens, Ashwater, Beaworthy, Devon, EX21 5DF, England
- <http://www.ces.ncsu.edu/chatham/ag/SustAg/marketing.html> - Growing Small Farms, North Carolina Cooperative Extension.

EXERCISE: REVIEW OF MARKETING

1. There were several sources of primary information listed in this section. List five primary sources of information that were not mentioned.

2. According to Michael Porter, there are five forces that influence how an industry or a business is structured. What are they?

3. How does governmental policy affect markets?

4. What are the five steps to marketing agroforestry products?

EXERCISE KEY

1. There were several sources of primary information listed in this section. List five primary sources of information that were not mentioned.

(No specific answer, this is a thinking question.)

2. According to Michael Porter, there are five forces that influence how an industry or a business is structured. What are they?

1) Barriers to entry, 2) bargaining power of suppliers, 3) bargaining power of buyers, 4) threat of substitute products, and 5) rivalry among existing firms.

3. How does governmental policy affect markets?

Governmental policies can influence numerous aspects of a market. For example, there are policies established for certain products that influence or set trade and quality standards. They also can influence production by controlling inputs, limiting harvesting, or banning certain forms of production. Ginseng is a good example of how the governmental policy banning wild harvesting on public lands can have a positive price impact for landowners who are growing ginseng in a wild simulated method on their land.

4. What are the five steps to marketing agroforestry products?

- a) Step 1: Market research: Identifying the "who, what, when, and where"
- b) Step 2: Market research: Identifying the "how and why"
- c) Step 3: Developing a marketing plan
- d) Step 4: Implementing the plan
- e) Step 5: Reevaluating your plan - Learning from experience

EXERCISE: What Am I Selling, Anyway?

In 50 words or less, describe each product or service that you will sell and what benefits it offers to the user. Why is your product better than the competition's?

If you are considering more than one enterprise, explain how the enterprises will work together.

Demands for products or services

Describe the current demand for your product or service.

Describe what the demand for your product or service will be three years from now.

List the sources of information on which you based your answers above and the date of each source (e.g. date of publication, date you acquired the information).

Charging for services

What price are you planning to charge for your product or service?

What price are you planning to charge for your product or service three years from now?

EXERCISE: What Am I Selling, Anyway? (cont.)

List the sources of information on which you based your answers above and the date of each source.

Potential buyers

Describe who your current potential buyers are.

Describe who your buyers will be three years from now.

List the sources of information on which you based your answers above and the date of each source.

Other

Describe your ideas for promoting your enterprise.

Record other marketing notes (whom to talk to, questions, ideas, etc).

EXERCISE: Marketing Options For A _____ Enterprise

Describe your marketing options for the enterprise	PROS	CONS
Option 1:		
Option 2:		
Option 3:		
Others:		

Example EXERCISE: Marketing options for a *Fee-Fishing* Enterprise

Describe your marketing options for the enterprise	PROS	CONS
Option 1: <i>Advertise in the local paper, radio station</i>	<i>Large local audience</i>	<i>Paper expensive but radio cheaper; need phone or website support for follow-up</i>
Option 2: <i>Word-of-mouth</i>	<i>Inexpensive; conveys good reputation of business to other potential customers</i>	<i>Takes time to develop new customers from word-of-mouth</i>
Option 3: <i>Brochure in tourism outlets</i>	<i>Good exposure to local people and visitors if in right places; allows promotion of business strengths; coupons and incentives</i>	<i>Can be costly, needs good exposure at proper outlets to catch people's attention</i>
Others: 1. <i>Sign at road</i> 2. <i>Ad on state tourism website</i>	1. <i>Informs people passing by of business</i> 2. <i>Reaches large audience</i>	1. <i>Sign can be costly, little impact for attracting passerby in remote areas; need phone or website for follow-up</i> 2. <i>Expensive?; need phone or website for follow-up</i>

EXERCISE: Who Is My Target Market?

Use whatever resources you can to determine the following information about your target market.

Market demographics. (Ethnic groups, age groups, average income, place of residence or work, number of children, marital status, education level, religion, etc.) _____

Customer lifestyle patterns. (Common interests, beliefs, values, wants and needs) _____

Customer expectations. (What buyers want and expect from your product or service) _____

Local resources for reaching the target market. Use specific company names and contacts if possible.

Farmers markets, roadside stands, field days, fairs _____

Wholesalers, brokers, distributors _____

Marketing cooperatives, food cooperatives _____

Restaurants, groceries, supermarkets, specialty stores _____

EXERCISE: Who Is My Target Market? (cont.)

Cooperative extension, local or state tourism agencies, and county and state economic development agencies _____

Fish and wildlife agency, wildlife consultants _____

State foresters, private foresters, forest product companies _____

Sportsman clubs, forest associations, farm bureaus, other associations _____

Yellow pages, newspapers, magazines, trade journals, fliers, inserts, Internet websites, list servers

EXERCISE: Who Are My Competitors?

1. *List the names and addresses of your direct competitors.*
 - A.
 - B.
 - C.

2. *Describe the price and quality of your competitors' products or services*
 - A.
 - B.
 - C.

3. *According to your observations and experience, try to estimate how much market demand for your product or service your competitors satisfy. Answer in terms of gross number of products sold or services rendered yearly. If you are unable to estimate this information, you may have to do some research to find the answers. It is critical that you have this information before you proceed with your enterprise.*
 - A.
 - B.
 - C.

4. *Describe the type of buyers your competitors target.*
 - A.
 - B.
 - C.

5. *Describe the strengths of your competitors' products or services.*
 - A.
 - B.
 - C.

6. *Describe the weaknesses of your competitors' products or services.*
 - A.
 - B.
 - C.

7. *Describe your indirect competition. (List the products or services along with the individuals or companies offering them. Also describe how you will deal with your indirect competition).*

EXERCISE: What Are My Legal, Regulatory and Liability Issues?

1. *Have you determined whether the enterprise will be allowed under existing federal, state and local regulations for zoning and other uses? How do you obtain the necessary permits and what do they cost? How likely are you to get approval of the necessary permits?*

2. *Have you considered the laws that apply to sales tax collection in your state? Does the way you plan to charge for the product or service meet the legal requirements for collecting taxes?*

3. *Do you know how to set up the enterprise to minimize the risk of liability (for example, if someone gets hurt)? Taking steps to minimize risk is known as risk management. Insurance agents can often advise you about ways you can reduce risk; reducing risk may be a requirement of insurance coverage.*

4. *Do you need special insurance and is it affordable? From which insurance company can it be purchased?*

5. *Have you contacted a lawyer to check on all necessary contracts and agreements?*

6. *List other problems and concerns related to legal, regulatory, or liability issues and how you will handle them.*

Notes

Notes

SECTION 10: Economic Considerations

In this chapter:

- **Agroforestry Budgeting**
- **Agroforestry Costs**
- **Revenues**
- **Funding Incentives for Agroforestry**

Agroforestry Economics Overview

This section is a brief overview of the resources and information found in the detailed Agroforestry in Action guides produced by the Center for Agroforestry. These guides are included in the Appendix of this Training Manual:

- *Economic Budgeting for Agroforestry Practices*
- *Tax Considerations for the Establishment of Agroforestry Practices*
- *Funding Incentives for Agroforestry in Missouri*

Agroforestry should not be thought of as a set of practices that take land out of production. Instead, agroforestry is a set of practices that responsibly weaves together production and stewardship. There are many economic benefits to incorporating agroforestry practices into agricultural landscapes. The five practices of agroforestry provide opportunities for generating income from a wide array of alternative products, ranging from edible nut and berry crops to diverse woody floral crops.

Monitoring the economic costs and benefits from an agroforestry practice is essential for analyzing its economic success or failure. Economic budgeting provides a method for systematically tracking costs and revenues that are incurred on any productive enterprise.

For most agroforestry practices, there are numerous incentive programs available that can help offset establishment costs. Federal income tax laws can also provide incentives in the form of increased deductions from taxable income and lower tax rates on certain types of income. This section will briefly discuss agroforestry from an economic perspective.

Budgeting, funding incentives, and tax incentives are three of the most important economic considerations when analyzing an agroforestry practice. Even if the goals of the landowner do not include managing the agroforestry practice for income, the landowner should be aware of ways to minimize the costs associated with establishing and maintaining that practice.

Economic Budgeting

Economic budgeting is a decision making tool used to :

- 1) report,
- 2) monitor,
- 3) analyze, and
- 4) forecast the financial performance of an economic enterprise.

Budgets can be highly detailed standardized forms or roughly delineated estimates on the back of an envelope. The quality of the economic analysis and thus the quality of the decisions made based on the analysis depend on the time and effort put into the budget.

There are several methods for budgeting, depending on the type of analysis being conducted. For agroforestry economic analysis, two main types of budgets are used: **enterprise budgets** and **cash flow budgets**.

- **Enterprise budget:** This is a detailed list of all cost and revenues for a single enterprise, such as corn or livestock, typically for a single planning period.

-
- **Cash flow budget:** This is a detailed schedule of the amount and timing of costs and revenues. Cash flow budgets can identify possible risks, predict cash needs over a period of time, and provide a basis for comparison with other alternatives. A cash flow budget can combine several enterprise budgets to identify areas where losses from one enterprise can be offset by revenues from another enterprise.

Costs

Costs can be grouped into two categories: fixed and variable. Within these two categories, costs are separated even further into cash and non-cash costs. Cash costs are those costs that require out-of-pocket cash payments. Non-cash costs are often called economic costs or opportunity costs. Understanding each of these categories of costs will help organize data into economic information.

- *Fixed costs:*

Fixed costs are typically those costs that are attributed to resource ownership. In other words, fixed costs occur regardless of any productive activity being attempted. Fixed cash costs are out-of-pocket expenses that are not dependent on production level or commodity. Examples of fixed cash costs include property taxes and insurance. Fixed non-cash costs are accounting costs that do not require a cash outlay. Although these costs are incurred regardless of production, they are influenced by production activities. For example, depreciation is a non-cash fixed cost that accrues regardless of whether the capital is used for production or not. A tractor will depreciate in value even if it is parked in a barn and never used. The amount and type of capital that depreciates will depend on the production activities. A crop enterprise may have depreciation from specialized equipment such as a combine and a planter, but a livestock enterprise will not have this type of depreciation.

- *Variable costs:*

Variable costs are those costs attributed to the productive use of resources. Variable cash costs

include all input costs, such as seed, chemicals, fuel, hired labor, and maintenance. Variable cash costs for agroforestry practices can be broken down even farther into four main cost areas: establishment, maintenance, harvesting, and marketing.

Revenues

Typical revenues from conventional forestry can come from things such as nuts, timber, and seedlings. In agriculture, revenues are typically based on monocultured crops or livestock enterprises. However, by combining agriculture and forestry, more revenue opportunities can be realized from the same natural resource base. Revenues in agroforestry are limited only by the creative resources of the decision maker.

Many agroforestry practices require significant investment during establishment years, followed by a period of several years before the trees start to generate a return on that investment. This may be a strong disincentive to the adoption of these practices, even if long-run estimates indicate that the practice will be more profitable. Because of this characteristic of agroforestry, landowners should be encouraged to seek out additional incentives for agroforestry.

Incentives for Agroforestry

Agroforestry incentives can come from many different sources. The fact that the practice improves the environmental quality of a landowner's property may be all the incentive needed to convince that landowner to adopt that practice. However, for some landowners to adopt requires a significant financial incentive. Programs designed to minimize or offset the initial establishment cost burden are the most common type of funding incentive available to landowners interested in agroforestry.

Funding incentives can come from at least three major sources:

- 1) Federal
- 2) State, and
- 3) private conservation programs.

Federal conservation programs are those initiated by major legislation, such as the Farm Bill. Examples of federally funded agroforestry incentives would include programs such as:

- Conservation Reserve Program (CRP)
- Continuous Conservation Reserve Program (CCRP)
- Conservation Reserve Enhancement Program (CREP)
- Environmental Quality Incentive Program (EQIP)
- Wetland Reserve Program (WRP)
- Wildlife Habitat Incentive Program (WHIP)
- Conservation Security Program (CSP)
- Forest Land Enhancement Program (FLEP)
- Sustainable Agriculture Research and Education Program (SARE)
- Partners for Fish and Wildlife (PFW)

These programs offer cost share payments, land easement payments, and other incentive payments to landowners who adopt environmentally responsible land-use practices. One downside to many of these programs is the fact that the landowner often foregoes design flexibility and alternative product market income for the guaranteed program payments.

State funding programs are very similar to the federal programs. In 1990, the State of Missouri passed an innovative program called the Missouri Agroforestry Program which was part of the Missouri Economic Diversification and Afforestation Act. Although this program has had limited funding, the concept is unique in the fact that it encourages landowners to seek income opportunities from alternative products grown or harvested from land that is managed primarily for conservation benefits. The Missouri Department of Conservation was given the responsibility of overseeing this program along with a cost share program that promotes conservation practices. Other sources of funding in Missouri include the Missouri Department of Agriculture and the Missouri Department of Natural Resources.

Private funding sources with application for agroforestry often center on organizations that

promote game animals or forestry. Private sources include groups such as Pheasants Forever, Ducks Unlimited, Quail Unlimited, and the National Wild Turkey Federation. These organizations offer cost-share programs and land easement payments to landowners who manage their land in a way that improves the habitat of the game animal they represent.

Tax Incentives

Another incentive for agroforestry adoption may be the income tax benefits that a landowner could receive.

There are three basic ways to substantially reduce your tax burden:

- 1) increased deductions,
- 2) reduced tax rate, and
- 3) tax credits

The current Internal Revenue Code (IRC) offers at least four areas where a landowner can reduce their potential tax burden by establishing an agroforestry practice.

The IRC offers tax benefits for

- 1) reforestation
- 2) conservation
- 3) business investment, and
- 4) capital gains.

- **Section 194** of the IRC describes the reforestation deduction and amortizable basis deduction. This deduction allows a landowner to deduct the first \$10,000 of reforestation expenses from taxable income and then amortize and deduct the remaining expense over an 84-month period.
- **Section 175** describes the conservation deduction that allows a landowner to deduct certain conservation expenses up to 25% of the gross income earned from the farming business. These conservation expenses must be incurred in accordance with a plan approved by the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) or similar agency.
- **Section 126** details how to exclude cost-share

payments received from approved federal or state conservation programs from taxable income.

- **Section 179** allows a landowner who is managing the agroforestry practice as an active business to deduct a large amount of expenses incurred for personal property used more than 50% in the business. The current deduction limit is \$105,000, which is also limited by the level of the person's taxable income and a \$420,000 maximum investment limit.

Summary

Agroforestry is a set of land-use practices that interlaces production and stewardship. From an economic standpoint, agroforestry can increase production diversity by integrating a wide range of commodity and alternative products. In order to monitor and analyze the economic parameters of an agroforestry practice, landowners may need to adopt some form of economic budgeting. Because of the impact of long establishment periods and long periods where no economic returns are generated, a combination of enterprise budgeting and cash flow budgeting is recommended in order to fully capture the short- and long-term revenue potentials.

Some agroforestry practices may have substantial cost during an establishment period and not generate revenue to offset those costs until several years later. Because of this, landowners may wish to seek funding incentives to help ease the establishment cost burden. Federal, state and private conservation programs offer land easements and cost-share payments for establishing agroforestry practices or related land use practices.

In addition to these programs, the IRC offers some substantial tax benefits for those who invest in reforestation, conservation, or some form of business that relies on the management of the natural resource base.

Additional Resources

Economic Budgeting Websites:

- <http://www.ext.vt.edu/pubs/vegetables/438-898/438-898.html> - Selected Costs and Returns Budgets for Horticultural Food Crops Production/Marketing, Virginia Cooperative Extension
- <http://extension.missouri.edu/explore/agguides/forestry/g05021.htm> - Economics of Agroforestry, University of Missouri Extension, G5021.
- <http://infobasket.gov.bc.ca/portal/server.pt?space=CommunityPage&cached=true&parentname=CommunityPage&parentid=1&control=SetCommunity&CommunityID=284&PageID=0> – Infobasket, British Columbia Ministry of Agriculture.

Funding Incentive Websites:

- <http://www.fsa.usda.gov> – USDA Farm Service Agency homepage.
- <http://www.nrcs.usda.gov> -USDA Natural Resource Conservation Service homepage.
- <http://www.sare.org> – Sustainable Agriculture Research and Education (SARE) homepage.
- <http://www.attra.org/attra-pub/summaries/betterrural.html> - Building Better Rural Places, A publication of the U.S. Department of Agriculture agencies working together for sustainable rural development in collaboration with The Michael Fields Agricultural Institute and The National Center for Appropriate Technology (NCAT).
- <http://www.na.fs.fed.us/pubs/misc/flg> - Forest Landowners Guide to Internet Resources: States of the Northeast, US Forest Service Northeastern Area and the Northeastern Area Association of State Foresters.

Tax Incentive Websites:

- <http://www.timbertax.org> – National Timber Tax Website
- <http://www.irs.gov> - Internal Revenue Service Website

EXERCISE: REVIEW OF ECONOMIC INCENTIVES

Variable cash costs can be grouped into four categories, what are they?

- 1.
- 2.
- 3.
- 4.

Two types of budgets are recommended for the economic analysis of agroforestry practices, what are they?

- 1.
- 2.

What are the four sections of the Internal Revenue Code (IRC) that can affect agroforestry adopters?

- 1.
- 2.
- 3.
- 4.

What is the difference between a variable cost and a fixed cost?

EXERCISE KEY

Variable cash costs can be grouped into four categories, what are they?

1. Establishment
2. Maintenance
3. Harvesting
4. Marketing

Two types of budgets are recommended for the economic analysis of agroforestry practices, what are they?

1. Enterprise budget
2. Cash flow budget

What are the four sections of the Internal Revenue Code (IRC) that can affect agroforestry adopters?

1. Section 194- Reforestation deduction and amortizable basis deduction
2. Section 175-Conservation deduction
3. Section 126-Cost-share exclusion
4. Section 179-Business investment deduction

What is the difference between a variable cost and a fixed cost?

A fixed cost is a cost that is associated with the ownership of resources. Fixed costs must be paid regardless of what activity is conducted on the property. Variable costs are costs associated with the productive use of resources. Variable costs are the costs that are used when comparing the economics of competing resource-use options.

Notes

Appendix Section 1:

- Economic Budgeting for Agroforestry Practices
- Funding Incentives for Agroforestry in Missouri
- Tax Considerations for the Establishment of Agroforestry Practices

The following three Agroforestry in Action guides:

- *Economic Budgeting for Agroforestry Practices*
- *Funding Incentives for Agroforestry in Missouri*
- *Tax Considerations for the Establishment of Agroforestry Practices*

are available for viewing, printing or downloading from the University of Missouri Center for Agroforestry web site at www.centerforagroforestry.org.



Economic Budgeting for Agroforestry Practices

3-2000*

by **Larry D. Godsey**

Evaluation of the economic aspects of agroforestry provides a basis for estimating financial needs and feasibility, highlights trade-offs between multiple benefits, and monitors economic efficiency. The main technique used in economic analysis is budgeting.

Economic budgeting is a very flexible process. However, effective application of budgets requires an understanding of the commodity, practice, or system to which it is being applied. Agroforestry poses some unique economic budgeting problems because it involves multiple enterprises with varying production cycles, such as trees, row crops, forages, and/or livestock.

Unique Characteristics of Agroforestry

1. Long planning horizons
2. Irregular cost and revenue occurrences
3. Fixed tree component with variable crop or livestock component

First, unlike most agricultural commodities, agroforestry has a “planning horizon” of greater than one season due to the tree component. A “planning horizon” is simply a time period in which all costs and revenues for a given practice are realized. For soybeans, a planning horizon may be six months to a year. For agroforestry, a simple planning horizon may be as long as sixty years when the trees are taken into consideration.

Second, because of the long planning horizon of agroforestry practices, many of the revenues and costs do not occur at regular or predictable intervals throughout the entire planning horizon, but are irregular in occurrence.

Finally, because agroforestry practices typically incorporate a fixed tree component with a crop or livestock component, the crop or livestock component may change over time. For example, an alley cropping practice may start out as soybeans grown between rows of eastern black walnut trees, but by the time the trees are producing nuts, hay may be the crop grown between the rows of trees because more of a mat is required to harvest the nuts.

These three characteristics of agroforestry practices require a specific type of budgeting method that will be flexible enough to allow for variable crop and/or livestock components, as well as comprehensive enough to show annual cash flows for the entire planning horizon.

Agroforestry Budgeting

Agroforestry budgeting is a two step process. The steps are 1) develop enterprise budgets, and 2) combine the enterprise budgets into a cash flow plan.

Two Steps to Agroforestry Budgeting

Step 1: Develop detailed enterprise budgets

Step 2: Combine all enterprise budgets into a cash flow plan.

An enterprise budget is simply a complete, detailed listing of all the costs and revenues expected for each single enterprise, such as corn, livestock, or trees. A cash flow plan combines the details from the different enterprise budgets in the agroforestry practice and adds a time dimension. The enterprise budget provides a framework for reporting and monitoring the profitability of each enterprise, and the cash flow plan provides the information necessary to assess and forecast the economic feasibility of the agroforestry practice over time.

Developing the Enterprise Budgets

<p>Three steps for developing an Enterprise Budget</p> <ol style="list-style-type: none"> 1. Revenues 2. Variable Costs (both cash and non-cash) 3. Fixed Costs (both cash and non-cash)
--

The development of an enterprise budget is a three-step process. The first step is to list all possible sources of revenue for an enterprise. For the tree component of an agroforestry practice, it is important to list not only the sources, but also list the timing of those revenues. For example, an alley cropping practice with eastern black walnut trees may receive CRP payments for the first ten years of the planning horizon but not after that period. Income from nut production

<p>Examples of Agroforestry Revenues</p> <ul style="list-style-type: none"> • Cost share payments • Nuts • CRP Payments • Biomass • Grafted Seedlings • Hunting rights • Scionwood and cuttings • Nature walks • Timber (sawlogs, veneer logs, etc.) • Seedlings

<p>Examples of Agroforestry Variable Costs</p>
<p>Cash Costs</p> <p>Establishment: Site preparation (mechanical/chemical) Seedlings Planting (labor and equipment) Watering Staking</p> <p>Maintenance: Fertilization Pest and Disease Control Grafting Thinning Pruning</p> <p>Harvesting: Nut harvest Timber harvest</p> <p>Marketing: Advertisement Transportation</p>
<p>Non-Cash Costs</p> <p>Family Labor</p>

may start at year ten or twelve and continue until the tree is harvested for wood in year fifty-five or sixty.

The second step is to list, in detail, all possible sources of variable costs. Variable costs are those costs attributed to the productive use of resources. Variable costs can be grouped into cash and non-cash costs. Variable cash costs include payments for establishment, maintenance, harvesting, and marketing. Variable non-cash costs do not require a cash outlay, but reflect opportunity costs. Opportunity cost is simply the value of the next best alternative that is not chosen. For example, labor supplied by family members may not require a cash outlay, but could still be considered in the economic analysis.

Reporting variable costs should include the source of the cost, the amount of the cost, and the time interval in which that cost will be incurred. For example, thinning trees may cost \$50 per acre and occur in years twenty-one and twenty-five.

The third and final step to preparing an enterprise budget is to list all fixed costs. Fixed costs are typically those costs that are attributed to resource ownership. In other words, fixed costs occur regardless of any productive activity being attempted. Fixed cash costs usually include property taxes, insurance, interest on intermediate or long-term debt, and lease agreements. Fixed non-cash costs are important when developing an investment analysis, because these costs have significant influence on taxes. However, these costs are difficult to determine. Depreciation and land costs are the two main areas of fixed non-cash costs. Fixed costs may not change as often as the revenues and variable costs. In fact, any changes may be predictable, such as, a two-percent increase in property taxes every year. When reporting fixed costs, be sure and note the source, the amount, and the estimated changes that will occur in the original amount.

Appendix A is an example of an enterprise budget for an alley cropping practice using eastern black walnut (*Juglans nigra* L.). The enterprise budget reports all costs and revenues on a

Examples of Agroforestry Fixed Costs	
Cash Costs	
	Property Taxes
	Insurance
	Interest Payments (intermediate debt)
	Lease Agreements
	Land - Interest (Option 1)
Non-Cash Costs	
	Depreciation
	Land - Opportunity Cost (Option 2)

per acre basis. Species and spacing are clearly described so that this budget will not be confused with other types of agroforestry practices.

Characteristics of a Cash Flow Plan
1. Allows for analysis of multiple enterprises
2. Incorporates a time dimension

From Enterprise Budgets to Cash Flow Plans

Once enterprise budgets are developed, a cash flow plan for the agroforestry practice can be developed. It is important to understand that an agroforestry practice may include more than one enterprise. For example, a well established alley cropping practice may combine a tree enterprise with a hay and livestock enterprise. As mentioned earlier, often times the tree enterprise is fixed while the crop or livestock enterprises vary over time. Cash flow planning has two major characteristics that benefit agroforestry economic analysis; 1) a cash flow plan allows for multiple enterprises to be considered; and 2) a cash flow plan incorporates a time dimension.

Using a cash flow plan in conjunction with enterprise budgets can simplify the process of economic analysis by allowing the enterprise budgets to reflect the detailed information, and let the cash flow plans use minimal data to provide the analysis. Appendix B is an example of a cash flow plan for an alley cropping practice that uses eastern black walnut (*Juglans nigra* L.) along with bluegrass and white clover hay.

Common Indicators of Economic Performance

There are several common indicators used to analyze an agroforestry practice for economic performance. Supplementing these common economic indicators with some very basic indicators of economic performance can help both produc-

ers and economists understand the economic performance of agroforestry practices.

A common economic analysis technique known as net present value (NPV) analysis can be conducted given the information provided in a good cash flow plan. Net present value is simply all future net income streams from the practice discounted to reflect their current or present value. Appendix C shows the formula for the calculation of NPV. This indicator is useful only as a basis for comparison. The net present value of the agroforestry practice can be compared to the net present value of other alternatives, such as a soybean monoculture, to see which practice is the most economically profitable. Assuming each practice is discounted using the same period of time and the same discount rate, the highest NPV would indicate the best alternative.

- | Common Economic Indicators |
|-----------------------------------|
| 1. Net Present Value (NPV) |
| 2. Internal Rate of Return (IRR) |
| 3. Annual Equivalent Value (AEV) |

The internal rate of return (IRR) is another common indicator of economic performance. The internal rate of return is the rate at which an investment is expected to grow. For example, a savings account pays 3% per year, therefore, an investor who puts money in a savings account is expecting to earn 3% on that investment. If an agroforestry practice has an IRR of 6% then a rational investor would choose the agroforestry practice over the savings account earning 3%. However, the internal rate of return does not always capture the uncertainty of returns over time. Using the savings account example, an investor is assured that the money put into a savings account is relatively risk free, however, investment in agroforestry practices may face uncertainties that were not predicted or planned. Appendix C shows the calculations for deriving the IRR.

Another common indicator of economic performance that can be derived from a cash flow plan is the annual equivalent value (AEV). The annual equivalent value is an estimate of a level income stream that would have the same net present value as the actual income streams. Actual income streams for agroforestry practices may be positive one year and negative another, however, with the annual equivalent value, a level income estimate is established. The annual equivalent value can be used to compare alternative practices with the agroforestry practice to determine which practice has the highest expected income potential.

Supplemental Economic Indicators

All three of the common indicators can be used to evaluate the economic success of agroforestry practices. However, there are easier ways to help evaluate the economic feasibility of agroforestry practices without the complicated discounting equations. Using a cashflow budget, three supplemental economic indicators can be derived: 1) frequency of negative cashflow, 2) duration of negative cashflow, and 3) magnitude of positive and negative cashflows.

The frequency of negative cashflow is simply determining the number of years in a planning horizon in which a practice will have a net loss. For many landowners, a practice that appears to be economically profitable according to a NPV analysis in the long run, may not be feasible due to several periods of net loss.

Similar to frequency, duration of negative cashflow reflects the length of time that the practice

- | Supplemental Economic Indicators |
|--|
| 1. Frequency of negative cashflow |
| 2. Duration of negative cashflow |
| 3. Magnitude of positive and negative cashflow |

returns a negative cashflow, or net loss. While frequency would describe a practice as having negative cashflow 4 out of 15 years, duration may indicate that three of those four years occurred consecutively. A landowner may not be concerned about having a negative cashflow occasionally. However, a continuous net loss may make a practice undesirable and infeasible.

The magnitude of positive and negative cashflow reflects the range of fluctuations that occur from year to year and throughout the planning horizon in net income. For example, one practice may have a very large net loss the first two years for startup costs, followed by several years of small net incomes. Over the long run, this practice may have a positive internal rate of return, but the periods of large net losses may make the practice infeasible. On the other hand, expected large net income in the future may make periods of small net losses tolerable.

The three supplemental indicators of frequency, duration, and magnitude require no special training in finance or math, and may have more influence on the decision process. The common indicators of net present value, internal rate of return, and annual equivalent value are still

important to help compare the agroforestry alternative to other possible alternatives. Using both types of economic indicators can help “fine tune” the economic analysis and aid in the decision process.

There are many other benefits to agroforestry besides those measured by economics. Environmental and social benefits may also have value to the decision-maker. These benefits are often difficult to quantify. With economic analysis, these benefits can be considered in light of financial considerations.

Reassessment

Economic analysis is not meant to be - nor is it designed to be a one-time activity. Economic analysis is designed to be a roadmap for a dynamic and living system. Reassessment takes the information gathered in the economic analysis and combines it with other information to change the original goals or fine tune the design so that it is more successful at meeting those goals. Reassessment is the continuous loop that helps redefine goals, adjust designs, and modify indicators. Economic analysis is just one part of the reassessment loop.

Agroforestry Enterprise Budget

	Amount	Time Interval	Amount	Time Interval
Revenues:			Variable Cash Costs	
Cost Share Payments	\$ -		1. Establishment:	
CRP	\$ 62.00	Year 1-10	a. Site preparation	
Seedlings Sold	\$ -		Mechanical	\$ 36.00
Grafted Seedlings Sold	\$ -		Chemical	\$ -
Scionwood / Cuttings Sold	\$ -		b. Fertilizer	
Nuts (Yield will increase at 3% for 10 ye	\$ 255.00	Year 11-60	N-P-K	\$ 40.00
Biomass	\$ -		Lime	\$ 18.00
Hunting Rights	\$ -		c. Planting	
Nature Walks	\$ -		Seedlings (RPM Grafted)	\$ 312.00
Timber (Thinnings)	\$ 1,200.00	Year 21	Labor	\$ 90.00
Timber (Sawlogs, veneer logs, etc.)	\$ 1,000.00	Year 60	Equipment	\$ 6.00
			d. Watering	\$ -
			e. Staking	\$ 96.00
			f. Maintenance	
Fixed Cash Costs			2. a. Fertilization (\$6.60 Yr2-3/\$10.1	\$ 6.60
Property Tax	\$ 0.40	Years 1-60	b. Pesticide/Fungicide	\$ 100.00
Insurance	\$ 0.20	Years 1-60	c. Herbicide	\$ 12.50
Interest Payments	\$ -		d. Mowing	\$ -
Leases	\$ 15.00	Years 11-60	e. Thinning	\$ 50.00
Management	\$ 1.40	Years 1-60	f. Pruning	\$ 4.00
Fixed Non-Cash Costs			3. Harvesting	
Depreciation	\$ -		a. Nut harvest	\$ 74.00
Land	\$ 9.00	Years 1-60	b. Timber harvest	
			4. Marketing	
			a. Advertisement	\$ -
			b. Transportation	\$ -
			Variable Non-Cash Costs	\$ -

Practice: Alley Cropping
Species: Black Walnut

Price Basis: \$/acre/year
Spacing: 30x30

Agroforestry Cash Flow Plan

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Revenues:											
Tree: Eastern Black Walnut	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 255.00
Crop: Hay	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 120.00
Total revenues:	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 62.00	\$ 375.00
Variable Costs:											
Tree: Eastern Black Walnut	\$ 650.50	\$ 19.10	\$ 19.10	\$ 26.70	\$ 26.70	\$ 26.70	\$ 44.50	\$ 44.50	\$ 44.50	\$ 44.50	\$ 202.00
Crop: Hay	\$ 34.50	\$ 30.00	\$ 30.00	\$ 44.50	\$ 30.00	\$ 30.00	\$ 30.00	\$ 44.50	\$ 30.00	\$ 30.00	\$ 60.00
Total Variable Cost	\$ 685.00	\$ 49.10	\$ 49.10	\$ 71.20	\$ 56.70	\$ 56.70	\$ 74.50	\$ 89.00	\$ 74.50	\$ 74.50	\$ 262.00
Fixed Costs:											
Tree: Eastern Black Walnut	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 11.00	\$ 26.00
Crop: Hay	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00
Total Fixed Costs:	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 45.00	\$ 60.00
Net Income/(loss)	\$ (668.00)	\$ (32.10)	\$ (32.10)	\$ (54.20)	\$ (39.70)	\$ (39.70)	\$ (57.50)	\$ (72.00)	\$ (57.50)	\$ (57.50)	\$ 53.00
NPV @ 10%											
Internal Rate of Return											
Annual Equivalent Value											

Practice: Alley Crop
 Species: Black Walnut
 Crop: Hay

Price Basis: \$/Acre/Year
 Spacing: 30x30

Agroforestry Cash Flow Plan

	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Year 31
Revenues:										
Tree: Eastern Black Walnut	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00
Crop: Hay	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00
Total revenues:	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00
Variable Costs:										
Tree: Eastern Black Walnut	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00
Crop: Hay	\$ 60.00	\$ 60.00	\$ 64.50	\$ 60.00	\$ 60.00	\$ 60.00	\$ 64.50	\$ 60.00	\$ 60.00	\$ 60.00
Total Variable Costs:	\$ 262.00	\$ 262.00	\$ 266.50	\$ 262.00	\$ 262.00	\$ 262.00	\$ 266.50	\$ 262.00	\$ 262.00	\$ 262.00
Fixed Costs:										
Tree: Eastern Black Walnut	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00
Crop: Hay	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00
Total Fixed Costs:	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00
Net Income/(loss)	\$ 141.00	\$ 141.00	\$ 136.50	\$ 141.00	\$ 141.00	\$ 141.00	\$ 136.50	\$ 141.00	\$ 141.00	\$ 141.00

Practice: Alley Crop
 Species: Black Walnut
 Crop: Hay

Price Basis: \$/Acre/Year
 Spacing: 30x30



Agroforestry Cash Flow Plan

	Year 43	Year 44	Year 45	Year 46	Year 47	Year 48	Year 49	Year 50	Year 51	Year 52
Revenues:										
Tree: Eastern Black Walnut	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00	\$ 343.00
Crop: Hay	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00	\$ 120.00
Total revenues:	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00	\$ 463.00
Variable Costs:										
Tree: Eastern Black Walnut	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00	\$ 202.00
Crop: Hay	\$ 60.00	\$ 64.50	\$ 60.00	\$ 60.00	\$ 60.00	\$ 64.50	\$ 60.00	\$ 60.00	\$ 60.00	\$ 64.50
Total Variable Costs:	\$ 262.00	\$ 266.50	\$ 262.00	\$ 262.00	\$ 262.00	\$ 266.50	\$ 262.00	\$ 262.00	\$ 262.00	\$ 266.50
Fixed Costs:										
Tree: Eastern Black Walnut	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00	\$ 26.00
Crop: Hay	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00	\$ 34.00
Total Fixed Costs:	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00	\$ 60.00
Net Income/(loss)	\$ 141.00	\$ 136.50	\$ 141.00	\$ 141.00	\$ 141.00	\$ 136.50	\$ 141.00	\$ 141.00	\$ 141.00	\$ 136.50

Practice: Alley Crop
 Species: Black Walnut
 Crop: Hay

Price Basis: \$/Acre/Year
 Spacing: 30x30

Appendix C: Calculations

Net Present Value (NPV) is an estimate of the current value of all future incomes from an investment. To determine net present value, future net incomes or net losses, called cashflows, must be discounted to reflect the fact that a dollar today will purchase more than a dollar in the future.

$$NPV = cashflow_0 + cashflow_1 \left(\frac{1}{(1+i)^1} \right) + cashflow_2 \left(\frac{1}{(1+i)^2} \right) + \dots + cashflow_n \left(\frac{1}{(1+i)^n} \right)$$

Where:

NPV = Net Present Value

$cashflow_n$ = net income or net loss for the year "n", for example $cashflow_1$ is the net income from the first full year of production.

i = discount rate, or the opportunity cost of investing. For example, the dollars could have been invested in the stockmarket with an expected return of 14% instead of being invested in an agroforestry practice, therefore, the opportunity cost of the agroforestry practice would be 14%.

n = number of years included in the budget

Internal Rate of Return (IRR) uses the same equation as net present value, however, instead of solving for the NPV, an arbitrary NPV of \$0 is assumed. The discount rate becomes the unknown variable in the equation. The " i " now represents the rate at which all discounted cashflow will equal zero. Or, in other words, the rate at which future incomes will return the initial investment ($cashflow_0$).

$$0 = cashflow_0 + cashflow_1 \left(\frac{1}{(1+i)^1} \right) + cashflow_2 \left(\frac{1}{(1+i)^2} \right) + \dots + cashflow_n \left(\frac{1}{(1+i)^n} \right)$$

Since $cashflow_0$ is not affected by the variability of the discount factor, it is moved to the other side of the equation.

$$- cashflow_0 = cashflow_1 \left(\frac{1}{(1+i)^1} \right) + cashflow_2 \left(\frac{1}{(1+i)^2} \right) + \dots + cashflow_n \left(\frac{1}{(1+i)^n} \right)$$

Annual Equivalent Value (AEV) modifies the equation used in the other two indicators. The AEV calculates an annuity (or an annual set payment) that would give the equivalent net present value at the same discount rate. The equation used in the NPV calculation assumes varying cash flows for each year. The AEV equation assumes that the cashflow is the same each year, therefore, the equation can be modified as follows:

$$NPV = Cashflow \left(\sum_{t=1}^n \frac{1}{(1+i)^t} \right)$$

To calculate the AEV using this equation, the *NPV*, *n*, and *i* must be known. The *Cashflow* is the annual equivalent value that is being calculated. The above equation can be manipulated as follows:

$$Cashflow = \left(\frac{NPV}{\sum_{t=1}^n \frac{1}{(1+i)^t}} \right)$$

Although this looks like a difficult equation, the summation portion (annuity discount factor) of the equation can be simplified as follows:

$$\sum_{t=1}^n \frac{1}{(1+i)^t} = \frac{1}{i} - \frac{1}{i(1+i)^n}$$

To show how this equation works, let's assume that we have budgeted for an agroforestry practice using the enterprise and cash flow plans described in this paper. Assuming that the opportunity cost of investing in this practice is 8% and the planning horizon is 50 years, we calculated that the NPV_{8%, 50} is \$1200. To calculate the AEV, all we need to do is estimate the annuity discount factor shown above and divide that factor into the NPV.

$$\frac{1}{.08} - \frac{1}{.08(1+.08)^{50}} \Rightarrow 12.5 - \frac{1}{.08(46.902)} \Rightarrow 12.5 - \frac{1}{3.752} \Rightarrow 12.5 - 0.2665 \Rightarrow \underline{\underline{12.233}}$$

$$Cashflow = \frac{NPV}{12.233} \Rightarrow \frac{\$1200}{12.233} = \underline{\underline{\$98.00}}$$

This indicates that the series of cashflows expected with this practice have the same net present value as an annuity that pays \$98 per year. This does not, however, reflect the variability of those cashflows or the time it takes to start generating positive cashflows.

Most spreadsheet programs have these equations programmed in. However, it is good to understand what the equation is doing and what the indicator is telling you. Misinterpreted financial indicators can lead to bad decisions.

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Notes



Funding Incentives for Agroforestry in Missouri

by Larry D. Godsey
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Agroforestry describes a set of land use practices that incorporate trees, shrubs, forages, crops and/or livestock designed in a way that provide environmental, social, and economic benefits. Agroforestry practices help landowners to diversify products, markets, and farm income; improve soil and water quality; and reduce erosion, non-point source pollution and damage due to flooding. The integrated practices of agroforestry enhance land and aquatic habitats for fish and wildlife and improve biodiversity while sustaining land resources for generations to come. The five recognized agroforestry practices are : 1) alley cropping, 2) windbreaks, 3) riparian buffers, 4) silvopasture, and 5) forest farming.

This publication is designed to help landowners and natural resource professionals find appropriate sources of funding for establishing and maintaining agroforestry practices. The financial success of agroforestry practices does not depend on the availability of government funding programs, nor should it. However, the funding programs noted in this publication were developed as incentives for good stewardship and, when properly designed and managed, agroforestry is good stewardship. Although there are more funding programs than described in this document, the programs listed represent federal, state, and private sources with the greatest application to agroforestry.

Changes in farm policy resulting from the 2002 Farm Bill are included in this publication and they may be subject to further change as the details of that policy are worked out over the next few years. For more detailed and up-to-date policies, contact the listed agencies sponsoring each program.



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1. Federal Funding Incentives for Agroforestry

Most federal funding for agroforestry is administered through United States Department of Agriculture agencies, including the Farm Service Agency (USDA/FSA), Natural Resource Conservation Service (USDA/NRCS), Forest Service (USDA/FS) and the Sustainable Agriculture Research and Education program (SARE). Other federal funding for agroforestry can come from the United States Fish and Wildlife Service (USFWS). Some federal funding programs are joint efforts with State agencies such as the Missouri Department of Conservation (MDC) and the Missouri Department of Agriculture (MDA). Figure 1 lists the federal funding programs and the agencies that support them. Figure 17, presented at the back of this publication, provides a detailed list of federal funding incentives by practice/benefit.

1.1 USDA/FSA Incentive Programs for Agroforestry

The USDA/FSA has three major programs that can be used to establish and maintain agroforestry practices on private land. They are the Conservation Reserve Program (CRP), the Continuous Conservation Reserve Program (CCRP) and the Conservation Reserve Enhancement Program (CREP) in partnership with each state. Each of these programs is designed to take environmentally sensitive and highly erodible land out of production by offering a soil rental payment, cost-share for the establishment of various conservation practices, and other financial incentives to landowners who offer to set aside their land.



Figure 1: Federal funding incentives and their sources that support landowner adoption of agroforestry practices.

1.1.1 Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP) is a voluntary program of land retirement that offers annual soil rental rate (SRR) payments, cost-share payments and annual maintenance payments. Annual SRR payments are based on the local average cash rental rates. Cost share payments cover up to fifty percent of the cost to establish conservation practices. Maintenance payments of \$5 per acre are paid annually in addition to the soil rental payments (Figure 2). Conservation practices (CP's) funded through CRP that involve tree planting include:

- CP3A Hardwood tree planting,
- CP4B Wildlife corridors,
- CP4D Wildlife habitat,
- CP11 Tree cover - established,
- CP25 Rare and declining habitat:
oak savanna restoration,
bottomland forest restoration.

The hardwood tree planting practice (CP3A) will allow the landowner to recover a portion of the tree planting costs. The minimal requirement for stand density is 302 stems per acre. The acreage planted to the CP3A can be "rolled over" into the established tree cover practice (CP11). This allows landowners to continue earning an annual soil rental payment and an annual maintenance payment while the trees are growing.

Wildlife corridors (CP4B) and wildlife habitats (CP4D) promote restoration of warm season grasses and woody vegetation for the benefit of wildlife. As a minimum requirement, CP4B and CP4D areas must be at least 66 feet wide and include at least 10 percent woody vegetation. Maximum width for both practices is 198 feet.

Finally, the restoration of rare and declining habitats (CP25) allows for the establishment of oak savannas

and riparian forests. For the restoration of the oak savanna, the minimum tree spacing is 30' x 30', or 48 trees per acre. Trees must comprise at least 10 percent of the field but not more than 50 percent, with a mix of oak, persimmon, and hickory. Restoring riparian forests only applies to land that is adjacent to perennial streams or land already enrolled as a CP22 riparian buffer or a CP25 riparian forest. Tree stocking rates and species follow the same guidelines as the CP3A hardwood tree planting practice and are identified in NRCS Standard 612.

For more information about CRP, contact your local USDA/FSA office.

1.1.2 Continuous Conservation Reserve Program (CCRP)

The CCRP is a voluntary program that focuses on funding CP's protecting environmentally sensitive land, including wetlands and riparian areas. Landowners with eligible land who wish to enroll that land in the CCRP may sign-up at any time during the year. Available funding through the CCRP can include:

- annual soil rental rate payments that can be up to 120 percent of the average soil rental rate for the area,
- annual maintenance payments of \$5 to \$10 per acre,
- cost share payments up to 50 percent of the establishment cost.

CRP	CCRP
Soil Rental Rate (SRR)	Soil Rental Rate (SRR) - up to 120 percent of the local average soil rental rate
50 percent Cost Share	50 percent Cost Share
Maintenance - \$5	Maintenance - between \$5 and \$10 Signing Incentive Payment (SIP) Practice Incentive Payment (PIP)

Figure 2: Payments and incentives available through CRP and CCRP for agroforestry.

Along with the three payments mentioned above, CCRP also has two one-time incentive payments available for certain CP's, including:

- a signing incentive payment (SIP) equal to \$10 per acre per number of contract years,
- a practice incentive payment (PIP) equal to 40 percent of the establishment costs.

Figure 2 highlights the CRP and CCRP payments and incentives.

There are 16 practices that are eligible for the CCRP. However, out of the 16, only eight allow for tree planting, including:

- CP5A Field windbreaks
- CP9 Shallow water areas
- CP16A Shelterbelts
- CP22 Riparian buffers
- CP23 Wetland Restoration
- CP29 Wildlife Habitat buffer on marginal pastureland
- CP30 Wetland buffer on marginal pastureland
- CP31 Bottomland timber establishment on wetlands

Field windbreaks designed and funded under CP5A are eligible for SIP, PIP, 120 percent SRR, and annual maintenance payments (Figure 3). The maximum width for field windbreaks in Missouri is one tree row. Tree species and spacing within the tree row is determined by the desired purpose of the windbreak. Design characteristics for field windbreaks are specified in NRCS Standard 380.

Riparian buffers have become a priority for most USDA agencies. Under the requirements of the CCRP's riparian forest buffer practice (CP22), landowners must establish at least a two-zone buffer. The total width of the riparian forest buffer will vary depending on the size of the stream and landowner objectives. For first and second order streams, the buffer must be at least 50 feet wide and cannot exceed 180 feet. Buffers along third order streams must be at least 100 feet wide. Riparian forest buffers along the Missouri and Mississippi Rivers may be increased to 300 feet. Buffers may be

Field Windbreaks (CP5A)

- 10-15 year contracts
- Continuous Sign-up
- SIP, PIP, and 120 percent SRR
- \$7 per acre per year maintenance payments
- Maximum width of one row for Missouri

Figure 3: Brief description of the CCRP funding and design characteristics that support the establishment of field windbreaks (CP5A)

extended beyond 180 feet or 300 feet for the purpose of improving water quality benefits. Figure 4 gives a brief description of the funding and design characteristics of the riparian forest buffer (CP22) practice. NRCS Standard 391 identifies the guidelines for establishing a riparian forest buffer for the CCRP.

The restoration of wetlands (CP23) allows for some tree planting. However, wetland areas must be restored to their original vegetation, thus, if the area being restored consists of grassland soils, then the area must be returned to grassland.

Riparian Forest Buffer (CP22)

- 10- to 15-year contracts
- Continuous CRP
- Eligible for the following CRP financial incentives
 - 120 percent SRR
 - 50 percent regular cost share
 - SIP
 - PIP
 - \$7-\$10 maintenance
- Width requirements (1st and 2nd order streams)
 - Grass zone: 25 feet max.
 - Minimum buffer width: 50 feet
 - Maximum buffer width: 180 feet
- Width requirements (3rd order streams)
 - Grass zone: 25 feet max.
 - Minimum buffer width: 100 feet
 - Maximum buffer width: 180 feet

Figure 4: Brief description of the CCRP funding and design characteristics that support the establishment of riparian forest buffers (CP22)

The shallow water area practice (CP9) consists of an area no larger than ten acres used to capture and hold water. The depth of the water cannot exceed an average of 18 inches. The area of shallow water must be surrounded by a buffer area between 20 and 120 feet in width. This buffer may be designed using the guidelines for the CP22 riparian buffer practice.

Shelterbelts (CP16A) can be used to protect farmsteads or livestock. Design characteristics allow for a 2- to 4-row shelterbelt for a farmstead or feed lot. For wildlife protection, a 5- to 10-row shelterbelt may be established.

The wetland restoration (CP23) and bottomland timber establishment on wetlands (CP31) practices are used to restore wetland ecosystems that have been under agricultural use. These practices support planting of hardwood and shrub species adapted to wet conditions. The wildlife habitat buffer on marginal pastureland (CP29) and wetland buffer on marginal pastureland (CP30) practices can help landowners plant trees and shrubs on marginal pasturelands. The incentives and buffer dimensions are similar in size to those associated with riparian buffers (CP22).

For more information about the CCRP, contact your local USDA/FSA office.

Missouri CREP Counties		
Adair	Daviess	Montgomery
Andrew	Dekalb	Nodaway
Bates	Gentry	Pettis
Barton	Harrison	Pike
Benton	Howard	Putnam
Buchanan	Johnson	Ralls
Caldwell	Knox	Randolph
Cass	Lafayette	Ray
Chariton	Lewis	Schuyler
Clark	Linn	Scotland
Clay	Macon	Shelby
Clinton	Monroe	Sullivan

Figure 5: Counties included in the Missouri Conservation Reserve Enhancement Program

1.1.3 Conservation Reserve Enhancement Program (CREP)

The conservation reserve enhancement program (CREP) is a joint Federal - State land retirement conservation program targeted to address local, state, and nationally significant agriculturally related environmental concerns. CREP is designed to reduce by 50 percent the risk of

CREP Practices

- Introduced grasses and legumes (CP1)
- Native grasses and legumes (CP2)
- Hardwood tree planting (CP3A)*
- Wildlife habitat (CP4D)*
- Contour grass strips (CP15A)
- Filter strips (CP21)
- Riparian forest buffers (CP22)*
- Wetland restoration (CP23)*

*Permit tree planting

Figure 6: Practices that are eligible for CREP funding

nutrients and sediment from farms entering the streams and reservoirs that supply rural water supplies to over 375,000 people. Missouri's goal is to retire 50,000 acres of highly erodible and environmentally sensitive land in 36 counties (Figure 5).

CREP is a voluntary program encouraging farmers and ranchers to enroll in CRP practices that address sediment run-off and water quality concerns by providing five financial incentives in addition to payments available through CRP. The additional financial incentives include:

- Signing Incentive Payment (SIP),
- Practice incentive payment (PIP),
- Soil rental rate increase of 15 percent or 25 percent of the dryland cash rental rate,
- State cost-share assistance (25 percent),
- State lump sum, one-time incentive equal to 150 percent of the annual rental rate.

There are eight practices eligible for the MO-CREP (Figure 6). Out of the eight eligible practices, four allow for tree planting, including CP3A, CP4D, CP22, and CP23. The first five

practices in Figure 6 pay 115 percent of the average soil rental rate, and the last three pay 125 percent.

CREP contracts are 14- to 15-year (contract length depends on sign-up time) and land enrollment follows the same guidelines as the CCRP enrollment. Marginal pastureland does not qualify for the MO-CREP.

For additional information on the MO-CREP, contact your local USDA/FSA office.

1.2 USDA/NRCS Funding Incentives for Agroforestry

The USDA/NRCS has four main programs that offer funds for tree planting and agroforestry. They are the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentive Program (WHIP), the Wetland Reserve Program (WRP) and the Conservation Security Program (CSP). In conjunction with the funding programs noted, the USDA/NRCS also provides technical assistance to landowners who are interested in conservation planning and application.

1.2.1 Environmental Quality Incentives Program (EQIP)

EQIP was created by the 1996 Farm Bill and combines the functions of the Agricultural Conservation Program (ACP), Water Quality Incentives Program (WQIP), and a couple of programs used primarily in the western United States. Funding through EQIP, directed states to establish designated, specific, targeted watersheds known as Conservation Priority Areas (CPA's) along with a state-wide program; however, the 2002 Farm Bill eliminated CPA's and made EQIP funds available state-wide. The State of Missouri has identified ten primary concerns to be addressed by EQIP funding. They are:

- Nutrient and pest management,
- Animal waste management,
- Health of grazing lands,
- Soil quality,
- Wildlife habitat,
- Forest health and management,

- Water conservation,
- Soil erosion,
- Stream bank protection,
- Expanded wildlife habitat management.

Sixty percent of the annual EQIP funding is designated for environmental concerns associated with livestock production. Landowners engaged in livestock or agricultural production can apply for 1- to 10-year contracts through a competitive application process based on environmental benefits. Eligible lands include cropland, rangeland, pasture, forestland, and other farm and ranch lands. Conservation practices are designed with the help of USDA/NRCS and other agencies to address the locally-identified priority resource concerns. EQIP contracts provide cost-share payments up to 50 percent of the establishment cost for conservation practices. Limited-resource farmers and ranchers may be eligible for up to a 75 percent cost-share.

Agroforestry Practices Funded by EQIP

1. Alley Cropping - \$50 payment per acre for up to 3 years on the land planted to trees and grass strip adjacent to trees. No more than 50 percent of the cropland can be enrolled.
2. Riparian Forest Buffers - \$50 per acre per year for up to 3 years.
3. Windbreak/Shelterbelt Establishment - a one-time incentive payment of \$0.10 per linear foot.

Figure 7: Agroforestry practices funded through EQIP

Additional incentive payments may be available for up to three years in order to support the use and management of the new conservation practice.

Specific agroforestry practices that can be funded through EQIP include: alley cropping, riparian forest buffers, and windbreak/shelterbelt establishment (Figure 7). For the alley cropping practice, funding incentives include a \$50-per-

acre payment for three years on the acres planted to trees and the grass buffer strip adjacent to the trees. These incentives can be paid on up to 50 percent of the acres in any cropland field.

For the establishment of riparian forest buffers, landowners may receive up to \$50 per acre on grassland or existing woodland located adjacent to permanent or intermittent streams, lakes, ponds, wetlands, and areas with ground water recharge. Using EQIP funds for riparian forest buffers on cropland is not recommended due to the availability of substantial funding in CCRP for riparian forest buffers on cropland.

EQIP will assist landowners who wish to establish a windbreak/shelterbelt by paying a one-time incentive payment of \$0.10 per linear foot.

EQIP also has funding available for certain practices that are not specifically considered agroforestry, but could indirectly assist landowners who are considering agroforestry. These practices are:

Forest harvest trails and landings - a flat rate cost-share used for the rehabilitation of areas frequently and intensively used in timber harvesting (\$300 for the first 20 acres, then \$15 for each additional acre).

Forest site preparation - a flat rate cost-share payment available for preparing sites for natural regeneration or tree and shrub planting (\$10 per acre for cropland sites and \$15 per acre for light preparation, \$40 per acre for medium preparation, and \$65 per acre for heavy preparation on non-cropland sites);

Forest stand improvement - flat rate cost-share payments are available for improving forest health and management through removal of competing vegetation (\$25 per acre for light improvement, \$40 per acre for medium improvement, and \$55 per acre for heavy improvement);

Tree/shrub establishment - 50 percent cost share for planting woody species, chemical or mechanical weed control measures for the first 5 years, tree shelters, weed barriers, root dips, fertilizer, and other animal damage control devices, fencing, and seedbed preparation;

Upland wildlife habitat management (Savanna restoration) - 50 percent cost-share payment for woody control, removal of individual trees that are not accessible to mechanical methods, and permanent forest openings which require some woody species removal.

The availability of this funding, potential contingencies and the applicability of each of these programs to specific on-farm goals, should be discussed with your local USDA/NRCS agent.

1.2.2 Wetland Reserve Program (WRP)

WRP is a voluntary land retirement program designed to establish and improve wetland areas. Three options are available to landowners, including: 1) a permanent land easement, 2) a 30-year land easement, and 3) a restoration cost-share agreement (Figure 8).

Under the permanent easement option, USDA/NRCS pays 100 percent of the costs of restoration and buys a perpetual land easement. The land easement is purchased at a value that is equal to the lesser of the agricultural value of the land, an established payment cap, or an amount offered by the landowner. The 30-year easement option pays 75 percent of the restoration costs and USDA/NRCS buys a 30-year easement at 75 percent of the value that would have been paid for a permanent easement. Finally, the restoration cost share option is a 10-year agreement that pays up to 75 percent of the costs for restoring degraded wetland habitat.

Wetland Reserve Program Options	
Permanent Easement	<ul style="list-style-type: none">• 100 percent cost-share for restoration• 100 percent land easement payment
30-year Easement	<ul style="list-style-type: none">• 75 percent cost-share for restoration• 75 percent land easement payment
Restoration Cost Share	<ul style="list-style-type: none">• 75 percent cost-share for restoration• 10-year agreement

Figure 8: Three options available through the Wetland Reserve Program (WRP)

Restoration of wetlands includes the planting of trees and shrubs. However, the trees and shrubs planted must be commonly found in wetland areas.

Land enrolled in the WRP still can be used for hunting, fishing, and other undeveloped recreational activities. In some cases, WRP land may even be grazed, cut for hay or harvested for wood products, providing wetland values are maintained.

To qualify for the permanent or 30-year easement, a landowner must have owned the land at least one year prior to enrolling in the WRP. However, to qualify for the restoration cost share, a landowner needs only to show proof of ownership.

Most farmed wetlands are eligible for WRP. However, ineligible land includes wetlands converted after Dec. 23, 1985; lands with timber stands established with CRP; federal lands; and lands where restoration is impossible.

1.2.3 Wildlife Habitat Incentive Program (WHIP)

WHIP is a program designed to develop and improve wildlife habitat on private land. Under

WHIP, the landowner and USDA/NRCS enter into a 5- to 10-year agreement that pays the landowner up to 75 percent of the cost to establish wildlife habitat practices, and allows USDA/NRCS agents the right to monitor the success of those practices. Forest land practices that qualify for WHIP funding include forest stand improvement, prescribed burning, woody cover removal (prairies and savannas), and wildlife herbaceous cover plantings. For agroforestry, the practices supported by WHIP can put existing timber stands under management which can lead to forest farming.

1.2.4 Conservation Security Program (CSP)

CSP, established by the 2002 Farm Bill, is designed to provide payments to producers for adopting or maintaining a wide range of management, vegetative, and land-based structural practices that address one or more resources of concern, such as soil, water, or wildlife habitat. Cropland, grazing land, and forest land that is an incidental part of the agricultural operation is eligible for the CSP program. However, cropland must have been cropped 4 out of 6 years prior to 2002. Lands enrolled in CRP, WRP, or the grass-

Conservation Security Program “Tiers” of Participation

- Tier I
Address one resource concern on a portion of the farm
5-year contracts (certain requirements for renewal),
Payment equal to 5 percent of average land rental for the specific land use,
50% cost share for adoption or maintenance of conservation practices,
\$20,000 payment limit per year.
- Tier II
Address one resource concern on entire farm
5- to 10-year contracts (renewable),
Payment equal to 10 percent of average land rental for the specific land use,
50% cost share for adoption or maintenance of conservation practices,
\$35,000 payment limit per year.
- Tier III
Address all resource concerns on entire farm
5- to 10-year contracts (renewable),
Payment equal to 15 percent of average land rental for the specific land use,
50% cost share for adoption or maintenance of conservation practices,
\$45,000 payment limit per year.

Figure 9: Summary description of the Conservation Security Program (CSP) tiers.

lands reserve program are not eligible. Animal waste storage or treatment facilities are also ineligible for the CSP.

Producers can participate in the CSP at one of three levels (tiers). Higher tiers require a greater conservation effort and offer greater payments. Figure 9 describes the conservation effort and the funding levels for each of the three tiers for the CSP.

Payments consist of a base payment and a cost share payment. The base payment is a percentage of the national per-acre average land rental rate for the specific land use, or another appropriate rate that ensures regional equity. The cost share is equal to 50 percent of the average county cost of adopting or maintaining practices.

The CSP also offers enhanced payments if the landowner uses multiple conservation practices; addresses local conservation priorities; participates in on-farm conservation research, demonstration, or a pilot project; is part of a watershed or regional resource conservation plan involving at least 75 percent of the producers in that area; or carries out assessment and evaluation activities for the conservation security plan.

None of the practices identified in the CSP are specifically agroforestry practices; however, agroforestry practices can be incorporated into the conservation security plan in order to meet the goals of certain practices. For example, one particular practice mentioned is conversion of a portion of cropland from a soil-depleting to a soil-conserving use. This soil conservation can be accomplished by using a well designed agroforestry practice.

CSP is available to landowners in specified watersheds only. For more information about CSP, contact your local USDA/NRCS office.

1.3 USDA/FS Incentive Program for Agroforestry

The USDA/FS has one program that supports private land management and agroforestry prac-

tices. The Forest Land Enhancement Program (FLEP) is a new program established by the 2002 Farm Bill that emphasizes sustainable management of private woodlots and other nonindustrial forested acres.

1.3.1 Forest Land Enhancement Program (FLEP)

The 2002 Farm Bill repealed the often underfunded Forestry Incentive Program (FIP) and the Stewardship Incentive Program (SIP), which were established by the Cooperative Forestry Assistance Act of 1978. In their place, the 2002 Farm Bill created the Forest Land Enhancement Program (FLEP). The program has seven major objectives including enhancing the implementation of agroforestry practices.

Specific activities and practices for Missouri that would qualify for up to a 75 percent cost share are;

1. the development of management plans,
2. afforestation and reforestation, including; tree and shrub establishment, woodland site prep, woody and herbaceous vegetation control, bottomland/wetland restoration,
3. forest stand improvement, including; woody vine control and woody vegetation control,
4. agroforestry implementation, including; alleycropping, shelterbelt/windbreak establishment and tree/shrub pruning,
5. water quality improvement and watershed protection, including; riparian woodland buffers, stream bank restoration and fencing,
6. fish and wildlife habitat improvement, including; prescribed burning, early successional management, herbaceous vegetation establishment and tree/shrub establishment,
7. forest health and protection, including woody vine and vegetation control,
8. invasive species control
9. fire and catastrophic risk reduction,
10. fire and catastrophic event reduction,
11. special practices, including; demonstration

sites, harvest prescription and timber marketing and restoration of fire-dominated forest communities.

Of the listed practices, top priority is given to practices 2 through 5 above.

To be eligible for the cost-share, you must be a non-industrial private forest landowner with at least 10 acres. Also, you must work with a state forester, another state official, or a professional resources manager to develop and implement a management plan that addresses site-specific activities and practices. Each nonindustrial private forest landowner can incorporate up to 1,000 acres into FLEP (this can be increased to 5,000 acres if the Secretary of Agriculture, in consultation with the state forester, determines that there are significant benefits from the acreage increase).

This USDA/FS program is administered through MDC. This program was not funded in 2004. For more information about FLEP, contact your local MDC office.

1.4 Sustainable Agriculture Research and Education Program (SARE) Funding Incentives

SARE funds are designed to help increase farmer and rancher knowledge and adoption of practices that are “economically viable, environmentally sound, and socially responsible.” SARE assigns funds based on a competitive grants program. Proposals submitted for funding through SARE are peer reviewed by regional administrative councils. Regional administrative councils are made up of diverse groups of producers, farm consultants, university researchers and administrators, state and federal government agency staff and representatives from non-profit organizations. Missouri is part of the North Central Region.

1.4.1 SARE Research and Education, Professional Development and Producer Grants

SARE has three types of funding. They are: 1) research and education grants; 2) professional development program grants; and 3) producer grants. Figure 10 gives a brief summary of the basics of each funding type.

Of the three funding types available through SARE, only one, the producer grant, is aimed at the landowner. Landowners who submit accepted proposals can receive up to \$15,000 to establish and maintain the sustainable practice that they propose. For groups of three or more landowners who develop a proposal together, funding is available for up to \$18,000. Partners or family members farming the same tract of land do not qualify as a group.

Agroforestry practices can be economically viable, environmentally sound and socially responsible. Therefore, landowners who want to adopt agroforestry practices can apply for SARE funding. However, due to the competitive grant process, there is no guarantee that a landowner’s proposal will be accepted. To find out more

SARE Funding Types
1. Research and education grants <ul style="list-style-type: none">• led by universities or nonprofit organizations• generally range from \$30,000 - \$200,000
2. Professional development program grants <ul style="list-style-type: none">• sponsor professional development training for Cooperative Extension, NRCS, and other agricultural professionals
3. Producer grants <ul style="list-style-type: none">• provide funds for landowners conducting on-farm research or demonstration projects• grants typically run between \$500 and \$15,000• three or more legally separate producers may receive up to \$18,000

Figure 10: Three types of funding programs administered by the Sustainable Agriculture Research and Education program (SARE).

about SARE producer grant applications and tips on how to write a winning proposal, visit SARE's website at www.sare.org/ncrsare, or contact the staff of the North Central Region SARE at:

*North Central Region SARE
University of Nebraska - Lincoln
13A Activities Building
P.O. Box 830840
Lincoln, NE 68583-0840
(402) 472-7081 email: ncrsare@unl.edu*

1.5 USFWS Partners for Fish and Wildlife (PFW) Funding Incentive

The PFW Program emphasizes native habitat restoration on an ecosystem and landscape scale, including riparian corridors, in-stream habitat, wetlands, upland native grasslands, and others. The goal of PFW is to help conserve, protect and enhance fish, wildlife, plants, and their habitats. A voluntary program, PFW focuses on restoring native vegetation to areas that have been affected by intensive land-use practices. Stream habitat restoration projects are prioritized based on imperiled species which are in greatest need of habitat restoration. For Missouri, these species include: Topeka shiner, Niangua darter, scaleshell mussel, Ozark cavefish, Neosho mucket, Arkansas darter, and Neosho madtom.

Landowners who wish to participate in this program must voluntarily agree to maintain/manage the habitat in its restored condition for no less than 10 years. The USFWS will provide at least 75 percent of the costs to restore the project area. If landowners agree to maintain/manage the area for additional years, the cost-share could reach as much as 95 percent. Cost-share funds are provided for native trees, shrubs, grasses, fencing, alternative watering sources for livestock, and contracted labor.

For more information on the PFW program, contact your local MDC Private Land Conservationist or the USFWS in Columbia, Missouri, toll free: 1-877-275-9134 .

2. State Funding Incentives for Agroforestry

In Missouri, three agencies provide the majority of the available state funding in support of agroforestry. These agencies are the Missouri Department of Agriculture (MDA), the Missouri Department of Conservation (MDC), and the Missouri Department of Natural Resources (DNR) (Figure 11).

2.1 Missouri Department of Agriculture Incentive Programs for Agroforestry

The Missouri Department of Agriculture (MDA) has one main program that can be used to establish agroforestry practices: the Alternative Loan Program.

2.1.1 Alternative Loan Program

The MDA offers direct loans through the Agriculture Development Fund to finance the production, processing, and marketing needs of an alternative agricultural enterprise. Alternative loans can be for up to \$20,000, with an interest rate of 7.5 percent and maximum term of 5 years with semi-annual payments.

Alternative agricultural enterprises that would be common in agroforestry settings include horticultural production and marketing; tree farming, shrubs and landscaping plants; fee hunting; apiaries; and value added enterprises such as processing equipment and packaging. Other projects that are funded include organic production enterprises; portable greenhouses, and irrigation equipment. This list is only a sample of possible enterprises.

The purpose of the alternative loan program is to promote entrepreneurial thinking, therefore, there is a great deal of flexibility as to what can be funded. MDA does recommend that potential borrowers check resources, talk to others, look for something in demand, visit markets and observe what is selling, attend conferences and workshops, read and plan.

For more information on the Alternative Loan Program, contact:

*Missouri Department of Agriculture
Market Development Division
Agriculture Development Fund Program
P.O. Box 630
Jefferson City, MO 65102
Phone: (573)751-4762*

2.2 Missouri Department of Conservation Incentive Programs for Agroforestry

The Missouri Department of Conservation (MDC) is a valuable resource for landowners who wish to adopt agroforestry. Much of the help offered by MDC is in the form of technical advice and partnerships with other agencies. However, MDC does have two programs that offer financial incentives to landowners who wish to adopt agroforestry practices. These two programs are called the Missouri Agroforestry Program and the MDC Cost Share Program. Availability of funds for these and other MDC programs are dependent upon year-to-year state budget constraints.

Missouri State Funding Incentives for Agroforestry

Missouri Department of Agriculture (MDA)

- Alternative Loan Program

Missouri Department of Conservation (MDC)

- Missouri Agroforestry Program
- MDC Cost Share Program

Missouri Department of Natural Resources

- Soil and Water Conservation Program (SWCP) Cost Share
- Agricultural Non-Point Source (AgNPS) Special Area Land Treatment Program (SALT) Grants

Figure 11: Funding Incentives for agroforestry offered through Missouri state agencies

2.2.1 *The Missouri Agroforestry Program*

The Missouri Agroforestry Program was established in 1990 with the passage of the Missouri Economic Diversification and Afforestation Act. This act was amended in 2001 with the passage of House Bill 904. The program is designed to compliment an existing or new Conservation Reserve Program (CRP) plan by providing financial assistance to share the cost (up to 75 percent) of establishing the trees and/or shrubs to be used in an agroforestry management program. Similar to CRP, enrollment in this program also entitles landowners to receive an annual incentive payment for up to 10 years. The amount of the incentive payment made to the landowner will be the lesser of:

1. an amount which when added to any cash or in-kind net income produced by crops raised on the land, is substantially equal to the amount per acre previously paid or would have been paid to the landowner under the CRP program; or
2. an amount less than that provided in 1 above, if such lesser amount does not significantly reduce the number of acres for which agroforestry incentive payments are made.

In other words, landowners are expected to pursue alternative market opportunities that are made available through the establishment of agroforestry practices. Therefore, they are allowed to generate income from the trees, shrubs or alternative crops. In years where no income from these alternative products is earned, the landowner will receive an incentive payment equal to the amount received as a soil rental payment from CRP. For example, if CRP would have paid the landowner \$65 per acre as a soil rental payment, then the program would pay the landowner \$65 per acre. Participants who are successful at generating an income from their alternative products may still receive an annual incentive payment. However, the annual incentive payment will be equal to the anticipated CRP soil rental payment (for example, the \$65 per acre soil rental payment) minus the net

income per acre earned through the marketing of alternative products.

Agroforestry practices that are covered by the Missouri Agroforestry Program include alley cropping, forested-riparian buffers, silvopasture, and windbreaks. To participate in the program, a written application must be submitted to the MDC. Landowners who qualify for this program will work closely with MDC personnel to ensure that the practice meets design and establishment criteria. Eligible lands include highly erodible land that has an erodibility index equal to or greater than eight over at least one-third of the designated field. Highly erodible land that has been enrolled in CRP on or after 1990 is also eligible.

Currently, the Missouri Agroforestry Program is not funded and may be subject to the limited application periods of the CRP regular sign-up. However, the State of Missouri is working on providing funds for this program.

2.2.2 *MDC Cost Share Program*

The MDC Cost Share Program offers cost share funds to private landowners who are not enrolled in any other federal or state incentive program. There are two areas of the Cost Share Program that can be applied to agroforestry: 1) MDC 700 tree/shrub establishment (Figure 12); and 2) MDC 900 woodland improvement (Figure 13). Both of these areas offer a 75 percent cost share on all approved practices, unless a flat fee has been established for the practice

The tree and shrub establishment practice (MDC 700) allows landowners to plant native trees and shrubs where needed for conservation purposes such as reforestation, watershed protection, wildlife habitat, erosion control, pollution control, filter or buffer strips, and energy conservation. Orchards and Christmas tree plantations are not eligible. MDC will pay a flat rate or a 75 percent based on approved component costs up to a total of \$15,000 per landowner per year, inclusive of all cost-shared practices. Cost share funds can be used to cover the costs of

nursery stock, root production method (RPM) seedling establishment, planting, weed control, site preparation for natural and artificial regeneration, and seeding. In return for the cost share assistance, landowners must maintain the plantings for a minimum of 15 years following the installation of all required practices. From an agroforestry standpoint, these funds could be used to establish riparian buffers and windbreaks.

MDC 700 Tree/Shrub Establishment

- 75 percent cost share for:
nursery stock
RPM seedling establishment
planting
weed control
site preparation
seeding
- 15-year agreement
- Orchards, Christmas tree plantations, and land enrolled in CRP are not eligible

Figure 12: Summary of the MDC 700 tree/shrub establishment cost share program.

The woodland improvement practice (MDC 900) can be used to improve timber production, wildlife habitat and forest health. Cost share funds can be used to offset the cost of thinning, chemicals used to remove competing vegetation, pruning, and crop tree release. Three different levels of thinning can be applied based on the basal area (BA) that is being removed:

- light thinning (20-30 BA)
- medium (30-40 BA)
- heavy (>40 BA).

Funds cannot be used for commercial thinning, Christmas tree plantings, or orchards. Livestock and grazing must be excluded from the treated acreage. Landowners can receive up to 75 percent reimbursement on projects costing up to \$5000 each year, and all practices must be maintained for at least 10 years. The MDC 900 cost share funds can be used to prepare an existing timber stand for a forest farming practice if approved by a MDC resource professional.

MDC 900 Woodland Improvement

- Pays for thinning, pruning, chemicals and crop-tree release
- 75% cost share
- \$3,750 maximum annual payment per project
- 10-year agreement
- Does not apply to commercial thinning
Christmas tree plantings, or orchards
- Does not allow livestock grazing

Figure 13: Summary of the MDC 900 woodland improvement practice.

2.3 Missouri Department of Natural Resources Incentive Programs for Agroforestry

The Missouri Department of Natural Resources (DNR) has two programs funded through the Soil and Water Conservation Program (SWCP) that can be used to offset the costs of establishing and maintaining certain agroforestry practices. These programs include a State SWCP cost share and the Agricultural Nonpoint Source (AgNPS) Special Area Land Treatment (SALT) program grants.

2.3.1 State SWCP Cost Share

The State Soil and Water Conservation Program (SWCP) cost share is a program funded by a portion of the Missouri Parks and Soils Sales Tax. Landowners who implement approved soil and water conservation practices that conserve soil, and consequently improve water quality by reducing sedimentation, may receive up to 75 percent cost share for the establishment of these practices.

There are numerous practices listed that are eligible for cost share; however, only one of the practices has direct application for agroforestry. Forest plantation (DFR-4) allows landowners to plant trees on marginal sites in order to encourage less intensive use and to reduce soil erosion. The stated goal of this practice is to convert marginal land into woodland. Cost share is authorized for :

- Seed or seedlings, seedbed preparation and seeding or planting.

- Field fencing to exclude livestock from woodland that lies within an existing functional interior or property line fence.
- Site preparation that is necessary to level gullies to accommodate a mechanical tree planter. Site preparation should not be used simply to clear or remove undesirable tree species so that desirable species can be planted.

Planting of orchard trees, ornamental trees and Christmas trees is not authorized for cost share funding. For land to be eligible, it must be subject to excessive erosion or have slopes of greater than 10 percent.

2.3.2 Agricultural Non-point Source (AgNPS) Special Area Land Treatment (SALT) Program

The Special Area Land Treatment (SALT) program is another element of the Soil and Water Conservation program that provides financial assistance to landowners who are willing to implement best management practices (BMP's) on their land for the purpose of improving water quality. Originally, the SALT program only focused on reducing water pollution caused by sedimentation resulting from erosion of agricultural land. The Agricultural Non-point Source SALT (AgNPS/SALT) program is the latest version of the SALT program and is designed to reduce all forms of agricultural non-point source pollution, including sedimentation.

The AgNPS/SALT program awards grants of up to \$750,000 to Soil and Water Conservation Districts (SWCD's) that identify priority watersheds that are suffering degradation caused by agricultural non-point source pollution problems. Local SWCD's can apply for one of these grants by identifying a

watershed needing protection, and setting goals by prioritizing BMP's to lessen the impacts of water quality impairments related to agricultural production. The purpose of the AgNPS/SALT program is to provide the resources for local people to identify and solve local problems.

Landowner's within the selected watersheds may apply to the local SWCD's to receive a cost share of up to 75 percent for the establishment of priority BMP's. In addition to the forest plantation (DFR-4) practice described in the SWCD cost share program, acceptable agroforestry BMP's include riparian forest buffers (N391) and windbreak/shelterbelt establishment (N380) (Figure 14).

Riparian forest buffers (N391) can be established on areas adjacent to permanent or intermittent streams, public drinking water reservoirs, and wetlands and ground water recharge areas. Cost share is offered at 75 percent of county average cost or actual cost for establishment of those components technically necessary to certify the practice according to NRCS standards. An out-of-production incentive payment may be authorized on a per acre, per year, basis not to

Agroforestry Practices Supported by AgNPS/SALT

- Forest Plantations
 - Up to 75 percent cost share
 - Pays for seeds, seedling, site prep, and field fencing
 - Does not include orchard plantings
- Riparian Forest Buffers
 - Up to 75 percent cost share
 - Out-of-production incentive payment may be authorized
 - 10-year agreement
- Windbreak/Shelterbelt
 - Only approved in seven counties in Missouri
 - Up to 75 percent cost share
 - One time incentive payment of \$1.50 per foot, per row
 - 10-year agreement

Figure 14: Three agroforestry practices funded by the AgNPS/SALT program

exceed 3 years per participant. The landowner must maintain the practice in accordance with NRCS standards and specifications for 10 years.

Windbreak/shelterbelt establishment (N380) can be approved for areas in Butler, Scott, Stoddard, Mississippi, New Madrid, Dunklin, or Pemiscot counties where woody plants are suited. The purpose of establishing a windbreak/shelterbelt is to reduce soil losses from wind erosion, protect plants and improve irrigation efficiency to maintain water quality.

Applicants must develop and apply a management plan based on NRCS standards for at least one of these stated purposes. Approved plans can receive up to a 75 percent cost share of the county average cost or actual cost, whichever is less, of the components technically required to install the practice. Along with the cost share, a one-time incentive payment of \$1.50 per foot, per row, of windbreak/shelterbelt is authorized for approved plans. The landowner must maintain the practice in accordance with NRCS standards and specifications for 10 years.

3. Private Funding Sources for Agroforestry

Besides the funding available through Federal and State programs, landowners may also wish to check for opportunities from private organizations (Figure 15). Numerous private organizations offer grants, cost-share and equipment-on-loan for landowners who are improving wildlife habitat with timber stand improvement or by planting shrubs, trees and forages. Examples of these private organizations include the National Fish and Wildlife Foundation (NFWF), the National Wild Turkey Federation (NWTf), Quail Unlimited (QU), Ducks Unlimited (DU) and Pheasants Forever (PF).

3.1 The National Fish and Wildlife Foundation (NFWF) Grant Programs

The National Fish and Wildlife Foundation (NFWF) is a private, non-profit, 501(c)(3) tax-exempt organization established by Congress in 1984. NFWF works to foster cooperative partnerships to conserve fish, wildlife and plant resources through the use of Challenge Grants. NFWF grants are called “Challenge Grants” because funding is based on an applicant’s ability to generate additional sources of funding. These additional funds generated by the grantee are called “Challenge Funds.” Challenge funds must be:

- Non-federal in origin (federally appropriated or managed funds cannot be used to

- match a Foundation grant);
- Derived from sources other than the project grantee (i.e., third party);
- Raised and dedicated specifically for the project in question;
- Applied only to the Foundation grant and not to other federal matching programs.

Many grants are available through NFWF; however, two grant programs have implications for private-land agroforestry. They are the Native Plant Conservation Initiative in partnership with the Plant Conservation Alliance (PCA), and Conservation on Private Lands in partnership with NRCS.

3.1.1 The Native Plant Conservation Initiative

The Plant Conservation Alliance (PCA) in partnership with the National Fish and Wildlife Foundation (NFWF) offers a challenge grant program that promotes funding for the benefit of declining native plant species. The NFWF will match Challenge Funds at a 1:1 ratio (i.e. one dollar of non-federal funds will be matched with one dollar of federal funds). The call for proposals begins in early June and closes in mid-August. Successful grants are those seeking funding for projects that:

- Provide plant conservation benefits,
- Provide benefits to multiple species,
- Have direct benefits to plants, fish, wildlife and other biotic resources on public lands,
- Have multiple and innovative partnerships, demonstrate the ability to find matching funds exceeding the minimum 1:1 federal/non-federal requirement,
- Use innovative ideas, such as landscape approaches, shareable new technologies, and teaching by example opportunities, achieve a variety of resource management objectives,
- Meet NEPA, Section 7 ESA, or other legal requirements and have all necessary permits and clearances.

<p>Private Funding Sources for Agroforestry</p> <p>National Fish and Wildlife Foundation (NFWF)</p> <ul style="list-style-type: none">-Native Plant Conservation Initiative-Conservation on Private Lands <p>National Wild Turkey Federation (NWTf)</p> <p>Quail Unlimited (QU)</p> <p>Ducks Unlimited (DU)</p> <p>Pheasants Forever (PF)</p>

Figure 15: Private funding sources for agroforestry

3.1.2 Conservation on Private Lands

The NFWF has partnered with the NRCS to provide a challenge grant that promotes effective conservation and stewardship on private lands. This particular challenge grant recommends that the applicant find additional funding at a 2:1 ratio. In other words, for every two dollars in non-federal funds, goods, or services, one dollar will be awarded by the Foundation. Qualified projects must meet the following criteria:

- Conservation on Working Landscapes - projects that integrate conservation practices in ongoing agriculture, ranching and forestry operations; and projects that link NFWF Challenge Grants with larger NRCS programs such as WRP, CRP and EQIP.
- Demonstrated Value for Fish and Wildlife - projects must clearly define the conservation problem that is being addressed and explain how the project will provide measurable benefits for fish and wildlife.
- Partnerships - projects must demonstrate diverse partnerships among a variety of stakeholders, with special emphasis on projects that unite conservation and agricultural interests.
- Leverage - projects must meet the minimum 1:1 match ratio, with a 2:1 match ratio strongly encouraged.
- On-The-Ground - projects must have a strong “on-the-ground” component, although capacity building, community development and other goals may be included.
- Landscape Scale - projects that address agricultural conservation at a watershed or landscape scale will be given preference.
- Immediacy of Need - projects must demonstrate a clear need for funding and proposals should define a time-line for implementation (which should be less than 1 year).

For more information about these two Challenge Grant programs, contact the National Fish and Wildlife Foundation at:

<http://www.nps.gov/plants/nfwf/index.htm>

http://www.nfwf.org/programs/grant_apply.htm

or contact NFWF at (202) 857-0166.

3.2 National Wild Turkey Federation Funding Incentives

The National Wild Turkey Federation (NWTf) is a private organization that promotes scientific wildlife management on public, private and corporate lands as well as wild turkey hunting as a traditional North American sport. Members of the NWTf may purchase tractor-trailer loads of seed for the cost of shipping through the Conservation Seed Program for habitat improvement projects. The Wild Turkey Woodlands program provides opportunities for landowners who actively manage their farms, ranches or woodlands for wild turkey and other wildlife to purchase seed and seedlings at a reduced cost. For more information about the NWTf contact the organization at:

*The National Wild Turkey Federation
Post Office Box 530
Edgefield, SC 29824-0530
1-800-THE-NWTf
<http://www.nwtf.org>.*

3.3 Quail Unlimited Funding Incentives

Quail Unlimited (QU) is a national, non-profit conservation organization dedicated to the wise management and conservation of America’s wild quail as a valuable and renewable resource. Local QU chapters raise funds for local habitat and education projects, state wildlife departments, upland game bird management, habitat research and education programs. QU organizations are involved in:

- Challenge Grants with the NFWF,
- Answer the Call, a partnership program with the USFS emphasizing quail management throughout the U.S.,
- Quail Habitat Improvement Programs, that

provide local chapters with free seed, low cost trees/shrubs, equipment on loan. QU supports numerous other habitat improvement practices.

To find out more about Quail Unlimited, contact your local chapter, Or write to:

Quail Unlimited National Headquarters
31 Quail Run or P. O. Box 610
Edgefield, SC 29824
Phone: (803) 637-5731
Fax: (803) 637-0037
<http://www.qu.org>

3.4 Ducks Unlimited Funding Incentives

Ducks Unlimited (DU) is a private conservation group that was started about 65 years ago by a group of sportsmen and has become the largest wetland and waterfowl conservation organization in the world. DU offers a variety of programs to restore grasslands, replant forests, and restore watersheds. These programs are designed to:

- help landowners enroll in government-subsidized easement and set-aside programs;
- purchase and distribute, on-loan, planting equipment for replanting natural grasses on lands no longer used for agriculture;
- plant hardwood seedlings in the Mississippi Alluvial Valley;
- restore drained wetlands, protect stream corridors, and establish buffer strips.

DU works in partnership with landowners, federal agencies and other private agencies to implement their programs. Their programs include:

- purchasing land, restoring land and donating land to agencies that will manage it for wildlife;
- purchasing perpetual conservation easements;
- offering financial incentives to landowners who agree to manage their land for waterfowl and other wetland wildlife for a period of 10 years;

-challenge grants that provide landowners with cost share through the North American Wetlands Conservation Act (NAWCA) of 1989.

For more information about programs offered by DU, visit their website at <http://www.ducks.org>, or write to:

Ducks Unlimited, Inc.
One Waterfowl Way
Memphis, TN, 38120
Phone: 1-800-45DUCKS or (901) 758-3825

3.5 Pheasants Forever Funding Incentives

Pheasants Forever (PF) is a private, non-profit conservation organization founded in 1982 in response to a declining ring-necked pheasant population. PF is dedicated to the protection and enhancement of pheasant and other wildlife populations in North America through habitat improvement, land management, public awareness, and education. Such efforts benefit landowners and wildlife alike. PF's unique system of county chapters allows 100 percent of net funds raised by chapters to remain at the chapter level for local habitat projects.

Local PF chapters raise money to support five habitat restoration programs. These five programs are:

- food plots,
- nesting cover,
- woody cover,
- land purchases,
- wetland restoration.

For more information about PF and programs that are available, contact your local PF chapter, visit on the web at <http://www.pheasantsforever.org>, or write to:

Pheasants Forever
1783 Buerkle Circle
St. Paul, MN 55110
Phone: (651)773-2000
or toll free: 1-877-773-2070

Federal Funding Incentives by Practice/Benefit

Agency/Program

Practice/Benefit

	Alley Cropping	Riparian Buffers	Wind-breaks	Silvo-pasture	Forest Farming	Timber Stand Improvement	Tree Planting	Wildlife
USDA/FSA								
Conservation Reserve Program (CRP)							CS,LE,M	CS,LE,M
Continuous Conservation Reserve Program (CCRP)		CS,LE,IP,M	CS,LE,IP,M					
Conservation Reserve Enhancement Program (CREP)		CS,LE,IP,M					CS,LE,IP,M	CS,LE,IP,M
USDA/NRCS								
Environmental Quality Incentives Program (EQIP)	IP	IP	IP				CS	CS
Wetland Reserve Program (WRP)		CS,LE					CS,LE	CS,LE
Wildlife Habitat Incentive Program (WHIP)					CS			CS
Conservation Security Program (CSP)	CS,LE	CS,LE	CS,LE	CS,LE				CS,LE
USDA/FS								
Forest Land Enhancement Program (FLEP)	CS	CS	CS	CS		CS	CS	CS
SARE								
Producer Grants	G	G	G	G	G	G	G	G
USFWS								
Partners for Fish and Wildlife (PFW)		CS					CS	

CS = Cost Share (ranges from 50% to 90%, based on a predetermined expected cost structure)

LE = Land Easement (Rental payments based on an average rental rate per land use type; easements are typically 5, 10, 15, 30 years or permanent)

M = Annual maintenance payments (range from \$5 - \$10 per acre)

IP = Additional incentive payments (payments could include sign-up bonuses, additional cost-share, and/or increased land easement rates)

G = Grants

State and Private Funding Incentives by Practice/Benefit

Agency/Program	Practice/Benefit									
	Alley Cropping	Riparian Buffers	Wind-breaks	Silvo-pasture	Forest Farming	Timber Stand Improvement	Tree Planting	Wildlife		
MDA Alternative Loan Program					X					
MDC Missouri Agroforestry Program	CS,LE	CS,LE	CS,LE	CS,LE						
MDC Cost Share Program						CS	CS			
DNR Soil and Water Conservation Program (SWCP) Cost Share							CS			
Agricultural Non-Point Source (AgNPS)Special Area Land Treatment Program (SALT) Grants		CS,IP	CS,IP				CS			
NFWF Native Plant Conservation Initiative Conservation on Private Lands									CG	CG
NWTF Member Programs							CS			
QU Member Programs							CS			
DU Member Programs		CS,LE					CS			
PF Member Programs		CS,G				CS,G				

CS = Cost Share (ranges from 50% to 90%, based on a predetermined expected cost structure; or relates to a reduced cost for seeds or seedlings)

IP = Additional incentive payments (payments could include sign-up bonuses, additional cost-share, and/or increased land easement rates)

G = Grants

CG = Challenge Grants (applicants must generate additional sources of funding)

X = General applicability (indirectly applies to a specific benefit)

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Tax Considerations for the Establishment of Agroforestry Practices

by Larry D. Godsey, Economist, University of Missouri Center for Agroforestry

Agroforestry is an integrated set of land management practices that helps land and forest owners to diversify products, markets and farm income, while simultaneously improving soil and water quality, enhancing wildlife habitat and sustaining land resources for long-term use. The five practices of agroforestry — alley cropping, silvopasture, riparian forest buffers, forest farming and windbreaks — offer a landowner opportunities for long-term income from areas that may not be currently utilized.

However, federal tax incentives may provide the greatest benefit to some landowners. Accordingly, agroforestry tax advantages can also be derived from four areas: 1) reforestation, 2) business investment, 3) conservation tax laws, and 4) long-term capital gains. These four areas of the Internal Revenue Code (IRC) are reviewed in this document.

According to the Internal Revenue Service (IRS), a farm business is defined as “. . . the trade or business of cultivating land or raising or harvesting any agricultural or horticultural commodity. This includes “. . . raising or harvesting of trees bearing fruits, nuts, or other crops. . . .” In other areas of the IRC, the IRS specifically says “you are not farming if you are engaged only in forestry or the growing of timber.” This seems to complicate the position of the taxpayer who has adopted agroforestry practices for the production of both agricultural commodities and timber. However, because agroforestry consists of raising trees and agricultural commodities, tax

advantages for the agroforester can come from both forestry and farming incentives.

Reforestation Incentives

Tax law changes in 2004 phased out the section 48 reforestation tax credit, but increased the advantages from the section 194 reforestation deduction. Reforestation costs up to \$10,000 that are incurred on or before October 22, 2004 are still eligible for the reforestation tax credit and reforestation amortization deduction. However, reforestation costs that are incurred after October 22, 2004 are now subject to the new rules in section 194.

Section 194

Section 194 of the IRC describes the reforestation deduction and the amortizable basis deduction. This incentive is directed towards “commercial timber production” and is applicable to agroforestry. Under section 194, the taxpayer may deduct (expense) up to \$10,000 (\$5000 if married and filing separately) per qualified property per year of reforestation expenditures and amortize the remaining expenditures over an 84-month period. This change eliminates the \$10,000 amortization deduction limit.

As an example, suppose a landowner spends \$30,000 in 2005 on qualified reforestation costs, then they may deduct \$10,000 and amortize the remaining \$20,000. Table 1 (next page) shows the annual percentage deduction for an 84-month amortization period. The total deductions from this reforestation would be as follows:



- **Year 1: \$10,000** recorded on Schedule F (Form 1040) line 34a-f (Other expenses) as an itemized deduction, \$1428.57 ($\$20,000 \times 1/14$) recorded as “qualified forestation and reforestation costs” on line 42 of Form 4562.
- **Years 2-7: \$2857.14** ($\$20,000 \times 1/7$) per year, recorded as “qualified forestation and reforestation costs” on Form 4562.
- **Year 8: \$1428.57** ($\$20,000 \times 1/14$) recorded as “qualified forestation and reforestation costs” on Form 4562.

Table 1: Annual Reforestation Amortization Deduction Percentage	
Year of Deduction	Percentage of Amortizable Reforestation Expenses Deducted
Year 1	1/14 or 7.14%
Years 2-7	1/7 each year or 14.29% each year
Year 8	1/14 or 7.14%

When filling out Form 4562, a separate sheet of paper should be attached for each property with the following information:

- a description of the costs and the dates they were incurred;
- a description of the type of timber being grown and the purpose for which it is being grown.

This form needs to be filed on a timely basis, including extensions, in the year in which the expenses are incurred. However, if the taxpayer did not choose to take the deduction on a timely filed return, but decides to take the deduction later, it is still possible. The taxpayer may file an amended return within six months of the due date of the original return, not including extensions.

Figure 1 (right) details what the IRS considers “qualified forestation and reforestation costs.” This deduction does not apply to Christmas tree production, ornamental tree production, trees planted solely to produce nuts or fruit, shelterbelts or windbreaks. The

Figure 1: IRS Qualified Reforestation Expenditures

“Direct costs incurred in connection with forestation or reforestation by planting or artificial or natural seeding, including costs -

- (i) for the preparation of the sites;
- (ii) of seed or seedlings; and
- (iii) for labor and tools, including depreciation of equipment such as tractors, trucks, tree planters, and similar machines used in planting or seeding.”

(Internal Revenue Code: Title 26, Subtitle A, Chapter 1, Subchapter B, Part VI, section 194)

reforested area must be at least one acre in size and located in the United States.

The goal of this program is timber production. Growing trees for purposes other than timber production would not qualify for the reforestation deduction and amortization basis deduction. For example, eastern black walnut trees planted in an alley cropping practice can benefit from the reforestation amortization deduction if the trees are maintained in such a way that 1) a marketable butt log will be harvested in the future and 2) timber production is the primary purpose of the plantation. Any nut crop would be an incidental enterprise that would be taxed as ordinary farm income. Expenses that are incurred in the harvesting and marketing of the nut crop would be deducted as ordinary farm expenses.

As mentioned earlier, “commercial timber production” would have to be the focus of the agroforestry practice in order for it to qualify for the reforestation amortization deduction. The IRS recognizes a written forest management plan as one way of indicating a focus on “commercial timber production.”

Business Investment Incentives

As a landowner engaged in an active farming or forestry business, section 179 of the IRC provides a special deduction for personal property. Personal property that is used more than 50 percent in a farming or forestry business qualifies for the deduction.

Section 179

Section 179 of the IRC provides a taxpayer with the option of deducting the cost of certain qualifying property in the year it was placed in service instead of taking the annual depreciation deductions. Under the rules of the section 179 deduction, a taxpayer may elect to deduct costs up to \$105,000 for personal property that is used in an active trade or business. Since agroforestry often involves active participation in the business of growing crops, livestock, or timber, the section 179 deduction should be considered. The deduction cannot exceed total taxable income from all sources in the year that the qualifying property is put into service. Therefore, the deduction is the smaller of total taxable income or \$105,000. If total taxable income is less than \$105,000, then the difference between \$105,000 and total taxable income can be carried forward to the next year.

The property must qualify based on the rules described by section 1245 which basically states that it must be depreciable personal property that is used as an integral part of an active trade or business. This does not include investment property or other property that is purchased solely for the production of income. Figure 2 has a partial list of qualifying property for section 179.

Figure 2: Qualifying Property Under Section 179

- **Tangible personal property** (e.g. agricultural fences, machinery, and equipment)
- **Business property** (all business property, other than structural components, contained in or attached to a building... e.g. office equipment)
- **Livestock**
- **Single purpose agricultural** (livestock) or horticultural structures

(IRS Publication 225, Farmer's Tax Guide. 2005)

Calculating the Section 179 Deduction

Calculation of the section 179 deduction is relatively straightforward. However, it is subject to three limits:

- the maximum dollar limit
- the investment limit
- taxable income limit

Along with these three limits, it is also important to note that the section 179 deduction must be figured before determining the depreciation deduction. This prevents the taxpayer from taking both the section 179 deduction and a depreciation deduction on the same dollar value of property.

As an example of the maximum dollar limit, suppose a taxpayer purchases qualifying property in the year 2005 that totals \$110,000. Based on the maximum dollar limit, only \$105,000 of that purchase can be considered for the section 179 deduction. The remaining \$5,000 becomes the unadjusted basis for the purchased property and can be depreciated. It is important to understand that section 179 does not specify how the maximum dollar limit is met by the taxpayer. In other words, suppose in the year 2005 a taxpayer purchases a tractor for \$12,000, a walnut harvester for \$8,000, and fully operational shelling operation for \$90,000. Each of these purchases qualifies for the section 179 deduction, but it is up to the taxpayer to determine how to meet the \$105,000 maximum dollar limit. For example, the taxpayer may choose to deduct the purchase prices for the tractor and the shelling operation ($\$12,000 + \$90,000 = \$102,000$) and depreciate the harvester (\$8,000). Or, the taxpayer may choose to deduct the cost of the tractor, harvester, and part of the shelling operation ($\$12,000 + \$8,000 + \$85,000 = \$105,000$) and depreciate the remaining shelling operation cost (\$5,000).

The second limit placed on the section 179 deduction is the investment limit. The maximum dollar limit will be reduced if the taxpayer exceeds the maximum investment limits of \$420,000. If a taxpayer has over \$420,000 of qualified property for a given year, then the \$105,000 deduction limit is reduced one dollar for every dollar of qualified property over \$420,000. For example, if a taxpayer purchases \$422,000 of qualified property in a given year, then the \$105,000 maximum dollar limit must be reduced by \$2,000, making the maximum deductible amount \$103,000.

The final limit on the section 179 deduction is the taxable income limit from the conduct of any active trade or business during the year. As an example, suppose a \$12,000 tractor is purchased that will be used to plant, prune, or harvest crops and timber in an alley cropping practice. If the taxpayer's total taxable income from the farming business for the year

in which the tractor was purchased is \$20,000, then the taxpayer may deduct \$12,000 from that amount. However, if the taxpayer's total taxable income from the farming business in the year the tractor was purchased is only \$10,000, then \$10,000 of the tractor cost may be deducted and the remaining \$2,000 must be carried forward for deduction in the following year. For many landowners, there may be more than one type of deduction that is based on taxable income, such as a charitable contribution.

The IRS suggests the following eight-step method to determine the amount of deductions to take:

- **Step 1:** Figure taxable income without the section 179 deduction or the other deduction. For example, suppose that the taxable income before the section 179 deduction or the charitable contribution deduction was calculated at \$15,000.
- **Step 2:** Figure a hypothetical section 179 deduction using the taxable income figured in Step 1. Suppose the taxpayer had \$13,000 worth of qualifying property. Based on the limits determined by section 179, this taxpayer's maximum section 179 deduction can only be \$13,000.
- **Step 3:** Subtract the hypothetical section 179 deduction figured in step 2 from the taxable income figured in step 1. This equals \$2,000 (\$15,000 - \$13,000).
- **Step 4:** Figure a hypothetical amount for the other deduction using the amount figured in Step 3 as taxable income. Using the \$2,000 from step 3 as taxable income and applying the 50 percent rule for charitable contributions, the taxpayer may hypothetically deduct up to \$1,000 for charitable contributions.
- **Step 5:** Subtract the hypothetical other deduction figured in step 4 from the taxable income figured in step 1. This equals \$14,000 (\$15,000 - \$1,000).
- **Step 6:** Now figure the actual section 179 deduction using the taxable income figured in Step 5. Using the \$14,000 figured in step 5, the taxpayer would still be able to deduct \$13,000.

- **Step 7:** Subtract the actual section 179 deduction figured in step 6 from the taxable income figured in step 1. This equals \$2,000 (\$15,000 - \$13,000).
- **Step 8:** Figure the actual other deduction using the taxable income figured in step 7. The taxable income figured in step 7 was \$2,000. The actual deduction for charitable contributions would be \$1,000.

Because of the numerous assumptions and exceptions to taxable income deductions, it would be to the advantage of the taxpayer to seek professional guidance when more than one deduction is available.

Reporting the Section 179 Deduction

The section 179 deduction is reported on Form 4562 and can be filed with either an original tax return filed in the year the property was placed in service or a "timely filed" amended return. If the taxpayer is filing IRS Form 4562 with an original tax return, the return does not have to be filed on time. However, if the taxpayer is filing IRS Form 4562 with an amended return, it will not be accepted if it is not filed on time, including any extensions.

Conservation Incentives

As a general rule, any improvements made to land are considered capital improvements and must be added to the basis of the land. However, landowners who make improvements for conservation or erosion control may choose to deduct a portion of those expenses under section 175. Likewise, payments received by landowners for implementing conservation practices may be excludable from taxable income under section 126. These two tax incentives are described in this section.

Section 175

According to Internal Revenue Code, section 175, if a taxpayer is in the business of farming, as defined earlier, then some soil and water conservation practices may qualify for deduction in the year that they occur. Typically, these expenditures would be considered capital expenses and would be added to the basis for the land. However, under section 175, expenses up to 25 percent of the gross farm income can be deducted. This deduction is possible as long

as the taxpayer is a material, or active, participant in the farm business. The list of acceptable conservation practices includes, but is not limited to:

- *treatment or movement of earth (such as leveling, conditioning, grading, terracing, contour furrowing and restoration of soil fertility)*
- *construction, control, and protection of diversion channels; drainage ditches; irrigation ditches; earthen dams; and watercourses, outlets and ponds*
- *eradication of brush*
- *planting of windbreaks*

The last two items on the list above are key elements that apply to agroforestry.

For soil and water conservation expenses to qualify for this deduction, they must be consistent with a plan approved by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), such as:

- **NRCS individual site plans**
- **NRCS county plans**
- **Comparable state agency plans**

It is important to remember that section 175 only applies to **capital expenses on productive farmland** for soil or water conservation and erosion control. If the conservation expenses will benefit both non-productive and productive farmland then you must allocate the expenses. For example, if the conservation practice will benefit 200 acres of your land, and only 120 acres of it qualifies as productive land, then you can only deduct 60% ($120 \div 200$) of the expenses.

Calculating the Section 175 Deduction

The section 175 deduction is limited to 25 percent of gross income in a given year. Gross income is the sum of all income earned from the farming business, such as the sale of crops, livestock, fruits, vegetables, and other farm products. Gross income does not include the sale of capital assets such as equipment or land. Any conservation expenses that exceed 25 percent of gross income for a given year may be carried over to the next year. However, the deduction in any given year may not exceed 25 percent of gross income for that year. It is also important to note that you cannot take the section 175 deduction if you

received cost share and choose to exclude that cost share payment under section 126 described below.

Reporting the Section 175 Deduction

Conservation expenses that are deductible under section 175 must be deducted in the year that they are incurred using Form 1040, Schedule F, line 14. Expenses that are not deducted must be capitalized. If the taxpayer wishes to change methods of treating soil and water conservation expenses or capitalize some conservation expenses and deduct others, the IRS must approve the change of methods. To get approval from the IRS, a written request must be submitted before the due date of the return for the first tax year the new method will apply. The written request must include the following:

- *name and address of the taxpayer*
- *first tax year the method or change of method is to apply*
- *whether the method or change of method applies to all soil and water conservation expenses or only to those for a particular farm or project. If the method or change of method does not apply to all expenses, identify the project or farm to which the expenses apply*
- *total expenses paid or incurred in the first tax year the method or change of method is to apply*
- *a statement that indicates the intention of the taxpayer to maintain separate accounting records for the expenses to which this method or change of method relates*

The request should be mailed to the following address:

**Cincinnati Submission Processing
Cincinnati, Ohio 45999**

Section 126

Section 126 allows landowners to exclude from gross income all or a portion of cost-sharing payments received from programs that promote conservation, reclamation and restoration. This exclusion only applies to the portion of the payment that meets the three following criteria:

- 1. It was for a capital expense.** However, capital expenses that can be deducted under section 175 above must be included in gross income and the costs incurred must be deducted as described above.
- 2. It does not substantially increase your annual income from the property for which it is made.**

Your income is considered to be substantially increased if it is more than the greater of the two following amounts:

- a. 10 percent of the average annual income from the affected acres during the past three tax years (not including this tax year),
- b. \$2.50 times the number of affected acres.

3. The Secretary of Agriculture certified that the payment was primarily made for conserving soil and water resources, protecting or restoring the environment, improving forests, or providing a habitat for wildlife.

Some of the programs that may qualify for the section 126 exclusion are the Forestry Incentive Program (FIP), Forest Stewardship Incentive Program (SIP), the Wetlands Reserve Program (WRP), the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentive Program (WHIP), the Forest Land Enhancement Program (FLEP), the Conservation Reserve Program (CRP) and various State programs designed to improve forests. Programs such as EQIP, FIP, FLEP, CRP and WHIP provide a flexible framework under which agroforestry practices can be incorporated on private lands. For a more complete listing of the programs that qualify for this exclusion, see IRS Publication 225, Farmer's Tax Guide or contact your local tax professional.

It is important to note that although CRP is listed as one of the programs that can be excluded from gross income, only the cost-share portion of the CRP income qualifies for this exclusion. Soil rental payments and one-time incentive payments received under CRP do not qualify for the exclusion under section 126. Soil rental payments and one-time incentive payments are reported on Schedule F (Form 1040), lines 6a and 6b.

Calculating the Section 126 Exclusions

In order to determine the exclusion amount eligible under section 126, a four-step procedure is used.

- **Step 1: Determine the "Section 126 Cost".** The "Section 126 cost" is calculated by first adding the amount paid by taxpayer plus amounts paid by all government programs to get the total cost of the improvement. Next, subtract any government payments that are not listed in Section 126(a) of the IRC and any portion of a government payment under a program which is listed in Section 126(a)

Excludable Programs Under Section 126

- *Forestry Incentive Program (FIP)*
- *Forest Stewardship Incentive Program (SIP)*
- *Forest Land Enhancement Program (FLEP)*
- *Wetlands Reserve Program (WRP)*
- *Environmental Quality Incentives Program (EQIP)*
- *Wildlife Habitat Incentive Program (WHIP)*
- *Conservation Reserve Program (CRP)*
- *Individual state programs designed to improve forests*

but is not certified by the Secretary of Agriculture as primarily for the purpose of conservation from the total cost of the improvements. Finally, subtract any government payment to the taxpayer which is in the nature of rent or compensation for services.

- **Step 2: Determine the value of the Section 126 improvement.** The value of the section 126 improvement is the "fair market value" of the improvement multiplied by a fraction, the numerator of which is the "Section 126 cost" determined in Step 1 and denominator is the total cost of the improvement. The "fair market value" of the improvement is the amount by which the fair market value of the portion of the property improved is increased by the improvement. Fair market value is defined by the IRC as the price at which property would change hands between a willing buyer and a willing seller, neither having to buy or sell, and both having reasonable knowledge of all necessary facts. This value can be determined by appraisal or analysis of recent sales of similar property.
- **Step 3: Determine the excludable portion of the cost.** The excludable portion is the present fair market value of the right to receive annual income from the affected acreage. This is determined by taking the largest of either 10 percent of the average annual income (gross receipts) for the last three years or \$2.50 per affected acre and dividing by an appropriate discount rate. Discount rates are published each spring (April or May) in a Revenue Ruling. The 2005 discount rate for Missouri is published in a Revenue Ruling 2005-41

and is taken from AgriBank, FCB.

- **Step 4: Determine the amount included in gross income.** The amount that must be included in gross income is the value of the section 126 improvement (as determined in Step 2) minus the taxpayer's contribution and the excludable portion (determined in Step 3). Rental payments and amounts received for services provided by the taxpayer must be added to this value since they are not excludable.

Calculation of the Section 126 exclusion is very complicated and should be done with the help of a professional tax consultant. The cost-share exclusion may be beneficial if the taxpayer is planning on disposing of the property in a short period of time and wants to avoid ordinary income recapture. Otherwise, it is to the taxpayer's benefit to include cost-share payments as part of their gross income in the year that

they occur and deduct their expenses to offset those payments.

Reporting Cost-Share Payments and the Section 126 Exclusion

Landowners who have received a conservation cost-share payment can expect to receive IRS Form 1099-G, which indicates the total amount of payment received. Regardless of whether this payment is going to be partially or completely excluded, it must be reported. In order to report the exclusion, the taxpayer must attach a plain sheet of paper to their tax return that states the following:

- *amount of the cost-share payment*
- *date it was received*
- *amount of the payment that qualifies for exclusion from gross income*
- *calculations showing how the exclusion amount was determined*
- *amount that will be excluded*

Summary of Tax Incentives for Agroforestry Establishment

Internal Revenue Code	Subject of Code	Limits	Reporting	References
Section 126	Cost-Share Payment Exclusions	<ul style="list-style-type: none"> √ Applies only to a limited number of programs √ Eligible amount depends on a Four-step calculation based on income received during the three prior years from affected land and the fair market value of the affected acres. 	Attach a plain sheet of paper to the return with the following information: <ul style="list-style-type: none"> √ amount of the cost-share payment √ date received √ amount that qualifies for exclusion √ calculations showing the excludable amount √ amount that will be excluded 	<ul style="list-style-type: none"> √ Form 1040, Schedule F, Instructions √ Form 1040, Schedule C, Instructions √ Form 1040, Instructions √ Publication 225, Farmer's Tax Guide √ USDA/FS Ag handbook #718, Forest Landowner's Guide to the Federal Income Tax
Section 175	Conservation Deduction	<ul style="list-style-type: none"> √ Cannot exceed 25% of gross income from farming √ Capital expenses must be from a plan approved by NRCS or similar state agency 	Form 1040, Schedule F, Line 14	<ul style="list-style-type: none"> √ Form 1040, Schedule F, Instructions √ Publication 225, Farmer's Tax Guide
Section 179	Qualifying Business Property Deduction	<ul style="list-style-type: none"> √ \$105,000 maximum dollar limit √ \$420,000 maximum investment limit √ Taxable income limit 	Form 4562	<ul style="list-style-type: none"> √ Form 4562, Instructions √ Publication 225, Farmer's Tax Guide √ USDA/FS Ag handbook #718, Forest Landowner's Guide to the Federal Income Tax
Section 194	Reforestation Deduction and Amortizable Basis Deduction	<ul style="list-style-type: none"> √ First \$10,000 deducted in year that they are incurred √ Remaining balance can be amortized over 84 months √ Expenses incurred prior to Oct 23, 2004 are eligible for the Section 48 reforestation investment credit 	Form 4562, Part VI with separate sheet of paper stating: <ul style="list-style-type: none"> √ description of costs and date incurred √ description of the type of timber and purpose for which it is grown 	<ul style="list-style-type: none"> √ Form 4562, Instructions √ Publication 225, Farmer's Tax Guide √ USDA/FS Ag handbook #718, Forest Landowner's Guide to the Federal Income Tax

The method of reporting income from cost-share payments depends on the level of participation and type of activity claimed by the taxpayer. For landowners who file as “investors,” the cost-share payment should be reported as “miscellaneous income” on the front of the Form 1040. Business owners who file as a sole proprietor should use Form 1040, Schedule C. Farmers who are reporting cost-share payments as part of their gross income should use Form 1040, Schedule F.

Capital Gains

For landowners considering or involved in agroforestry, the sale of timber may be a necessary part of the establishment phase of an agroforestry practice or an expected revenue source of an existing agroforestry practice. The income from the sale of timber can be classified as either a capital gain or an ordinary income; depending on how long the taxpayer has owned the timber and whether the timber is owned for personal use, as an investment, or part of an active business or trade. For timber to qualify as a capital asset, and thus qualify for capital gains treatment, it must be held for longer than one year. Timber that you acquire through either inheritance or gift is the only exception to this rule. According to the IRS, if you inherit property you are considered to have met the one-year holding requirement. Likewise, if timberland is given to you and the donor’s basis is used to figure your basis, then you may also use the donor’s holding period as your holding period.

Timberland that is owned for personal use or as an investment is classified as a capital asset. According to section 1221 of the IRC, real property that is not held “primarily for sale to customers in the ordinary course of a trade or business” is considered a capital asset.

Timberland that is owned as part of a trade or business can still benefit from capital gains treatment. Prior to 2005, the only way timber business owner’s could get capital gains treatment for the sale of their

timber was to sell the timber as either a Section 631(a) (cutting of standing timber with an election to treat as a sale) or Section 631(b)(disposal of standing timber with an economic interest retained) transaction. The new change allows lump sum sales of standing timber that is cut after December 31, 2004 to be taxed as a capital gain. The timber must meet the requirements of long-term capital assets, more specifically, the timber must be held for more than one year prior to the date of disposal. The date of disposal for outright sales may be the date that payment is received. It is important to note that income from the sale of cut products, such as logs, is considered ordinary income.

Regardless of how you treat your timber (personal use, investment, or business), you can reduce your tax burden when timber is sold by establishing a basis on the timber. Your timber basis is the proportionate amount of the original purchase price of the total property that can be attributed to the timber, plus any capital costs incurred in managing the timber that you have not deducted under section 175 or section 126. MU Guide G5055, “**Determining Timber Cost Basis**” provides a step-by-step explanation for determining timber basis and is available online at

Summary of capital gains treatment, by purpose of ownership and method of timber sale

	Personal Use/Hobbyist	Investor	Active Business
Lump Sum	- taxed as capital gains - qualifies as a capital asset under Section 1221 of the IRC	- taxed as capital gains - qualifies as a capital asset under Section 1221 of the IRC	- Timber sold before December 31, 2004 is taxed as ordinary income - Timber sold on or after January 1, 2005 can be taxed as capital gain
Economic Interest Retained / Shares Contract	- Date of sale is the date volume and value are determined - Seller’s share should be payment for stumpage and is taxed as capital gain	- Date of sale is the date volume and value are determined - Seller’s share should be payment for stumpage and is taxed as capital gain	- Income from the sale of the stumpage can be taxed as capital gain under Section 631(b) of the IRC
Election to treat the cutting as a sale	- Does not apply	- Does not apply	- Income from the sale of the stumpage can be taxed as capital gain under Section 631(a) of the IRC

<http://muextension.missouri.edu/explore/agguides/forestry/g05055.htm>.

For more information regarding capital gains treatment on the disposal of standing timber consult the IRS Publication 225 **Farmer's Tax Guide**, IRS Publication 544 **Sales and Other Dispositions of Assets**, MU Guide G5056 "**Managing Your Timber Sale Tax**", or your local tax professional.

Conclusion

It becomes apparent that in order for an agroforestry practice to benefit from the current tax codes, the taxpayer must be aware of the requirements of each tax incentive. For the reforestation deduction and the amortizable basis deduction described in section 194, tree species that have timber value must be incorporated into the agroforestry practice. Ornamental trees, Christmas trees or fruit trees would not qualify. Trees planted solely for nut production would also be disqualified. The IRC does not specify a planting density or provide an acceptable species list. Therefore, the taxpayer's planting intent will most likely be the determining factor as to whether or not the practice qualifies for the section 194 incentives. Remember, the reforestation deduction and the amortizable basis deduction are for "commercial timber production;" any intent other than that will not qualify for these incentives.

Under section 179, a deduction of up to \$105,000 can be taken in a given year to recover the cost of personal property used in an active trade or business. Farm fences, livestock, machinery and equipment qualify for this deduction. Structures specifically used for the growing of mushrooms or commercial plants would also qualify. The key to this deduction is that the taxpayer must have an active trade or business enterprise from the agroforestry practice, whether it be crops, livestock, timber, nuts, or some other product.

Capital expenses for soil and water conservation on productive farm land, including the establishment of windbreaks that are designed based on USDA/NRCS approved plans, are deductible for up to 25 percent of gross farm income. Section 175 of the IRC specifically identifies planting windbreaks and the eradication of brush as deductible soil and water conservation expenses.

Finally, for the cost-share exclusion of section 126, it is important to work with natural resource professionals to identify excludable cost-share programs that are currently funded and support agroforestry practices.

Tax deductions, tax credits and income exclusions can provide financial incentives above and beyond the expected revenues from agroforestry practices. As stated before, the key to all tax benefits is good record keeping. Most university extension services have publications describing the best method of record keeping for both timber production and agricultural production, such as "Maintaining Woodland Tax Records" which is published by University Extension, University of Missouri-Columbia.

A great resource for more forestry and agroforestry tax considerations is the **National Timber Tax Website** (www.timbertax.org). For more information about whether or not a practice will qualify for an available tax incentive, contact your local Internal Revenue Service office or consult your personal tax advisor.

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Definitions:

Active Trade - See “Business.”

Adjusted Basis - Adjustments to original basis including the cost of any improvements made to the original property. For timber property, this could include additional seedlings and associated costs of planting.

Amortization - The periodic subtraction of an allowed annual amount to recover qualifying capital costs over a specified period of time.

Basis - The basis of an asset is how much it actually costs (Section 1012 of the Internal Revenue Code). For timber acquired by purchase, the basis is the amount paid for the timber. (See Section 1016 Internal Revenue Code and Department of the Treasury, Internal Revenue Service, Publication 551, Basis of Assets.) Basis for property acquired by other means is determined based on the method of acquisition. For example, basis for inherited property is equal to its fair market value as of the date of death or some alternate valuation date. Similarly, the basis for property acquired as a gift is equal to the donor’s basis at the time of transfer. Also see “Adjusted Basis” and “Stepped-up Basis.”

Business - An activity that is established for the purpose of earning profit, which involves regular transactions. There are many factors determining whether or not an activity is an active business. However, the two most important factors are the “presumption of profit” and regular transactions. Also see “For Profit,” “Investment,” “Material Participation,” “Passive Participation,” and “Profit.”

Capital Costs - Expenditures for the acquisition or improvement of real estate, machinery or other equipment that has a useful life of more than one year. These expenditures may be added to the original cost of the property in order to calculate adjusted basis. Tree planting costs are an example of a capital expenditure.

Capitalization - The process of adding the cost of acquiring a capital asset to a capital account. Depending on the nature of the asset, the capitalized amount may be recoverable through depreciation, depletion, amortization, or only through sale or exchange.

Carry Back (Carry Forward) - An accounting technique that allows a taxpayer to get full benefit of available excess annual tax credits and deductions by applying them to previous tax returns (carry back) or future tax returns (carry forward).

Depletion - The using up or wasting away of a natural resource. In the case of timber, depletion is the recovery of an owner’s basis in timber. It applies when timber is harvested and the cut logs are sold or used in the owner’s business.

Depreciation - The process by which the basis of a capital asset with a determinable useful life is recovered as the asset is used for the production of income. Capital assets associated with forest ownership whose basis is recoverable through depreciation include equipment, buildings, fences, temporary roads and the surfaces of permanent roads.

Expensing - The recovery of an expense by subtracting it from taxable income in the year it is paid or incurred. This is also called deducting.

For Profit - A profit motive is presumed if the activity produced a profit in at least three of the last five tax years, including the current tax year. There are special cases where this profit requirement is modified. For example, certain activities involving the breeding, showing, training and racing of horses need to show profit in at least two of the last seven tax years. (See USDA/FS Agriculture Handbook 718, Forest Landowner’s Guide to the Federal Income Tax.) Also see “Profit.”

Intangible Property - Property that cannot be seen or touched. Examples of intangible property include lease rights, goodwill, patents, copyrights, etc.

Investment -- An activity engaged in for the purpose of realizing a profit, that does not require the regular transaction necessary to be considered a trade of business. The least active level of participation in an income-producing activity. Also see “Business,” “For Profit,” “Material Participation,” “Passive Participation,” and “Profit.”

Material Participation - “Regular, continuous, and substantial” participation in a business. A material participant in a business must meet at least one of the following seven tests.

1. You participated in the activity more than 500 hours.
2. Your participation was substantially all the participation in the activity of all individuals.
3. You participated at least 100 hours during the tax year, and no other individual participated more.
4. The activity is a significant participation activity, and you participated in all significant participation activities for a total of more than 500 hours. A significant participation activity is a trade or business in which you participated more than 100 hours and you did not materially participate based on all of the other tests for material participation.
5. You materially participated in the activity for any five of the 10 immediately preceding tax years.
6. The activity is a personal service activity in which you materially participated for any three preceding tax years. A personal service activity involves the performance of personal services including the fields of health, law, engineering, architecture, accounting, actuarial science, performing arts, consulting, or any other trade or business in which capital is not a material income-producing factor.
7. Based on all the facts and circumstances, you participated in the activity on a regular, continuous, and substantial basis.

(See Department of the Treasury, Internal Revenue Service, Publication 925, Passive Activity and At-Risk Rules.)

Ordinary Expenses - Currently deductible operating expenditures including management, taxes and interest. These expenses are generally deductible in the year they occur. Pruning costs, noncommercial thinning costs and harvesting costs of annual crops are examples of ordinary expenses.

Passive Participation - A person is a passive participant in a trade or business if they do not meet any of the rules required for material participation. (See Department of the Treasury, Internal Revenue Service, Publication 925, Passive Activity and At-Risk Rules.) Also see “Material Participation.”

Personal Property - Personal property is property that is not permanent in nature and is not a permanent fixture on land. For example, machinery, equipment and livestock are considered personal property.

Profit - Profit is calculated by subtracting expenses from gross income for a trade or business activity in a given tax year. Appreciation in the value of assets is also considered profit. Profit from timber will most likely be realized from appreciation in value through physical growth and enhanced quality until it is harvested. (See USDA/FS Agriculture Handbook 718, Forest Landowner’s Guide to the Federal Income Tax.) Also see “Active Trade,” “Business,” and “For Profit.”

Real Property - For taxation purposes, real property refers to land and permanent fixtures on the land, such as buildings, ponds, roads and standing timber. A fixture is permanent if it is “...erected on, growing on, or attached to land ...” and cannot be removed from the land without destroying its original use, purpose or function. (See Department of the Treasury, Internal Revenue Service, Publication 551, Basis of Assets.)

Stepped-up Basis - If property is acquired through inheritance, the basis may be “stepped-up” or increased. The stepped-up basis is determined by the fair market value of the property on the deceased’s date of death or some other alternative valuation date. (See Department of the Treasury, Internal Revenue Service, Publication 551, Basis of Assets.)

Tangible Property - Property that can be seen or touched. This would include trees, machinery, equipment, etc.

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Appendix Section 2: Trees and Shrubs for Agroforestry

In this chapter:

- Identifying the Proper Trees and/or Shrubs
- Design and Management
- Tree and Shrub Recommendations
- Selection Table



The Center for Agroforestry is conducting research on Chinese chestnuts as a tree for profitable agroforestry plantings.

Agroforestry combines trees, shrubs, forages, grasses, livestock and crops in innovative, flexible combinations tailored to the landowner's needs. However, it is the trees and shrubs that are the foundation of any of the agroforestry practices. They occupy land for many years, taking longer to produce marketable crops than other agricultural crops and, thus, require careful thought before planting and long-term care. Yet, through deliberate integration with farm practices, long lasting production and conservation benefits can oc-

cur simultaneously.

What makes a Tree Appropriate for Agroforestry?

The answer is not always the same for any given situation, and will likely vary according to each landowner's specific interest. That said, many trees and shrubs can be planted in configurations and/or densities that will enable them to meet several objectives.

The following pages may be used as a general reference and guide for the selection of appropriate trees and/or shrubs.

Identifying the proper trees and shrubs

When selecting a tree species, begin by matching the species with the site. The selected species should be capable of providing the products and services desired by the landowner. Depending on the practice selected, other considerations might include:

- *Suited to the soil and site conditions*
- *Species compatibility trees should be compatible with the companion crop*
- *High value*
- *Fast growing or of such high value that a slower growth rate is acceptable*
- *Deep-rooted so the trees do not compete with companion crops for moisture*
- *Drought-tolerant or capable of growing on a wet site*
- *Produce a light rather than a heavy shade.*
- *What species already exist on the site?*
- *Marketability - What products (nuts, wood, etc.) do you want to market? Do markets exist?*

Tree and Shrub Recommendations

Following is a table of tree and shrub species suitable for agroforestry practices in Missouri. Included in the table are recommended regions, agroforestry application, potential markets, typical site (upland or bottomland), soil moisture requirements, growth rate, height, light preference, and additional notes for each species. Trees and shrubs are listed in alphabetical order by common name.

This list is not exhaustive, but rather a starting point. All species listed for a given region may not be suited to all sites in that region. Species not generally recommended for a given region may have application on individual sites. For more specific information on trees and shrubs for a particular site, contact the area Missouri Department of Conservation Forester or Private Lands Specialist.



Mark Coggeshall, UMCA Tree Improvement Specialist, works to produce control pollinated seeds from eastern black walnut trees he is growing on a trellis system.

In addition to the table, a series of crop sheets have been developed that contain a short description of each species, its habitat, management and harvesting considerations, methods of propagation and economic uses.

Design and Management of Trees and Shrubs for Agroforestry

Planting design and management of an agroforestry practice depends on existing site conditions and the goals of the landowner (you may also refer to the section on each specific practice for more information on design considerations). Trees can be planted in single or multiple rows, on contours or in groups. Consider the products you wish to produce, any conservation or wildlife benefits desired, on-farm equipment and the needs of companion crops when planning the planting design.

As trees require some maintenance, management requirements may influence the planting design. Some important management considerations are:

- Weed control** - most important in a young trees life
- Fertilization** - depends on species selected and production objectives
- Pruning** - a must for timber production and recommended for nut production
- Thinning** - timely thinnings are critical to maintaining tree growth
- Grafting** - recommended for nut production, yet limit the number of trees requiring grafting in any given year.

- Weed control can reduce competition for moisture, nutrients and, in some cases, for light. Options for weed control include the use of herbicides, mulches (including living mulches such as many clovers, and fabric mulches) and cultivation. To gain the best growth from newly established trees, weed control should be maintained for a minimum of 3 years, and often for as many as 5 years.
- Timely fertilization may be necessary for high-yielding fruit and nut production. In fruit and nut production, having certain nutrients available to the tree at the appropriate time of year is often essential for flower and nut set. For timber production, the cost of fertilization is usually not recovered over the time it takes for a timber tree to reach maturity.
- Pruning allows room for equipment to pass below the branches and can be used to promote the production of desired products such as timber. Pruning is also a useful tool in management of fruit and nut trees. Through proper pruning, the shape of the crown and its density can be managed to facilitate and improve a trees productivity.
- Timely thinnings promote good tree growth by reducing competition for water, light and nutrients. As trees mature they grow to occupy more of the space where they are being managed. As crowns of adjacent trees begin to touch or overlap, this is also a general indicator that their root systems are overlapping. When trees touch or overlap, competition for light, moisture and nutrients between adjacent trees may become a factor limiting tree growth. At this point, thinning can be beneficial.
- Grafting primarily applies to fruit and nut production. By grafting scion wood to a tree you are assured that the fruit or nut produced has the potential to exhibit the exact same characteristics as the adult tree from which the scion came. However, this does not always occur, since moisture, nutrients and management also play a significant role in fruit and nut development. Yet, it is the best way to ensure success. Spread planting over several years to limit the number of trees that will require grafting in a single year.

Trees and Shrubs for Agroforestry Practices in Missouri

Common Name Scientific Name	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Trees									
American basswood <i>Tilia americana</i>	1 - 8	RB, FF	HV, LV, E	B-U	M	F	75-130'	● - ◐	Missouri native Sprouting habit
American holly <i>Ilex opaca</i>	1, 3 - 7	WB	NT, W	B	W-M, X	S	40-50'	◐	High tolerance to flooding Missouri native
American sycamore <i>Platanus occidentalis</i>	1 - 8	RB	LV, W	B	M-W	F	100'+	○ - ◐	Coppice regeneration Missouri native Disease prone
Austrian pine <i>Pinus nigra</i>	1 - 6, 8	WB	O, NT	B	M, X	F-I	70-120'	○	Diseases: foliar fungus/blight
Baldcypress <i>Taxodium distichum</i>	1 - 8	WB	O, W	B-U	W-M	S-I	100'+	○ - ◐	Missouri native
Black cherry <i>Prunus serotina</i>	2, 3, 5, 7, 8	RB	LV, HV		D-M	I	80-100'	○ - ◐	Missouri native
Black locust <i>Robinia pseudoacacia</i>	1 - 8	RB, AC, SP, WB	LV	U	M-D	F	40-60'	○	On MDC noxious plant list Missouri native Nitrogen fixing
Black oak <i>Quercus velutina</i>	1 - 8	AC, WB	LV, W	U	D-M	I	50-60'	◐	Missouri native
Black walnut <i>Juglans nigra</i>	1 - 8	RB, AC, SP, WB	HV, LV, F	B	M	I	70-90'+	○	Very site sensitive Missouri native Allelopathic (chemical growth inhibitor)
Black willow <i>Salix nigra</i>	1 - 8	RB	LV, E, W	B	M-W	V	30-60'	○	Missouri native
Blackgum <i>Nyssa sylvatica</i>	7, 8	RB	LV	B-U	W-D, X	I	50-100'	● - ◐	Missouri native
Blue spruce <i>Picea pungens</i>	1 - 6, 8	WB	O, W	U	M-W, D	I	70-100'	◐ - ○	Disease & insect problems
Bur oak <i>Quercus macrocarpa</i>	2 - 8	RB, AC, SP, WB	LV, HV, W	B-U	M-D, X	S	70-80'	○ - ●	Commonly used in CRP Missouri native
Cherrybark oak <i>Quercus pagoda</i>	6 - 8	AC, RB	HV, W, O	B	M, X	I-F	100'+	◐ - ○	Excellent market Missouri native
Chinkapin oak <i>Quercus muehlenbergii</i>	1 - 5, 7, 8	WB	LV, HV, W	U	D-M	S	60-80'	◐	Lumped with white oak for sale Missouri native
Common hackberry <i>Celtis occidentalis</i>	1 - 8	RB, WB	LV, NT	B-U	W-D	S-F	100'	◐ - ○	Can be hard to sell Missouri native
Eastern cottonwood <i>Populus deltoides</i>	1 - 8	RB, AC, SP, WB	W, LV	B	M-D	V	80-100'	○	Missouri native
Eastern redbud <i>Cercis canadensis</i>	1 - 8	WB	W, O, NT	U	M	I	<45'	● - ○	Easily transplanted Missouri native

Region: see UMCA Region map // **Agroforestry Application:** AC-alley cropping, SP-silvopasture, WB-windbreak, RB-riparian forest buffer, FF-forest farming, D-to add diversity // **Markets:** HV-high value wood products, LV-low value wood products, NT-non-timber forest products, F-fruit, W-wildlife food or shelter, O-ornamental or Christmas trees, E-environmental // **Site:** B-bottomland, U-upland // **Soil Moisture:** W-wet, M-moist, D-dry, X-well-drained // **Growth Rate:** V-very fast, F-fast, I-intermediate, S-slow // **Height:** maximum range in feet under optimal site conditions // **Light Preference:** ○-full sun, ◐-partial shade/sun, ●-full shade

Common Name Scientific Name	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Eastern redcedar <i>Juniperus virginiana</i>	1 - 8	WB	W, LV, HV	U-B	D-M, X	S	<50'	○ - ◐	Some disease and insect problems Spreads/naturalizes easily Missouri native
Eastern white pine <i>Pinus strobus</i>	1 - 8	WB, AC	O, NT	U	D-W, X	I-F	<80'	◐	Disease and insect problems Preferred deer browse
Flowering dogwood <i>Cornus florida</i>	2 - 8	D	W, O	U	M, X	I-F	10-30'	◐ - ●	Problem with Armillaria root rot Invader or pest species Missouri native
Green ash <i>Fraxinus pennsylvanica</i>	1 - 8	RB, AC, SP, WB, FF	LV, NT	B-U	W-M, D	I	30-50'	○ - ◐	Commonly used in CRP Subject to borers and anthracnose Missouri native
Honeylocust (thornless) <i>Gleditsia triacanthos</i> var. <i>inermis</i>	1 - , 8	AC, SP, WB	LV	B-U	M-D	F	70-80'	○	Only thornless varieties recommended Pods can be used for cattle feed Missouri native
Ironwood (Hophornbeam) <i>Ostrya virginiana</i>	1, 3, 8	D	W, LV	U	M-D	S	<30'	● - ◐	Very hard wood Missouri native
Kentucky coffeetree <i>Gymnocladus dioica</i>	1 - 8	RB, AC, SP, WB	LV, HV, O	B	M	I-F	100'	○ - ◐	Ring shake can be a problem Missouri native
Loblolly pine <i>Pinus taeda</i>	3 - 8	SP, AC	NT, LV, O	B-U	W-D	F-V	90-110'	○	Does not produce seed this far north Susceptible to ice damage
Northern red oak <i>Quercus rubra</i>	1 - 8	AC, SP, WB, FF	HV, LV	U	M-D, X	I-S	60-80'	◐ - ○	Susceptible to oak wilt & chlorosis Missouri native
Northern white-cedar <i>Thuja occidentalis</i>	1, 4, 5, 7	WB	O	U	D-W	S-I	40-50'	◐	Wood is resistant to decay
Norway spruce <i>Picea abies</i>	1 - 8	WB	O	B-U	M	I-F	60-90'	○ - ◐	Good WB substitute for other conifers Disease & insect problems
Nuttall oak <i>Quercus texana</i>	8	RB	LV, HV, W	B	W-M	F	100'	◐ - ○	Self prunes better than pin oak High flood tolerance
Osage-orange <i>Maclura pomifera</i>	1 - 3	WB	LV, HV, W	B-U	W-D	I-F	10-40'	○ - ◐	Sometimes a pest tree
Overcup oak <i>Quercus lyrata</i>	8	RB	LV, W	B	W	S	100'	○	High flood tolerance Missouri native
Pawpaw <i>Asimina triloba</i>	3	FF	W, F	B	M	F-I	15-30'	◐ - ●	Site specific Missouri native
Pecan <i>Carya illinoensis</i>	1 - 8	AC, RB, SP	W, LV, HV, F	B	M, X	I-F	110-140'	◐ - ○	Use proper cultivars for nut production. Missouri native
Persimmon <i>Diospyros virginiana</i>	1 - 8	AC, SP, WB, FF	W, F, LV, HV	U-B	D-M, X	S	30-50'	● - ○	Missouri native
Pin oak <i>Quercus palustris</i>	1 - 8	AC, RB	LV, W, O	B-U	W-M	I-S	70-80'	○	Not tolerant of growing season floods Susceptible to oak wilt & chlorosis Missouri native

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Common Name Scientific Name	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Red (slippery) elm <i>Ulmus rubra</i>	3, 4	RB	LV, NT	B	M-D	I	40-70'	○	Missouri native
Red maple <i>Acer rubrum</i>	1 - 8	RB, AC, WB, FF	LV, O	B-U	W-D	F	50-70'	◐	Missouri native
Red mulberry <i>Morus rubrum</i>	3, 5	RB	F	B	M, X	I	40-50'	○ - ◐	Missouri native
Red pine <i>Pinus resinosa</i>	1 - 5, 8	WB	W, NT, O	U	M-D, X	S	<50'	◐ - ○	Short-lived
River birch <i>Betula nigra</i>	1, 3, 8	RB	LV, O, E	B	M	I	50'	○ - ◐	Missouri native
Sassafras <i>Sassafras albidum</i>	2 - 4, 8	D	W, NT	U	D-M, X	I	30-50'	○	Missouri native
Scarlet oak <i>Quercus coccinea</i>	3, 5, 7, 8	AC, SP, WB, FF	LV, HV	U	D-M	I-F	70-80'	○	Fastest growing oak Missouri native
Scotch (Scot's) pine <i>Pinus sylvestris</i>	7	WB, AC	O	B-U	M-D	S-I	35-60'	○ - ◐	Many disease and insect problems Short-lived
Shagbark hickory <i>Carya ovata</i>	1 - 8	RB, WB	W, LV, F	U-B	D-M	S	70-80'	◐ - ●	Missouri native
Shellbark hickory <i>Carya laciniosa</i>	1, 3, 8	RB	W, LV, F	B	W-M	S	80-100'	● - ◐	Missouri native
Shingle oak <i>Quercus imbricaria</i>	1 - 8	WB	LV, HV, W	U-B	M-D	S	50-60'	○ - ◐	Susceptible to oak wilt & insects Missouri native
Shortleaf pine <i>Pinus echinata</i>	2 - 8	WB, SP, AC	HV, LV, W, NT	U	D-M, X	F-I	70-100'	○	Missouri native
Shumard oak <i>Quercus shumardii</i>	3, 7	AC, SP	LV, HV	B-U	M, X	I	100'	○	Susceptible to oak wilt & insects Missouri native
Silver maple <i>Acer saccharinum</i>	1 - 8	RB, WB	LV, O	B	W-M, D	F-V	60-80'	◐ - ○	Prone to ice and wind damage Missouri native
Sugar maple <i>Acer saccharum</i>	1, 3	FF	NT, LV	U	M, X	F	60-80'	● - ○	Syrup ration - 80:1 Missouri native
Swamp chestnut oak <i>Quercus michauxii</i>	7, 8	AC, RB	LV, HV, O	B	M-W, X	S	60-80'	○	Best white oak for bottom areas Missouri native
Swamp white oak <i>Quercus bicolor</i>	1 - 6, 8	AC, RB	LV, HV, W, NT	B	W-M	S	60-70'	○ - ◐	Common in CRP Missouri native
Sweetgum <i>Liquidambar styraciflua</i>	1 - 8	RB, WB	LV, HV, O, NT	B-U	M, X	I	80-120'	○	Recommended for southern areas Missouri native
Tulip-poplar <i>Liriodendron tulipifera</i>	2 - 8	AC, WB	LV, HV, O	B	W-M	F	100'	○	Site-sensitive Suffers some wind damage Missouri native
Virginia pine <i>Pinus virginiana</i>	2 - 8	WB, SP	W, O	B-U	D-M, X	I	40'	○	Tolerant of a variety of soils Prefers clay, loam, or sandy loam Often used in land reclamation

Region: see UMCA Region map // **Agroforestry Application:** AC-alley cropping, SP-silvopasture, WB-windbreak, RB-riparian forest buffer, FF-forest farming, D-to add diversity // **Markets:** HV-high value wood products, LV-low value wood products, NT-non-timber forest products, F-fruit, W-wildlife food or shelter, O-ornamental or Christmas trees, E-environmental // **Site:** B-bottomland, U-upland // **Soil Moisture:** W-wet, M-moist, D-dry, X-well-drained // **Growth Rate:** V-very fast, F-fast, I-intermediate, S-slow // **Height:** maximum range in feet under optimal site conditions // **Light Preference:** ○-full sun, ◐-partial shade/sun, ●-full shade

Common Name Scientific Name	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Washington hawthorn <i>Crataegus phaeopyrum</i>	1 - 8	D	W, O	U	M-D	I-S	15-25'	○	Susceptible to rust diseases Thorns
Water oak <i>Quercus nigra</i>	1, 4, 7	RB, WB	LV	B-U	M-W	I	60-70'	○ - ◐	Poorer quality than other red oaks Missouri native
White ash <i>Fraxinus americana</i>	1, 3, 4 7	AC, RB, WB	LV	U-B	M, X	I	70-100'	◐ - ○	Disease problems Missouri native
White oak <i>Quercus alba</i>	1 - 8	AC, SP, WB, FF	HV, W, LV	B-U	D-M	S	80-100'	◐ - ○	Can be hard to regenerate/establish Missouri native
White spruce <i>Picea glauca</i>	1 - 5, 8	WB	O, W	B	M-W	S	50-80'	○ - ◐	Not drought tolerant
Willow oak <i>Quercus phellos</i>	3, 7, 8	AC, SP, RB	O, LV, HV	B-U	M	S	80'	○ - ◐	Missouri native
Common Name Scientific Name	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Shrubs									
American cranberrybush <i>Viburnum trilobum</i>	6, 8	D	W	B-U	M-W, X	F-I	8-12'	○ - ◐	Minimum root depth 14"
American plum <i>Prunus americana</i>	1 - 8	RB, WB, FF	W, F	B	M	S-I	<15'	○	Thicket forming Missouri native
Arrowwood <i>Viburnum dentatum</i>	1 - 4, 6, 8	D	W	B-U	M-D, X	I-F	<8'	○ - ◐	Adaptable to varying site conditions
Blackberry, raspberry <i>Rubus</i> spp.	1 - 3, 8	AC, RB, WB	W, F	B-U	D-M, X	F	6-10'	○ - ◐	Thicket former Missouri native
Blackhaw <i>Viburnum prunifolium</i>	1 - 8	D	W	B-U	M-D	I	12'	○ - ●	Missouri native
Buckthorn <i>Rhamnus cathartica</i>	5	RB, WB, D	W	B-U	W-D	F	10-20'	◐ - ○	Alternate host for Oak Rust Can be invasive
Buttonbush <i>Cephalanthus occidentalis</i>	1 - 8	RB	W, E	B	W-D	F	6-10'	○	Wetland invasive problem Missouri native
Common chokecherry <i>Prunus virginiana</i>	1 - 8	RB, D	W, F, E	B	M	F	3-20'	○	Foliage toxic to livestock Natural wetland species Missouri native
Common elderberry <i>Sambucus canadensis</i>	2, 5	RB, D	W, F	B-U	M-D	F	<10'	○ - ◐	Edible Good wildlife food source
Coralberry (Buckbrush) <i>Symphoricarpos orbiculatus</i>	1, 3, 5, 8	D	W	U	M-D	I	4-10'	○ - ◐	Holds berries late in the season Missouri native
Cornelian cherry dogwood <i>Cornus mas</i>	1, 4, 8	D	W, O	U	M, X	I	10-20'	○ - ◐	Few disease or insect problems
Deciduous holly <i>Ilex decidua</i>	1 - 8	D	W, O	B-U	M-W	S-I	<20'	● - ◐	Adaptable to varying site conditions
Fragrant sumac <i>Rhus aromatica</i>	1 - 8	D	W	U	D	F-I	<10'	◐ - ●	Missouri native

Region: see UMCA Region map // **Agroforestry Application:** AC-alley cropping, SP-silvopasture, WB-windbreak, RB-riparian forest buffer, FF-forest farming, D-to add diversity // **Markets:** HV-high value wood products, LV-low value wood products, NT-non-timber forest products, F-fruit, W-wildlife food or shelter, O-ornamental or Christmas trees, E-environmental // **Site:** B-bottomland, U-upland // **Soil Moisture:** W-wet, M-moist, D-dry, X-well-drained // **Growth Rate:** V-very fast, F-fast, I-intermediate, S-slow // **Height:** maximum range in feet under optimal site conditions // **Light Preference:** ○-full sun, ◐-partial shade/sun, ●-full shade

Common Name Scientific Name	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Gray dogwood <i>Cornus racemosa</i>	1 - 8	D	W, O	B-U	W-M, X	I-F	10-15'	●	Thicket forming Can be invasive
Gooseberry <i>Ribes spp.</i>	1 - 3, 8	AC, RB, D	W, F	B-U	M	F	3'	○ - ●	Thicket forming Missouri native
Hazelnut <i>Corylus americana</i>	1 - 38	AC, FF, RB	W, F, O	B-U	M	F	7-15'	○ - ●	Difficult to establish from seed Missouri native
Nannyberry viburnum <i>Viburnum lentago</i>	1 - 6, 8	D	W	B-U	M	F	10-15'	●	Thicket forming
Ninebark <i>Physocarpus opulifolius</i>	1 - 8	RB	W, E	B-U	W-D	F	10'	○ - ●	Missouri native
Pussy willow <i>Salix discolor</i>	1, 3 - 7	RB, D	W, NT, E	B-U	W-D	I	<15'	○	May be propagated by cuttings
Redosier dogwood <i>Cornus stolonifera</i>	1, 3 - 6, 8	RB, WB	W, O, NT	B	M	I	6-10'	● - ○	Thicket forming
Rusty blackhaw <i>Viburnum ruficulm</i>	3, 7	D	W	B-U	M-D	S	<30'	● - ●	Missouri native
Serviceberry <i>Amelanchier spp.</i>	3, 7, 8	FF	W, O	U	M-D	I-F	<30'	●	Missouri native
Shrub lespedeza <i>Lespedeza bicolor</i>	3	RB, SP, WB	W, E		M-D	F	4-6'	○ - ●	Good cover and food for game birds and small mammals
Silky dogwood <i>Cornus amomum</i>	1 - 4, 6	WB, RB	W, NT, O, E	B-U	M	F-I	6-10'	●	Thicket forming Missouri native
Wahoo <i>Euonymus atropopureus</i>	1 - 8	D	W	B-U	M	I	<25'	○ - ●	Susceptible to foliar diseases Missouri native
Winged sumac <i>Rhus copallina</i>	5, 7, 8	D	W, O	U	D-M	F	5-10'	○	Missouri native
Witch-hazel <i>Hamamelis virginiana</i>	1, 3, 8	AC, FF, WB, D	W, NT	B-U	M-D	I	5-15'	●	Can be hard to establish Missouri native

Additional Resources

Online:

- USDA NRCS Plant Database – <http://www.plants.usda.gov/>
- University of Connecticut Plant Database of Trees, Shrubs and Vines – <http://www.hort.uconn.edu/plants/a/a.html>
- Grow Native – <http://www.grownative.org/>
- Native Plant Information – <http://www.grownative.org/index.cfm?fuseaction=plants.main>
- Silvics of North American Trees – http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm
- MDC Private Lands Division – <http://www.mdc.mo.gov/landown>
- Missouri Flora Database – <http://www.missouriplants.com/>
- Arkansas Home and Garden Plant Database – http://www.arhomeandgarden.org/plantoftheweek/archivesa_d.htm
- Grasses of Iowa – <http://www.eeob.iastate.edu/research/iowagrasses/speciescn-nat.html>
- Kansas Wildflowers and Grasses – <http://www.lib.ksu.edu/wildflower/>
- USDA Forest Service Plant Database – <http://www.fs.fed.us/database/feis/plants/>
- The Right Tree Handbook - Minnesota Power – <http://www.mnpower.com/treebook/>

Notes

Appendix Section 3: Grasses and Forages for Agroforestry

In this chapter:

- **Identifying the Proper Grasses and Forages for Agroforestry**
- **Design and Management**



Shade Trials: Learning about the shade tolerance of plant species is important to the Center for Agroforestry. Here mulches and forage crops are tested to identify their potential for planting under trees.

Agroforestry combines trees, shrubs, forages, grasses, livestock and crops in innovative, flexible combinations tailored to the landowner's needs. Through their integration with farm practices, production and conservation benefits can occur simultaneously. However, because the same resources are often used by all the plants in a given area, competition can pose some challenges to productivity.

What makes a Forage/Grass appropriate?

The answer will likely vary according to each landowner's specific interest and goals. That said, many trees and shrubs can be planted in configurations or densities that will also enhance the production of select forages and/or grasses.

In fact, the University of Missouri Center for Agroforestry has researched and identified many cool season grasses and legumes that produce better or the same under 50% shade as compared to full sun.

The following pages may be used as a general reference and guide for the selection of an appropriate forage/grass for your agroforestry practice.

As a component of a farm system, the properly designed and implemented agroforestry practice will help:

- Increase crop production
- Diversify products and farm income
- Improve soil quality and reduce erosion
- Improve water quality and reduce damage due to flooding
- Enhance wildlife habitat and improve biodiversity
- Reduce pest management inputs.

Design and Management

Planting design and management of an agroforestry practice depends on existing site conditions and the goals of the landowner. (You may also refer to the section on each specific practice for more information on design considerations) Many forages/grasses will do quite well under partially shaded conditions. The following table outlines some of the forages/grasses that the University of Missouri Center for Agroforestry has identified for use in partially shaded environments, and what can be expected from their productivity in shaded environments. In all cases, consider the products you wish to produce, any conservation or wildlife benefits desired, on-farm equipment and the needs of companion crops when planning the planting design.

When you decide on the appropriate forage/grass for your agroforestry practice, you should then seek out specific information on how to manage or establish that specific forage/grass species. Some considerations that will have a significant influence on the success of the forage/grass of choice include:

- Soil pH
- Time of seeding
- The use of companion or nurse crops
- Seeding method (broadcast vs. drilling)
- The use of herbicides to control undesirable/competing species
- Seeding rates
- The need for Inoculation
- Seed bed preparation
- Soil fertility

Each of the above mentioned establishment and management considerations can have a significant impact on both growth and productivity of a forage/grass stand. For more on establishing forages and seeding of a variety of forages common to Missouri, please reference:

Forage and Grass Recommendations for Agroforestry

Following is a table of forage and grass species suitable for agroforestry practices in Missouri. Included in the table are recommendations on practice applicability, potential uses and general site recommendations. Forages and grasses are listed in alphabetical order by common name. Consult with your regional agronomy specialist, or check with your University Extension personnel, to identify specifics on the appropriateness of a forage or grass to your region.

The following list is not exhaustive, but rather a starting point. All species listed may not be suited to all sites or regions within the State.

Identifying the proper forages and grasses

When selecting a forage/grass species, consider compatibility with the site. The selected species should be capable of providing the products and services desired by the landowner. Depending on the agroforestry practice selected, other forage/grass considerations may include:

- *Level of shade tolerance*
- *Season of production (example, warm vs. cool season grasses)*
- *Productivity capacity for a given site. For example: is it drought-tolerant, or capable of growing on a wet site that is known to flood periodically?*
- *Compatibility with end use (example: is the forage for livestock, or is the grass intended for erosion control and other conservation needs?)*
- *What species already exist on the site and can a natural forage/grass stand be enhanced?*

Common Grass and Legume Forages for Agroforestry Practices in Missouri

Common Name Scientific Name	Agroforestry Application	Valued for ...	Growth Characteristics	Site Requirements	NOTES:
Alfalfa <i>Medicago sativa</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Hay 	<ul style="list-style-type: none"> • Perennial • Cool-season • Legume • Persists 5-8 years • Flood intolerant 	<ul style="list-style-type: none"> • Best on well drained soils • Does best in full sun • Soil pH above 6.0 	<ul style="list-style-type: none"> • Excellent hay • High maintenance • Low to moderate - tree competition
Alsike clover <i>Trifolium hybridum</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Cool-season • Legume 	<ul style="list-style-type: none"> • Low, wet areas on a variety of soil types • Higher tolerance to soil acidity than Alfalfa 	<ul style="list-style-type: none"> • Sometimes utilized for forage and hay production in mixtures with red clover and grasses
Annual lespedeza <i>Kummerowia stipulacea</i> or <i>striata</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Wildlife benefits 	<ul style="list-style-type: none"> • Annual • Warm-season • Legume • Tolerates lower pH than other legumes • Tolerates high temperature 	<ul style="list-style-type: none"> • Productive on shallow, infertile soils • Best growth on well-drained soils 	<ul style="list-style-type: none"> • Allow to reseed in late summer • Best used in pastures and most effective when grown in grass sod
Annual ryegrass <i>Lolium multiflorum</i>	<ul style="list-style-type: none"> • Silvopasture 	<ul style="list-style-type: none"> • Forage 	<ul style="list-style-type: none"> • Annual • Cool-season 	<ul style="list-style-type: none"> • Best under high fertility 	<ul style="list-style-type: none"> • Winter Annual
Bermudagrass <i>Cynodon dactylon</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Warm-season • Not shade tolerant 	<ul style="list-style-type: none"> • Prefers deep, sandy loam or medium textured soils • Will grow on poorer soils with management 	<ul style="list-style-type: none"> • Grazing tolerant • May winter kill particularly in Northern Missouri
Big bluestem <i>Andropogon gerardii</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Warm-season • Not shade tolerant 	<ul style="list-style-type: none"> • Prefers deep, well-drained soils • Intolerant of continuously wet soils 	<ul style="list-style-type: none"> • If burned, care must be taken to protect trees • Native
Birdsfoot trefoil <i>Lotus corniculatus</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Cool-season • Legume 	<ul style="list-style-type: none"> • Tolerates poorly-drained, droughty, infertile and acidic soils better than Alfalfa 	<ul style="list-style-type: none"> • Allow stand to naturally reseed every 2-3 years
Buffalograss <i>Buchloe dactyloides</i>	<ul style="list-style-type: none"> • Silvopasture 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Warm-season • Drought resistant • Sod forming 	<ul style="list-style-type: none"> • Avoid sandy soils 	<ul style="list-style-type: none"> • Withstands heavy grazing

Common Name Scientific Name	Agroforestry Application	Valued for . . .	Growth Characteristics	Site Requirements	NOTES:
Canada wildrye <i>Elymus canadensis</i>	<ul style="list-style-type: none"> • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Perennial • Cool-season 	<ul style="list-style-type: none"> • Grows in wet shaded areas 	<ul style="list-style-type: none"> • Native
Caucasian bluestem <i>Andropogon caucasia</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Warm-season • Not shade tolerant • Long active growth period 	<ul style="list-style-type: none"> • Needs good drainage 	<ul style="list-style-type: none"> • Grazing tolerant • Don't need to burn
Creeping red fescue <i>Festuca rubra</i>	<ul style="list-style-type: none"> • Silvopasture • Riparian Buffer 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Cool-season 	<ul style="list-style-type: none"> • Grows best in well drained, infertile and droughty soils 	<ul style="list-style-type: none"> • Shade tolerant • Usually used for turf
Crownvetch <i>Coronilla varia</i>	<ul style="list-style-type: none"> • Alley cropping • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control 	<ul style="list-style-type: none"> • Perennial • Deep taproot • Spreads vegetatively • Legume 	<ul style="list-style-type: none"> • Best adapted to well-drained, fertile soils with pH 6.0 or greater 	<ul style="list-style-type: none"> • Does not tolerate grazing
Eastern gamagrass <i>Tripsacum dactyloides</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Warm-season • Slow to establish • Tolerates temporary flooding • Stiff upright stems • Forms large clumps or mounds • Not tolerant of shade 	<ul style="list-style-type: none"> • Deep soils in low areas 	<ul style="list-style-type: none"> • Excellent forage • Native
Hop clover <i>Trifolium agrarium</i>	<ul style="list-style-type: none"> • Silvopasture 		<ul style="list-style-type: none"> • Annual • Cool-season • Legume 	<ul style="list-style-type: none"> • Tolerates poorly-drained, droughty and infertile soils 	<ul style="list-style-type: none"> • Used mainly in Southern Missouri
Illinois bundleflower <i>Desmanthus illinoensis</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Wildlife benefits 	<ul style="list-style-type: none"> • Warm-season • Legume 	<ul style="list-style-type: none"> • Grows well on clay or limestone soils 	<ul style="list-style-type: none"> • Sometimes used in mix with warm-season grasses • Native
Indiangrass <i>Sorghastrum nutans</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Perennial • Warm-season • Not shade tolerant • grows 4-6 feet tall • 2-3 years to establish 	<ul style="list-style-type: none"> • Deep, moist soils 	<ul style="list-style-type: none"> • Native • If burned care must be taken to protect trees

Common Name Scientific Name	Agroforestry Application	Valued for ...	Growth Characteristics	Site Requirements	NOTES:
Kentucky bluegrass <i>Poa pratensis</i>	<ul style="list-style-type: none"> • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Weed suppression 	<ul style="list-style-type: none"> • Perennial • Cool-season 	<ul style="list-style-type: none"> • Grows on a variety of soil types 	<ul style="list-style-type: none"> • Usually used in mixes for grazing
Little bluestem <i>Schizachyrium scoparium</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Perennial • Warm-season 	<ul style="list-style-type: none"> • Droughty sites • Grows on a variety of soil types 	<ul style="list-style-type: none"> • Mix with warm-season grasses • Native
Orchardgrass <i>Dactylis glomerata</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Cool-season • Shade tolerant • Short lived • Not tolerant of overuse • Bunch grass 	<ul style="list-style-type: none"> • Tolerates moderately poor drained soils, yet is intolerant to flooding 	<ul style="list-style-type: none"> • Mixes well with legumes (alfalfa, ladino clover) • Matures yearly • Moderate - tree competition • Disease problems under some conditions
Red clover <i>Trifolium pratense</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Cool-season • Short lived • Legume • Easy to establish 	<ul style="list-style-type: none"> • Prefers fertile, well-drained medium to heavy textured soils 	<ul style="list-style-type: none"> • Requires reseedling • Best in grass/legume mixture • Common in pastures • Can crowd out grass in seeding year if planted too thick
Redtop <i>Agrostis gigantea</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Cover crop in orchards 	<ul style="list-style-type: none"> • Perennial • Cool-season • Long-lived • Sod forming 	<ul style="list-style-type: none"> • Will grow at lower pH and in wetter soils • Adapted to a wide range of soil conditions 	<ul style="list-style-type: none"> • Moderate - competition with trees • Use smooth bromegrass, redtop, alsike clover and ladino clover in filter strips
Reed canarygrass <i>Phalaris arundinacea</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Cool-season • Grows up to 6 feet tall and dense • Tolerant of wet and drought. • Mat forming - dense • Hard to establish 	<ul style="list-style-type: none"> • Grows well in wet or dry soil • Wet areas 	<ul style="list-style-type: none"> • Recommend low alkaloid variety • Too competitive with trees • Invasive in wet areas

Common Name <i>Scientific Name</i>	Agroforestry Application	Valued for . . .	Growth Characteristics	Site Requirements	NOTES:
Sideoats grama <i>Bouteloua curtipendula</i>	<ul style="list-style-type: none"> • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Perennial • Warm-season 	<ul style="list-style-type: none"> • Droughty sites • Grows on a wide variety of well-drained soils 	<ul style="list-style-type: none"> • Mix with other native warm-season grasses • Native
Smooth bromegrass <i>Bromus inermis</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Cool-season • Sod former with good fertility • Winter hardy 	<ul style="list-style-type: none"> • Best growth on deep, fertile soils 	<ul style="list-style-type: none"> • Weeds or companion crops may retard establishment from spring sowing
Sorghum-sudangrass <i>Sorghum</i> hybrids	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Hay 	<ul style="list-style-type: none"> • Annual • Warm-season 	<ul style="list-style-type: none"> • Requires high fertility and moisture 	<ul style="list-style-type: none"> • Tall growing, competitive
Sudangrass <i>Sorghum bicolor</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Hay 	<ul style="list-style-type: none"> • Annual • Warm-season 	<ul style="list-style-type: none"> • Requires high fertility and moisture 	<ul style="list-style-type: none"> • Tall growing, competitive
Sweetclover <i>Melilotus</i> sp.	<ul style="list-style-type: none"> • Alley cropping • Silvopasture 	<ul style="list-style-type: none"> • Soil improvement 	<ul style="list-style-type: none"> • Annual/Biennial • Legume • Drought tolerant • Winter hardy • Deep taproot 	<ul style="list-style-type: none"> • Not tolerant of acid soils 	<ul style="list-style-type: none"> • Improperly cured hay can contain the poison Dicoumarol
Switchgrass <i>Panicum virgatum</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Warm-season • Long lived • Grows 4-6 feet tall • Flood and herbicide tolerant • Good deep root filtering • Slow to establish (2-3 years) 	<ul style="list-style-type: none"> • Performs well in wet areas • Will grow where many grasses will not • Prefers fertile, well-drained sites 	<ul style="list-style-type: none"> • Plant thick to avoid weed competition • If burned, care must be taken to protect trees • Native
Tall fescue <i>Festuca arundinacea</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Hay • Seed 	<ul style="list-style-type: none"> • Perennial • Cool-season • Drought tolerant • Hardy 	<ul style="list-style-type: none"> • Tolerates many soil conditions 	<ul style="list-style-type: none"> • May be too competitive with trees • Endophyte free/friendly endophyte varieties recommended • Grazing tolerant • Good fall pasture

Common Name Scientific Name	Agroforestry Application	Valued for ...	Growth Characteristics	Site Requirements	NOTES:
Timothy <i>Phleum pratense</i>	<ul style="list-style-type: none"> • Alley cropping • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Erosion control • Hay 	<ul style="list-style-type: none"> • Perennial • Cool-season • Winter hardy • Short lived • Bunch grass 	<ul style="list-style-type: none"> • Prefers well-drained, moist soils • Not tolerant of droughty sites 	<ul style="list-style-type: none"> • Intolerant of overgrazing • Use in a mixture with other cool season grasses and legumes • Low - competition with tree
Virginia wildrye <i>Elymus virginicus</i>	<ul style="list-style-type: none"> • Riparian Buffer • Silvopasture 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Cool season • Perennial • Slow to get started 	<ul style="list-style-type: none"> • Grows in moist sandy soils • Prefers medium textured soils 	<ul style="list-style-type: none"> • Should be used in conjunction with other grasses
Western wheat grass <i>Pascopyrum smithii</i>	<ul style="list-style-type: none"> • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Perennial • Cool-season 	<ul style="list-style-type: none"> • Grows well on low, heavy soils 	<ul style="list-style-type: none"> • Produces an open but uniform sod
White/Ladino clover <i>Trifolium repens</i>	<ul style="list-style-type: none"> • Silvopasture • Riparian buffer 	<ul style="list-style-type: none"> • Wildlife benefits • Erosion control 	<ul style="list-style-type: none"> • Perennial • Cool-season • Legume • Not drought tolerant 	<ul style="list-style-type: none"> • Does best in wet soils and seasons • Performs poorly on shallow, droughty soils 	<ul style="list-style-type: none"> • Use in combination with grasses
GENERAL NOTE:					
<ul style="list-style-type: none"> • *Warm season grasses may need prescribed fire for management which may not be compatible with agroforestry 					

Additional Resources

Online:

- For a number of publications on specific forages and grasses, visit:
<http://muextension.missouri.edu/explore/agguides/crops/#Forages>
- Establishing Forages – <http://muextension.missouri.edu/explore/agguides/crops/g04650.htm>
- Seeding Rates, Dates and Depths for Common Missouri Forages – <http://muextension.missouri.edu/explore/agguides/crops/g04652.htm>
- USDA NRCS Plant Database – <http://www.plants.usda.gov/>
- University of Connecticut Plant Database of Trees, Shrubs and Vines – <http://www.hort.uconn.edu/plants/a/a.html>
- Grow Native – <http://www.grownative.org/>
- Native Plant Information – <http://www.grownative.org/index.cfm?fuseaction=plants.main>
- Silvics of North American Trees – http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm
- MDC Private Lands Division – <http://www.mdc.mo.gov/landown>
- Missouri Flora Database – <http://www.missouriplants.com/>
- Arkansas Home and Garden Plant Database – http://www.arhomeandgarden.org/plantoftheweek/archives_a_d.htm
- Grasses of Iowa – <http://www.eeob.iastate.edu/research/iowagrasses/speciescn-nat.html>
- Kansas Wildflowers and Grasses – <http://www.lib.ksu.edu/wildflower/>
- USDA Forest Service Plant Database – <http://www.fs.fed.us/database/feis/plants/>
- The Right Tree Handbook - Minnesota Power – <http://www.mnpower.com/treebook/>

Appendix Section 4:

The Basics of Selling Timber

Selling timber can be a rewarding experience for some forest land owners while a traumatic experience for others. Landowners who do a thorough job of planning and marketing are usually satisfied with a timber harvest; those who did not prepare for a timber sale are likely to be dissatisfied. Many people receive a fraction of their timber's true value because they do not know what they have or do not know how to sell it. This article presents guidelines to assist individuals in selling timber from their woodlands.

Define Your Objectives

A wise man once said, "Without a road map, you will probably never get to your destination." A successful timber harvest begins with identifying your objectives. This can best be done with a written Forest Management Plan that identifies your objectives, steps to achieving them, and times when they will be conducted.

The plan should also identify the type of harvest to be conducted and steps to be taken for reforestation after the harvest.

You need to tell the log buyer exactly what you expect from the timber sale. This is best done through provisions written into a timber sale contract. For example, if one of your objectives is maintaining water quality, a provision in the contract should state that Best Management Practices (BMPs) will be followed during road building, stream crossing, and harvesting. For a list of voluntary BMPs, contact a Missouri Department of Conservation (MDC) forester.

Why Sell Timber

Other than simply for financial gain, timber harvesting is a tool for accomplishing objectives that you may have identified in your forest management plan. Such objectives may include:

- *Improving the overall health and vigor of the forest*
- *Promoting seedling regeneration*
- *Creating wildlife habitat*
- *Reducing the density of the forest (if overcrowded)*
- *Establishing planting areas*
- *Creating vistas and trails*
- *Developing certain types of recreational activities*
- *Salvaging damaged trees*

Steps in Selling Timber

When selling timber these steps should be followed:

1. **Know what you have to sell**
2. **Determine what your timber is worth**
3. **Determine what method you will use to sell your timber**
4. **Determine a method of payment**
5. **Advertise your sale**
6. **Develop a written contract with the buyer**
7. **Supervise and inspect the harvest**
8. **Practice good forestry**

Know What You Have to Sell

Before advertising a timber sale, you first need to determine what you have to sell. This involves selecting the trees to be harvested and determining what volumes and products are present in those trees. Make sure the trees are, in fact, on your property. Settle any boundary disputes with your neighbors *before* you sell any timber. Clearly mark the trees to be harvested so the logger can easily see them. Mark each tree with a spot of paint about chest high (bright blue or orange works best) on the same side of the tree so they are visible from a main trail or road. A second spot of paint should be placed at the ground line. This paint spot will remain after logging to serve as a check to make certain that only marked trees were harvested.

After selecting the trees to be harvested, estimate

the wood volume or the number of products that will be cut by species. Timber volumes are estimated by measuring individual trees. For more details read the University Extension guide “How to Measure Trees and Logs,” which is available from a MDC forester or the county Extension Service agent.

Some common products that may be produced from trees include sawlogs, stave bolts (to make barrels), veneer logs, firewood, pulpwood (to make paper), posts and poles. These products are determined by the species, size and quality of your timber and can vary greatly in price. There may not be a market for all these products within any given area. Local mills will determine the specifications for each product they purchase. For current market conditions, Timber Price Reports are available from a MDC forester.

Determine What Your Timber is Worth

The price paid for standing trees before they are harvested (called stumpage) has no set value.

Your timber is worth whatever you and the buyer agree to. Many factors influence the price of standing trees. These include:

- **Tree species.** Wood from some species is more valuable than wood from other species.
- **Tree size.** Large trees will have more volume and clear wood than smaller trees.
- **Tree quality.** Trees with fewer defects (e.g., branch scars, decay, imbedded wire) have higher quality, more valuable wood.
- **Volume of sale.** Large volume sales will bring a higher per unit price than small volume sales.
- **Distance to the mill.** The closer a woodlot is to the mill, the lower the hauling costs.
- **Site accessibility.** The ease with which the forest land can be reached affects costs.
- **Logging difficulty.** Steepness of terrain and soil moisture conditions affect the equipment that can be used and speed of harvesting.
- **Market conditions.** Poor markets mean lower

timber prices. Buyers often pay more for logs when their inventories are low to ensure continued mill operation.

- **Your restrictions** on harvesting and skidding techniques. Restrictions set forth in your timber sale contract, such as seeding skid trails after harvest, will increase logging costs.

Different buyers may offer substantially different prices for the same timber, depending on their own particular costs and markets. The only way to actually determine what your timber is worth is to offer it for sale on the open market and contact as many potential buyers as possible.

Determine a Selling Method

Selecting the appropriate selling method for marketing your timber is the key to having a successful timber sale. The two methods commonly used in Missouri are sealed bid and negotiation.

The *sealed bid* sale is recommended most often for private woodland owners. This process informs potential buyers about the timber sale. These buyers are allowed a length of time (usually 4 to 6 weeks) to inspect the sale and submit bids. Each bidder is allowed to make only one bid and late bids are always rejected. Bids are then opened at a specified time and place, and the successful buyer is selected. If no bids meet your minimum requirements, you have the right to refuse all bids. No further price negotiations should take place after a buyer has been selected and unsuccessful bidders notified that the timber was sold. A blank Bid Solicitation is available from a MDC forester.

A *negotiated sale* involves face-to-face negotiations between the seller and a single buyer. This procedure often results in a price well below what the timber is worth because the buyer has no competition and the seller is often uninformed about the timber’s value. For that reason, do not be too anxious to accept the first offer for your timber. A negotiated sale, however, may be the best method if:

- *You have a small amount of timber or poor quality timber to sell.*
- *Markets for the species and products for sale are so poor that few buyers would be interested.*
- *You want to work with a particular buyer that you know and trust.*
- *You are marketing certain specialty products.*

Method of Payment

There are two methods of payment available to woodland owners who sell timber.

In a ***lump sum*** sale you receive a single payment for the trees to be sold before the harvest begins. Splitting payments for each cutting area may be necessary for large sales. Payment is based on the amount of timber volume estimated and not the actual volume harvested. Lump sum sales, therefore, depend heavily on the accuracy of your estimate of the volume and quality of timber for sale.

An advantage of a lump sum sale is simplicity. The landowner is relieved of the burden of keeping track of the volume of timber being harvested and income is provided before harvesting begins. A disadvantage is that the seller receives bids that are based on an estimate of the volume to be harvested, which may be different from the amount actually harvested.

In a ***yield sale*** the landowner is paid a certain amount for each unit of product cut. This requires that someone (usually at the mill) scale the volume of products after harvest. An advantage of a yield sale is that the landowner is being paid for the timber that is actually being harvested. The disadvantage is that problems can arise in obtaining an accurate tally since tracking the logs is difficult once they leave your property.

Advertising Your Sale

There are several steps to follow in preparing a timber sale notice. You must have accurate, reliable information and you need to send it to as many prospective bidders as possible. An up-to-date Log Buyers List is available from a MDC

forester. A timber sale notice should include the basic information that will later become part of the timber sale contract including:

- *Your name, address and telephone number.*
- *Location of the timber for sale. Include a map, legal description and directions.*
- *Description of the trees or logs to be sold. Include volume by species, number of trees, diameter classes and sawlog grades if appropriate. Describe how the trees and sale boundaries will be marked.*
- *Type of bid you are expecting: lump sum or yield sale.*
- *Times when potential buyers can visit and inspect the timber.*
- *Date, time and place written bids will be opened. Include how the successful bidder will be selected and notified.*
- *Whether or not a down payment is required to bind the offer when the contract is signed. An amount of 5 to 10 percent of the bid price is normally required.*
- *Any limitations or special ownership considerations on the sale. Such considerations include harvesting deadline, restrictions on access, conditions when loggers cannot operate (such as wet conditions), streamside management zones or buffers, etc.*
- *Requirements for a performance bond. A performance deposit is an amount of money above the sale price (usually 10 percent of sale price) posted by the buyer when the contract is signed and held in escrow by the seller. The bond's purpose is to ensure that the buyer abides by the terms set forth in the contract. The performance deposit should be refunded immediately after the sale is completed and contract requirements are met.*
- *Statement whether the logger must carry insurance and liability. Insurance will avoid possible legal complications if a logger is injured on your property and liability insurance will cover any damage to your property or adjoining lands caused by the logger.*
- *Statement indicating your right to reject any or all bids.*

Timber Sale Contract

The purpose of a timber sale contract is to protect the interests of buyer and seller and must be signed by both parties. You should meet with the logger or buyer to discuss the items to be included in the contract; this will reduce the possibility of misunderstandings.

The written contract does not need to be a complex document, but it should reflect what you and the logger have agreed to with respect to the sale. Timber buyers will frequently provide their own standard contract. Such contracts may not adequately represent your interest as a seller. A blank Timber Sale Contract is available from a MDC forester. You may want to have a lawyer draft or review your contract. It is critical that you include the provisions that you feel are important regarding the harvest on your property.

Supervise the Timber Harvest

One of the most important things you can do during the harvest is to inspect it periodically. Before harvesting begins, review the timber sale contract with the logger and point out sale boundaries. If possible, walk the site to be harvested with the logger. This will accomplish two objectives; 1) it will give you an opportunity to get to know the logger, and 2) it will give you a chance to explain your objectives of harvesting timber. A logger that is familiar with you personally and aware of your objectives will likely do a better job on the site.

Once timber harvesting begins, visit the area frequently. When you visit the site make sure that logging meets the terms of the contract. Questions that arise should be discussed with the logger. Unless you discover a flagrant violation of the contract, a simple suggestion to the logger in charge of the operation will usually solve the problem. After the harvest is completed and all provisions of the contract have been fulfilled, write a letter releasing the buyer from the contract and return the performance deposit.

Practice Good Forestry

Improper logging practices can have adverse ef-

fects on water quality, wildlife and forest regeneration. To ensure that you are satisfied with the end result of the timber harvest, it is important that good forestry practices are applied during and after the logging operation. Following BMPs and having a reforestation plan are two important considerations for harvesting timber on your property.

Sources of Forestry Advice

Landowners who have little experience in forestry should contact a professional forester to assist in managing their woodlands. There are private and public foresters available to help you with your management plan.

Private Sources. A consultant is a professional forester whose services are available on a contract or fee basis, with the fee paid by the client. Consultants can perform a variety of work including forest inventories, timber sales and land appraisal. Consultants may also serve as the main contractor in carrying out a Forest Management Plan on your land. A list of consulting foresters is available from the Missouri Department of Conservation.

Public Sources. The Missouri Department of Conservation can help private landowners become good stewards of their forest land by providing technical forestry assistance. A forester can provide a variety of services to help you meet your land management goals. These services are free-of-charge and will be as in-depth as you need, depending on your commitment to the long-term management of your forest lands. A forester can answer your questions over the telephone or may provide on-site assistance. A brochure entitled "Forest Management Assistance for Missouri Landowners" is available from a MDC forester and describes the services offered.

Contact: State Forester or a local forester at:
Missouri Department of Conservation
P.O. Box 180
Jefferson City, MO 65102-0180

Notes

Appendix A: Sample Solicitation of Bid for Timber

You are invited to bid on timber located as follows: in the NW 1/4, Section 23, Township 25 North, Range 14 West, Timber County, Missouri. The timber is located five miles south of Oak Grove on Route AB.

For additional information or for directions on how to see the timber, contact: Forrest Farmer, Oak Grove, Missouri; telephone 573/555-1234.

DESCRIPTION:

Approximately 160 acres of mixed oak timber. The trees to be cut are marked with a fresh orange paint spot at breast height and on the stump. About 1,600 trees are marked. Bids are to be made on a lump sum basis.

BID INSTRUCTIONS:

After the bid is completed, return it to:

*Forrest Farmer, Route 1
Oak Grove, MO 61234*

On or before -- Time: 1:00 P.M. Date:

Mark "TIMBER BID" on the envelope.

The owner reserves the right to reject any or all bids.

BIDDER: TELEPHONE:

ADDRESS: SIGNATURE:

AMOUNT OF BID:

Appendix B: Sample Timber Sale Contract

Joe Logger of Big Cedar, Missouri, herein after called the Purchaser, agrees to purchase from Forrest Farmer of Oak Grove, Missouri, herein after called the Seller, the designated timber specified below:

WITNESSETH:

ARTICLE I. *The Seller hereby agrees to sell to the Purchaser, subject to the terms listed below, all of the timber specified below, on a certain tract owned by the Seller, located in NW 1/4, Section 23, Township 25 North, Range 14 West, County of Timber, State of Missouri, located on 160 acres, more or less.*

ARTICLE II. *The Purchaser agrees:*

- 1. To cut only those trees marked with a fresh orange paint spot. Trees marked with an "X" may be cut if desired.*
- 2. Trees other than those specified above may be cut only for access on areas used for roads and landings.*
- 3. To pay the Seller a lump price of \$12,000.00 when the contract is signed to pay for the trees designated for cutting.*
- 4. To pay three times the stumpage value per tree, a penalty rate, for each tree that is cut which is not designated for cutting.*
- 5. To keep fields, fences, roads, and streams free from tree tops and other logging debris at all times. He also agrees to remove all oil and gasoline cans and other debris accumulated during cutting.*
- 6. And understands that the Seller is not responsible or liable in any manner for injury or damage resulting from the cutting and removing of these trees.*
- 7. That this contract cannot be transferred to another party without the written permission of the Seller.*

ARTICLE III. *The Purchaser further agrees to cut and remove said timber in strict accordance with the following conditions:*

- 1. To waive all claims to the above described trees unless they are cut and removed on or before December 31, 1999.*
- 2. To do all in his power to prevent and suppress forest fires on or threatening the sale area.*
- 3. To protect from unnecessary injury young growth and other trees not designated for cutting.*
- 4. To repair damage caused by logging to fences, bridges, roads, trails, or other improvements damaged beyond ordinary wear and tear.*
- 5. To allow the owner to cut and remove any portion of a tree left on the ground by the Purchaser after he has removed his products.*

Sample Timber Sale Contract (cont.)

ARTICLE IV. *The Seller agrees to the following conditions:*

1. *To guarantee title to the forest products covered by this agreement and to defend it against all claims at his expense.*
2. *To grant or secure necessary entry and right-of-way to the Purchaser and his employees on and across the area covered by this agreement, and also other privileges usually extended to purchasers.*

ARTICLE V. *It is mutually understood and agreed by and between the parties hereto as follows:*

1. *All timber included in this agreement shall remain the property of the Seller, and shall not be removed until paid for in full.*
2. *In case of a dispute over the terms of this contract, we agree to accept the decision of an arbitration board of three selected persons as final. Each of the contracting parties will select one person and the third will be the State Forester or his chosen representative.*

Signed in duplicate this _____ day of _____, 20__.

(Witness) (Purchaser)

(Witness) (Seller)

(Witness) (Seller)

ACKNOWLEDGMENT

STATE OF _____
COUNTY OF _____

On this _____ day of _____, 20__ before me personally appeared _____ to be known to be the person(s) described in and who executed the foregoing instrument and acknowledged that _____ executed same as _____ free act and deed.

In Testimony Whereof, I have hereunto set my hand and affixed my official seal, at my office in _____, the day and year first above written.

My Commission as Notary
Public Expires _____.

NOTARY PUBLIC [an error occurred while processing this directive]

Appendix Section 5:

Planning for Agroforestry Workbook

Steps to Developing an Agroforestry Plan

Objectives for Development Area

- Step 1: Initial Objectives and Priorities
- Step 2: Evaluate Personal Resources
- Step 3: Identify Current Land Uses
- Step 4: Map Area(s) for Agroforestry Development

Site Assessment

- Step 5: Climate Assessment
- Step 6: Soil Assessment
- Step 7: Physical Features (Terrain)

Vegetation Inventory

- Step 8: Timber and Non-Timber Forest Crop Inventory

Brainstorming

- Step 9: Agroforestry Development Ideas

Choosing your 'Best Bet'

- Step 10: Listing 'Best Bets'
- Step 11: Revising Your 'Best Bets'
- Step 12: Identifying Buyers and Their Needs
- Step 13: Researching the Competition
- Step 14: Exploring the Industry
- Step 15: Adding Value to Products
- Step 16: Setting the Price
- Step 17: Getting Products to the Buyer
- Step 18: The 'Final Cut'

Agroforestry Practice Design and Management

- Step 19: Revisit Your Objectives and Priorities
- Step 20: Detailed Crop Information
- Step 21: Designing Your Agroforestry Practices

The Agroforestry Development Plan

- Step 22: A Five-Year Management Projection
- Step 23: Yearly Activity Schedule

Objectives for the Development Area

Step 1: Identify Landowner Objectives and Priorities

Rank (X) the following management objectives according to your land-use priorities (low, medium, high). Remember that these objectives are a starting point, and you can (and probably will) modify them later.

If possible, numerically rank the top five objectives for your agroforestry project (1= highest to 5= lowest priority).

Objective	Low	Medium	High	Top 5
A new source of income from un-productive land				
Reduce costs of current farm or forest operations				
Develop new source of long-term income (i.e., timber).				
Increase short-term income while awaiting long-term timber income				
Tax advantages				
Increase grazing opportunities				
Increase wildlife opportunities				
Undertake environmental improvements				
Access to government programs and cost-share				
Other				

Objectives for Development Area Step 2: Evaluate Landowner Resources

What resources -- in addition to your land base -- do you have that could be put into your agroforestry development? The section below allows you to list and evaluate the resources of all the family members who will be involved and that you think will have an impact on your ability to develop this agroforestry area.

Resource	Landowner use and potential of resource
1. Management time - when will the new activity not be in conflict with existing activities?	
2. Labor - times of year when labor is most available.	
3. Equipment and facilities - for animals, storage, value-added processing, time of year available.	
4. Specialized farm equipment - Identify special farm equipment, such as tractors, ATVs, spray equipment, etc.	
5. Irrigation - water source available.	
6. Plant material - Your own sources of seed, seedlings, cuttings and larger trees, or will you need to purchase them?	
7. Livestock - Cattle, sheep or other animals. What are their needs, and when are those needs greatest -- for instance, perhaps during calving.	
8. Materials - sawdust or shavings, manure and straw, or pine straw, for mulch, etc.	
9. Other	

EXERCISE: Can I Meet My Labor and Management Needs?

	Total hours for year	Distribution of hours (for one year or for production period)			
		Jan-Mar	April-June	July-Sept	Oct-Dec
Suggested hours for full-time worker (~ 40 hours/week)	2,000	500	500	500	500
My estimate for cost of wages for a full-time worker (\$5.15/ hour minimum wage)					
Labor and management hours available					
Principal manager					
Team member no.1					
Team member no.2					
Team member no.3					
Hired labor					
Total hours available					
Direct labor and management hours needed by enterprise					
Enterprise 1					
Enterprise 2					
Enterprise 3					
Total labor hours needed					
Total labor hours available (from above)					
Additional labor hours required <i>(total hours needed minus total hours available)</i>					
Excess labor hours available <i>(total hours available minus total hours needed)</i>					

Step 3: Identify Current Land Uses

List present uses of each part of your land and the products you harvest. Possibilities include: residential, recreation, farming (which crop), grazing (type of livestock), timber production, non-timber production, wildlife areas and green belts.

Land Use	Products/Resources Available
1. Residential	
2. Recreation	
3. Farming (list crops)	
4. Grazing Livestock (Type)	
5. Timber Production	
6. Non-Timber Production	
7. Wildlife Areas	
8. Green Belts	
9. Other	

EXERCISE: Inventory Your Land and Natural Resources

Agricultural land resources: cropland and pasture

Who can help? Your local extension agent or NRCS (Natural Resource Conservation Service) office can look at your property, indicate whether your present farm-management plan is sound, and recommend other options that could enhance your operation. Cost share programs or the sale of your agricultural development rights are other options that may be of value to you.

Number of acres of tillable land _____

Number of acres of pasture _____

Number of acres left idle _____

Number of acres you farm _____

Number of acres rented _____

Current crop(s) _____

Number of head of livestock _____

Total annual rental income from land rented to others who grow crops _____

Total annual rental income from land rented to others who raise livestock _____

Fertility of land for agricultural crops: Excellent Good Poor

Fertility of land in forests: Excellent Good Poor

Total annual income from pasture and livestock _____ How much of the annual pasture and livestock income is from land rented to others? _____ Rented from others? _____ Total annual income from cropland _____ How much of the annual cropland income is from land rented to others? _____ Rented from others? _____

Natural resources

Forest. Who can help? You may want to contact a state forester to assist you with the inventory and evaluation of your forest resources. He or she can advise you on the procedure for developing a forest stewardship plan. In some states, a state forester can help you prepare a forest stewardship plan. In all states, they can provide names of private consultant foresters to assist with a timber sale or assess the potential of your forest under different management options.

Total number of acres of forest _____

Three most common tree species (oak, poplar, pine, hickory, ash, etc.) _____

Do you have a written forest management plan? _____ If yes, what year was it prepared? _____

Have your property taxes been reduced because you are enrolled in a land-use-tax assessment program for forestry? _____

EXERCISE: Inventory Your Land and Natural Resources (cont.)

Natural resources (cont.)

What nontimber forest products, if any, are present on the property? (Include edible and medicinal plants, decorative or floral products, specialty wood products, and native wild plants).

Have you or has a past owner sold timber to a commercial timber harvester? _____

If yes, when? _____ How many acres? _____
(Developing a forest stewardship plan will provide the information to answer the last two questions).

How many acres of forest could a commercial operator potentially harvest during the next five years? _____

Within the next five years, what is the estimated income from a commercial timber harvest(s) that is compatible with your forest stewardship objectives? _____

Wildlife

Who can help? State wildlife biologists have limited time but may be able to visit and discuss options. Leasing the hunting rights is an option that could generate income to pay taxes or more. Investigate educational materials on hunting options and discuss them with your extension wildlife specialist. Also contact the U.S. Fish and Wildlife Service.

Are deer causing significant crop or forest damage? _____

Are other wildlife species causing crop damage? _____ If yes, what species? _____

Do you have large numbers of geese on your property? _____

Do you have quail or pheasant on your property? _____

Do you have wild turkeys on your property? _____

What other type of wildlife have you seen on the property? _____

What type of habitat improvements could be made to attract the wildlife you are interested in introducing to the property (timber harvesting, food plots, tree planting, etc.)? _____

Do you or other family members hunt on the property? _____

EXERCISE: Inventory Your Land and Natural Resources (cont.)

Wildlife (cont.)

Do neighbors or other local residents now hunt on the property, with or without permission? _____

Do existing hunters pay you for the right to hunt on the property? _____

If yes, how much are you paid a year? _____

List any unique wildlife habitats or species on your property (e.g., forest ponds, wetlands, old forests, caves). _____

Aesthetic or intangible resources

List locations on your property that have aesthetic appeal and could be developed for recreational enterprises, such as vacation cabin or hunting camp. Unique locations include rivers, streams, scenic overlooks, rock cliffs and wetlands. _____

Water resources

If you have more than one pond, or spring, assess each. **Who can help?** For assistance with evaluating your water resources, you may want to contact your local cooperative extension office. An extension agent should be able to direct you to a water-quality specialist in your area.

Ponds. Pond size (in acres) _____ Maximum pond depth (in feet) _____

Maximum summer water temperature at 2 feet _____ pH _____

Alkalinity (in parts per million) _____

What type of fish live in the pond? _____

Do livestock have full access to the pond? _____

Does livestock waste drain into the pond? _____

Streams/ Rivers. Stream width _____ Stream depth _____

Does the stream run all year? _____

What type of fish live there? _____

Do livestock use the stream or does livestock waste run into the stream? _____

Is the stream bordered by forest of at least 25 feet in width along each side? _____

Springs. Number of springs on the property _____

Rate of flow of largest spring (gallons per hour) _____

EXERCISE: Inventory Your Physical and Personal Resources (cont.)

Buildings, houses, barns and other structures

List size, age, condition, and the cost to convert or upgrade structures for use in the enterprise.

House _____

Barn 1 _____

Barn 2 _____

Other _____

List rental cost and location of any available public or private structures or facilities that you can use for your enterprise (e.g., kitchen, storage facility, or processing facility). _____

Machinery and equipment

For each piece of equipment (tractor, chainsaw, wagon, rototiller, backhoe, bulldozer, etc.), list make, horsepower, age, condition, attachments, or other relevant information.

1. _____

2. _____

3. _____

4. _____

5. _____

Use of byproducts of farm / forest operation

Is animal manure produced from the farm operation? _____

Can it be used onsite? _____

List other byproducts, if any, from farm operations _____

Can they be used onsite? _____

How and where? _____

Are limbs and other wood from a recent timber harvest currently available for use? ___

What is the type and quantity of this material (e.g., cords of firewood that it would produce and number and species of vines)? _____

EXERCISE: Inventory Your Physical and Personal Resources (cont.)

Labor and management resources

Time for management and labor involved in an enterprise must come from the team members or from outside sources. The chart bellow will help team members determine how much time they have available during each quarter of the year for management and labor activities. The time available can be on weekends or weekdays. Completing the chart will help you look at your time realistically and determine whether the enterprises you are investigating are compatible with the time you have available.

Resource person	Hours by season and time of the week				
	Total hours available/year	Jan.-Mar. Weekday/ Weekend	Apr-June Weekday/ Weekend	July-Sept. Weekday/ Weekend	Oct.-Dec. Weekday/ Weekend
Management / labor					
Labor					
Potential labor sources outside of team					

EXERCISE: Inventory Your Physical and Personal Resources (cont.)

Financial Resources

How much startup money can you raise by using personal or family resources? _____

Where will the startup money come from (e.g. personal savings, family member, farm credit, bank, cooperative)? _____

Do you plan to borrow money from a bank for the enterprise? _____

Is there a grant program that could provide some startup money? _____

Special skills that are commonly overlooked

If you or any of your team members have any of the following skills or experience, fill in the names. Also, add the names of relevant agencies or organizations with which you or your team members may have connections (such as cooperative extension, university agricultural experiment stations, the U.S. Department of Agriculture, state department of agriculture, and state forestry agencies).

Relevant experience	Name of person	Short description of skill or experience
Marketing skills		
Computer skills		
Production skills		
Sales ability		
Special skills, such as innovative thinking		
Other (<i>list skill</i>)		

Step 4: Map Area(s) for Agroforestry Development

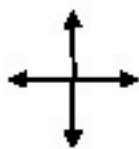
Using the legend, draw a sketch map of your agroforestry development area in the space below. This map will be used to mark the locations of areas that have various advantages and limitations. Note key reference points, such as roads, boundaries and buildings, and include:

Existing land uses - such as crop fields, pastures, stands of trees

Be sure to label with a scale and orientation arrow

Physical features - like steep slopes, rock outcrops, streams and ponds*

Scale]-----[

Orientation 

road	windbreak	quarry	debris pile
property boundary	building	plantation	flood/silt/wamp
fence	access road/trail	marsh	orchard
brush	grass/abandoned field	bridge	Scale _____
woodland area	hydro line	steep slope	
watercourse	railway	shallow & rocky	

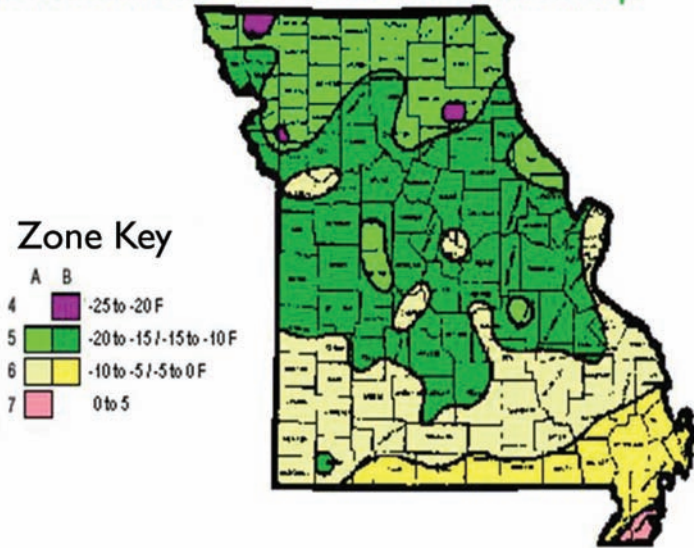
Step 5: Climate Assessment

Simply stated, the site assessment provides an overall measure of a land areas ability to support, or grow, a desired plant. Therefore, as a part of this assessment, the biological areas that will be considered include the climate, the soils and the lands physical features, sometimes called the topography or terrain.

Development Area	
Hardiness Zone: Include frost-free days, first and last frosts (see heat zone map on the next page).	
Indicator Plants	
Other Useful Climate Information: <ul style="list-style-type: none">- Mean annual rainfall- Mean annual snowfall- Average Temperatures- Open Ground: Average date of spring thaw and fall freeze.	

Step 5: Climate Assessment (cont.)

Missouri USDA Hardiness Zone Map



USDA Hardiness Zones and Average Annual Minimum Temperature Range

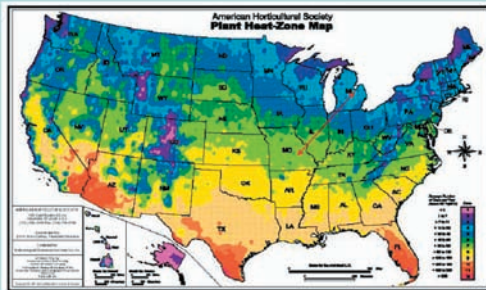
Zone	Fahrenheit	Celsius	Example Cities
4a	-30 to -25 F	-31.7 to -34.4 C	Minneapolis/St. Paul, Minnesota; Lewiston, Montana
4b	-25 to -20 F	-28.9 to -31.6 C	Northwood, Iowa; Nebraska
5a	-20 to -15 F	-26.2 to -28.8 C	Des Moines, Iowa; Illinois
5b	-15 to -10 F	-23.4 to -26.1 C	Columbia, Missouri; Mansfield Pennsylvania
6a	-10 to -5 F	-20.6 to -23.3 C	St. Louis, Missouri; Lebanon, Pennsylvania
6b	-5 to 0 F	-17.8 to -20.5 C	McMinnville, Tennessee; Branson, Missouri
7a	0 to 5 F	-15.0 to -17.7 C	Oklahoma City, Oklahoma; South Boston, Virginia
7b	5 to 10 F	-12.3 to -14.9 C	Little Rock, Arkansas; Griffin, Georgia

AHS Plant Heat-Zone Map

The 12 zones of the map indicate the average number of days each year that a given region experiences "heat days"-temperatures over 86 degrees (30 degrees Celsius). That is the point at which plants begin suffering physiological damage from heat. The zones range from Zone 1 (less than one heat day) to Zone 12 (more than 210 heat days).

Avg. No. Days Annually Temp. Is Over 86° F

- ZONE 1: -1
- ZONE 2: 1 to 7
- ZONE 3: 7 to 14
- ZONE 4: 14 to 30
- ZONE 5: 30 to 45
- ZONE 6: 45 to 60
- ZONE 7: 60 to 90
- ZONE 8: 90 to 120
- ZONE 9: 120 to 150
- ZONE 10: 150 to 180
- ZONE 11: 180 to 210
- ZONE 12: 210 +plus+



Step 6: Soil Assessment

This area is for notes about the soil(s) present on specific areas of the sketch map. You should include information that is directly useful to your agroforestry development. Photocopy the table below if you are assessing more than one development area.

Development Area	Soil Type(s) if Known:
1. Soil texture and composition: sand and gravel, loam, silt and clay, organic layer (depth).	
2. Soil depth: include rock outcroppings and hardpan (depth of soil cover), rockiness.	
3. Soil moisture: particular note of wet areas and flooding (with time of year).	
4. Soil nutrients: pH, salinity, fertility (attach soil reports).	
5. Aspect: especially south vs. north facing.	
6. Terrain relief: slope, steepness, gullies.	
7. Soil stability: presence of high risk indicators such as sheet, rill or gully erosion.	
8. Frost pockets	
9. Roots, stumps and other debris in or on soil.	

Step 7: Physical Features (topography)

There are a number of physical features, or topography characteristics, that can influence the capability of your land to produce particular crops on a site. Because physical features are often closely related to soil characteristics, the information you obtain for each of your agroforestry development areas should be entered into the same table as the information from Step 6: Soil Assessment.

In combination, the terrain relief and aspect create a lay of the land that often will enhance the opportunities for a successful agroforestry practice. By listing unique land features you will be better able to place practices and plant species to the landscape to best ensure their survival and growth. For example, slope is very important in relation to the moisture available for plant growth. In general, north-facing slopes will have better moisture than south-facing slopes that are typically drier.

Step 9: List Agroforestry Ideas for Each Practice

List your agroforestry ideas separately for each development area. An additional category (Associated Practices) is provided for systems that are not real agroforestry systems, such as hybrid poplar plantations.

Development Area	Agroforestry Ideas
1. Forest Farming	
2. Alley Cropping	
3. Silvopasture	
4. Riparian Forest Buffers	
5. Windbreaks	
6. Associated Practices (e.g., Poplar plantations)	
7. Wildlife Areas (e.g., increase quail habitat, lease hunting)	
8. Other ideas for integrating forest practices on the farm	

EXERCISE: Assessing My Resources, Goals and Possible Enterprises

1. Describe the long-and short-term goals that you and your team hope to achieve by starting this new enterprise.

(a) Long-term goals

- 1.*
- 2.*

(b) Short-term goals

- 1.*
- 2.*

2. List the family members or team members who want to be actively involved. Describe each person's responsibilities.

3. Specify how much time each week you and your teammates will have available to spend on your new enterprise.

4. How much money can each team member provide now to initiate the enterprise?

Assessing My Resources, Goals and Possible Enterprises (cont.)

(Read and fill in number 5 only if you currently run a natural resources – based enterprise; otherwise, go to number 6).

5. Check the responses that best characterize your business goals during the next three to five years for your current enterprise. Answer any follow-up questions.

- Maintain at about the same level as in the past** _____
- Expand. How?** _____
- Get out altogether. Why?** _____
- Other:** _____

6. The following information will help you determine your financial goals for any current or new enterprise. List the yearly income (you and your family or teammates) expect from the sources listed below:

Current farm/forest enterprises _____

New enterprise (once it is established) _____

Non-natural-resource employment (current job) _____

Other _____

TOTAL _____

EXERCISE: What Will It Take To Produce My Product or Service?

You will probably have to make some capital purchases, such as buying buildings, equipment, or land and making major improvements, to start your new business. List the capital purchases and their costs.

What will be your major production tasks, such as planting, harvesting, building, advertising, sales, and maintenance? Describe the tasks according to the month they should occur. Also indicate which months you expect to receive income.

Month	Task
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

EXERCISE: Relative Merits of Various Enterprise Ideas

Criteria	Enterprise ideas*				
Total					

* Rated on a scale of 1 to 10, with 1 being least compatible and 10 being most compatible

Example EXERCISE for the Smiths: Relative merits of various enterprise ideas

Criteria	Enterprise ideas *				
	<i>Shiitake</i>	<i>Grapevine wreaths</i>	<i>Hunting lease</i>	<i>Ginseng</i>	<i>Aquaculture</i>
<i>Compatible with residency status</i>	10	10	7	10	10
<i>Preferred by family</i>	9	6	7	9	3
<i>Meets financial goals</i>	9	9	5	10	9
<i>Uses underused physical resources</i>	4	9	8	6	8
<i>Uses management / labor resources</i>	8	6	5	3	6
<i>Potential market exists</i>	10	5	9	10	6
<i>Uses farm and forest byproducts</i>	9	9	3	7	5
<i>Family financial resources available</i>	10	8	10	4	8
Total	69	62	54	59	55

* Rated on a scale of 1 to 10, with 1 being least compatible and 10 being most compatible

Step 14: Exploring the Industry

The table below will help you develop a clear picture of the entire industry in which you intend to participate. You should focus your attention on industry standards, influences and trends. Fill in industry information for each of your 'best bet' selections. Photocopy the table below if you are assessing more than one development area. *(Refer to Marketing chapter for exercises.)*

Development Area	Available Government Incentive Programs:	
Crop/Product	Industry/Market	Standards, Influences and Trends

Step 19: Revisit Your Objectives and Priorities

List your top five land management goals (see original objectives listed in Step 1):

Top Five Land Management Goals:
1.
2.
3.
4.
5.

Step 20: Detailed Crop Information

Use the table to summarize everything you know about each plant you plan to grow in one agroforestry development area. You can photocopy the table below so that you have one for each crop plant.

Crop Plant:	
Agroforestry practice (best produced in)	
Where produced (in development area)	
Shade (requirement or tolerance)	
Soil and water (requirement or tolerance)	
Particular plant needs (to produce needed quantity and quality)	
Labor required to grow and harvest (amount and time of year)	
Resource use fit (time, labor and other resources with other activities)	
Compatible crop plants (can be grown with or should not be grown with)	

Step 20: Detailed Crop Information (cont.)

Crop Plant:	
Compatible livestock (animal and useful interaction)	
Harvest requirements (e.g., by hand, machine, cut tops, dig)	
Post-harvest requirements (e.g., storage, drying)	
Packaging and shipping requirements	
Cost to grow and harvest	
Product(s) on market	
Current market price	
Profit potential	
Volume (potential production)	

Step 20: Detailed Crop Information (cont.)

Crop Plant:	
Grade standards in market	
Product influences and trends	
Value-added opportunities	
Other	

Notes

Appendix Section 6:

**Plant Resource Guide:
Materials and Management**

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Alfalfa (*Medicago sativa* L.)

Description

Alfalfa is an herbaceous perennial legume that can produce large amounts of nutritious forage material. It is a legume, with a tap-root, and can last up to 5 years if managed correctly. The energy and protein yield/acre rivals that of corn as used for silage purposes. It has the highest feed value of any commonly grown hay crop.

Habitat

Alfalfa is best suited to deep, fertile, well-drained soils with a pH of 6.0 to 6.5. However, with correct management it can be grown on differing soil types.

Management Considerations

Attacks by insects can be very problematic to alfalfa. The alfalfa weevil and potato leafhopper are the main insect problems in Missouri. By careful monitoring and management (chemical or harvest timing) can help control adverse insect problems.

High fertility is needed for establishment, along with proper levels of fertilizer and lime for successful competition of alfalfa and stand maintenance.

Harvesting Considerations

Alfalfa can be used as silage, hay, or pasture. Hay harvest can occur every 30 to 35 days during the growing season if weather permits normal rates of regrowth. Allowing livestock to graze for 3 days, then giving alfalfa 30 days for recovery, works well. Using this approach to graze alfalfa obviously involves partitioning the pasture area into smaller areas. Thus, fencing can be an added cost of using alfalfa in this manner. Intensive grazing is not much different than harvesting alfalfa for hay, where forage is cut, baled, and hauled away.

It is advisable to not cut or graze from September 15th to November 1st, allowing the plant to store over-wintering energy. However, following November 1st a final pre-winter harvest of the forage is permissible.

Propagation

Alfalfa exhibits autotoxicity, seed will not grow in existing stands of alfalfa. As old stands begin to decline, they must be plowed under before reseeding. Seeding of alfalfa can be done in the fall or late summer. If herbicides are not used for weed control, it is recommended to have a companion crop of oats (usually oats at 1/2 normal seeding rate) to help control the weeds and prevent erosion during the seedling establishment period. The oats should be harvested early to alleviate competition on the alfalfa. Depending on whether alfalfa is seeded alone, or with other legumes and grasses, approximately 10 to 15 lbs of seed per acre will

usually be needed. Seeding can be broadcast, no-tilled, or drilled into a prepared seedbed. With proper preparation, such as fertilizer and liming, the establishment of a stand in correct soil types should prove no problem.

Economic Uses

Hay, silage, and pasture are the most economic uses for the small landowner. Sprouts for human consumption are also a viable market, but the research for buyers must be thorough. Generally, local hay markets are readily available, and in bulk can often be sold to large corporations. Such marketing usually will require meeting with the buyer and addressing special considerations for product quality/appearance. Silage may be sold or used by the landowner as feed, just like hay. Pasture is mainly useful to the landowner, but cash-renting possibilities are available.

Notes

Uses in agroforestry for alfalfa include Alley Cropping and Silvopasture. Alley cropping can be implemented with rows of trees and strips of alfalfa for hay or silage lying in-between the tree rows. Silvopasturing can also be used, with grazed alfalfa providing benefits to both the trees and livestock. The same tree configuration, trees in rows, can be used in both alley cropping and silvopasture practices, or the trees can be managed in a grid pattern for the silvopasture practice. In either case, the only difference in forage removal is whether mechanical methods or animals are used. However, if livestock are used remember to protect the trees from browsing and/or rubbing.

Additional Resources

<http://muextension.missouri.edu/explore/agguides/crops/g04550.htm>

American Basswood (*Tilia americana* L.)

Description

American Basswood, also known as American Linden, is native to all of New England and the Midwestern United States. American Basswood is a favorite tree of bees as they extract nectar from its flowers, making a very high-quality honey in the process. Basswood is also a valuable timber tree. The stately appearance of American Basswood makes it a favorite shade tree for large areas, such as parks. Its leaves are the largest of any of the native basswoods. When found in the open, it may reach 80 feet tall by 40 feet wide, with its lower limbs pendulous but upswept at the tips. Basswood has alternate, ovate leaves that are about as wide as long, with a truncate (flattened) or heart-shaped base, finely serrated margins, and a short tip at the apex of the leaf.

Habitat

American Basswood prefers moist, well-drained, deep, rich soils and will grow on in a variety of pH levels. It thrives in full sun to partial sun.

Management Considerations

Basswood has a very fast growth rate. Consequently, it will also have a high site index associated with it, and may reach heights of up to 70 feet in 50 years in unmanaged forest stands. Management that reduces competition can provide improved growth rates. However, open grown conditions may result in sprouting. Basswood is less shade tolerant than most of its common associates, but vigorous sprouting and rapid sprout growth allows it to persist under competitive conditions.

In forested settings basswood is likely to develop a straight, clear bole. However, basswood may be easily damaged by fire. Caution should be used since this burn wounds will likely result in hollow or otherwise defective trees.

Harvesting Considerations

Many of the products gained from basswood include specialty wood products and markets for these should be sought out locally. These products can include soft wood for hand carving. Additionally, the bark has been used in weaving products like baskets. Little defect is noted in basswood when harvested before it reaches 120 years of age, but beyond this age decay and losses due to decay increase.

Propagation

Basswood will readily resprout from stumps of harvested trees. Futuristically, this can result in a clump of trees. Management of clumps as a result from cut trees should leave no more than 2 sprouts per stump. Ideally, management for a single stem is best for most species, but basswood is likely to be a prolific sprouter.

Seed and vegetative propagation can be used for establishing basswood. Basswood seeds show a pronounced dormancy and typically have poor germination rates. To enhance germination, and break dormancy, the seed coat must be penetrated. Use abrasion or acidic solutions to facilitate this process. Correctly treated seeds commonly average from 20 to 30 percent germination following stratification at 2° to 5° C (36° to 41° F) for 110 to 130 days. Seeds should be collected when it turns brown, but before they become dry and hard. It is desirable to have a moisture content of 20 to 40 percent (green weight).

Economic Uses

Basswood is a tree that has historically been used in a variety of ways. Its wood has been used for carving and in furniture. Its inner bark fiber has been used to weave rope and baskets. Its flower produces excellent honey. And, throughout the Eastern United States, basswood is frequently planted along city streets.

Uses

Its preference for moist, well drained soils, and its propensity to develop a spreading root system over time, makes it a good candidate for the agroforestry practice of riparian buffers. Additionally, it can provide farms with production potential as a timber tree, or a tree that produces top quality honey.

Additional Resources

USDA Silvics Manual on line at:

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/tilia/americana.htm.

American Hazelnut (*Corylus americana*)

Description

Hazelnuts and filberts are produced by species of *Corylus*. Commercial filberts (*C. colurna* L. and *C. maxima* Mill.) are cultivated in various parts of the world, particularly Turkey, Italy, Spain, China, and the US. Nuts of the native American species (*C. americana* and *C. cornuta*) are smaller but similar to the cultivated ones in flavor, and *C. cornuta* also is commercially cultivated for nut production. Edible brown nuts 1/2 inch in diameter are enclosed in a hairy, leaf-like husk with ragged edges; initially green, ripening to a brown in late summer. The nuts are sweet and may be eaten raw or ground into flour for cake-like bread. The nuts were used by American Indians to flavor soups.

Habitat

American hazel occurs from Maine west to Saskatchewan, south to eastern Oklahoma, east to Georgia, and north through New England. American hazel grows along streams, hedgerows, meadows, woodlands, roadsides, and forest margins. It grows best on rich, moist, well-drained soils.

A large, deciduous, thicket forming shrub that can grow 3'-10' in height. Straight trunk, with spreading, ascending branches. Roots typically in upper 6" of soil. Some smaller roots run vertically toward the surface and branch profusely into very fine laterals. Broadly oval leaves with a heart-shaped or rounded base are dark green above and paler below, 2 1/2 to 5 inches long, with doubly serrated margins. Light brown male flowers are 1 to 3 inches in length in clusters of two or three, inconspicuous gray-brown female flowers, appearing as short, thin, red threads in early spring.

Management Considerations

American hazel is a competitive understory tree. It often competes with hardwoods and pines for light and moisture. Because of shading and aggressive growth, it has long been recognized as a major restriction to the successful regeneration of land conifers. American hazel is shade tolerant. It can grow under a light intensity of 15 percent or less and in some places even as low as 1 percent. However, do not expect good nut production under heavy shade.

If the light and nutrient needs of American hazel are met, this tree could be used in agroforestry practices like alley cropping and maybe forest farming. American hazel produces a sweet tasting nut that has been commercially sold, eaten raw or made into other delectable treats. If desired to grow hazelnut for its nuts it should not be used in conjunction with animals. The leaves, twigs, and catkins of American hazel are browsed by deer and moose. The nuts are eaten by small mammals, northern bobwhite, ruffed grouse and other large birds, and deer. Even though American hazel likes to grow along streams, it should be advised that

beaver like to eat the bark. American hazel could persist well in an alley cropping design. Additionally, quail could use the bare ground that develops on the ground beneath. This design could include large deciduous trees that will provide American hazel with ample shade for superior growth and moderate light for nut development.

Harvesting Considerations

The flowers of American hazel are formed in the summer and open the following spring before new leaves emerge. The hazelnuts form from the fertilized flowers by late summer or early fall. While plants of American hazelnut may begin producing seed after the first year and produce good seed crops every 2-3 years, commercial production levels will likely be later, with maximum production reached at about year 12. At harvest time, usually in October, the area underneath the trees should be trimmed and kept clean. Placing a tarp under the tree before mechanically removing the nuts can aid in nut collection. Once nuts are collected, they should be dried to about 10% moisture. If the seed is to be planted rather than eaten, then seed dormancy will need to be overcome by cold treatment.

Propagation

Hazelnut can be propagated by seeds or cuttings. Propagation by seed will provide more genetic variability between plants, and requires seed stratification. Production from cuttings will demonstrate the genetics of the specific clone (the parent).

Economic Uses

Hazelnuts are a highly profitable nut used in cooking and confectionary items. Many niche markets exist that use hazelnuts in their products. Hazelnuts are sold dried and in shell around winter holiday season.

Notes

Turkey produces about 65% of the hazelnuts on the world market. In North America, the main area of production is Oregon. Eastern Filbert Blight, a fungal disease, is a threat to all hazelnut trees and needs to be managed for if trees are infected.

Additional Resources

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

Bald Cypress (*Taxodium distichum*)

Description

Bald Cypress is a long-lived and wind-firm tree that is native to the Southeastern United States. This deciduous conifer is very majestic in appearance and is rarely blown over, even in hurricane winds. Life expectancy is 200+ with 500 yr old specimens cut throughout the 1970's. The largest remaining stand of old-growth bald cypress trees in Missouri can be seen at the Allred Lake Natural Area where the trees range from 500 to 1000 years old. Usually 50-70 feet in height but can easily reach 130 ft with roughly a 30 foot spread. Creates a heavy straight trunk, sometimes up to 13 feet in diameter, and becomes flat topped in maturity. On wet sites, Cypress will likely forms "knees" with age. These are root protrusions from the soil and it is believed that these knees provided for gas exchange.

Habitat

A misconception with Bald cypress is it's assumed that it has to have "wet" soils. In actuality seed must be in a source of constant moisture for germination to occur and this is most commonly found in a swamp. It is very adaptable to wet or dry sites but is not tolerant to high pH soils.

Management Considerations

Because of its adaptability to both wet and dry sites, it can be planted in a variety of situations. However, due to its habit of developing a widespread root system, it can be difficult to place into integrated tree-crop systems where roots will compete for water and moisture. But this habit can be useful for reduced wind throw within windbreaks and riparian zones. And because of its adaptability, it can be a great addition to either system because of its tolerance to any areas soil characteristics. Its usefulness in riparian areas can be recognized through greater stream bank stabilization as a result of the widespread root system.

Harvesting Considerations

Because of its slow maturity and slow growth, it is not likely that marketable sawlogs will be produced within 40 yrs. This can be a plus in riparian settings where a long lived tree provides many year of soil stability. And, when a marketable size is reached, the wood of cypress is valuable. It produces a wood that is very decay resistant.

Propagation

Because of its need of water to germinate, the bald cypress may not propagate well in every area planted. However, seedlings are readily available.

Seedlings require light for good growth, thus control of competing vegetation is necessary. Bald cypress will also produce vigorous sprouts from the stumps of both young and old trees, following disturbance such as harvesting.

Economic uses

Bald Cypress wood is noted for its insect and decay resistance. It is used for heavy construction, including docks, fence posts, railroad ties, barrels, caskets, warehouses, boats; bridges as well as general millwork and interior trim.

Additional Resources

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm

Big Bluestem (*Andropogon gerardii*)

Description

Big bluestem was one of the more important grasses of the tall-grass prairie that formerly covered much of the state. Big bluestem grows to a height of between 3 and 10 ft. Its roots can reach depths of 8 to 10 feet. It has tall, slender stems. The grass is green throughout much of the summer; the stem turns to a blue-purple as it matures. This is the reason for the name bluestem. The seed heads usually have three spike-like projections and resemble a bird's foot. This results in another common name for big bluestem -- "turkey foot."

Habitat

Big bluestem is adaptable to a wide range of soils; it thrives in light, porous soils as well as heavier, less well drained soils, even clays. It tolerates acidic or alkaline soils. It does well in dry or humid climates and tolerates cool as well as hot summers. The big bluestem grows in moist soils and lowlands and is not very plentiful in uplands. This native plant starts its growth in April and begins to flower in late summer with most growth occurring in August. Big bluestem can withstand short periods of waterlogged soils in summer, but not in winter. Of all the native grasses, Big Bluestem has one of the highest tolerances of acidity in the soil. It is useful for seeding of spoil areas and other poor sites where it has been known to thrive on areas with a pH as low as 4.5.

Management Considerations

Uses for Big Bluestem are many. Due to its rapid growth pattern, it is a top choice for erosion control on moderately to well drained soils. It is one of the most palatable warm season's grasses, thus making it popular for forage. Wildlife management agencies use Big Bluestem as a primary component in plantings for upland birds and mammals, which use it for nesting and escape cover throughout the year. In addition, insects are attracted in large numbers to Big Bluestem, which insures the usage by many species of songbirds.

Harvesting Considerations

Big bluestem, the "King of Grasses" produces better quality and greater amounts of forage than any other Native American prairie grass. Big bluestem is excellent forage. It can yield two to four tons of hay per acre.

Propagation

Planting can occur in April or early May, mainly by no-till practices. For stands that are being planted for wildlife purposes, it will require 6-8 lbs PLS (Pure Live Seed) of seed per acre. If planting an area for forage a higher rate (10-12 lbs PLS) of seeding will be needed. If using bulk seed, rates should be doubled. Dormant plantings can be done from December through February.

Economic Uses

Although commonly recognized for its forage value, big bluestem has broad application in conservation plantings. It is often used in mixes of warm-season grasses to control erosion and benefit wildlife. Often, the outer zone of the forested riparian buffer will incorporate big bluestem. Additionally, it can be applied adjacent to tree rows in an alley cropping setting, or as an outside set of rows in a windbreak, both will help with make an effective conservation practice and enhance wildlife benefits.

Notes

Wildlife biologists and upland game managers use warm-season grasses for game habitat, nesting and holding areas. The stubble of the grasses remains erect over the winter providing nesting cover and protected "trafficways." Little bluestem, lovegrass and sideoats grama are usually in these seeding mixtures in addition to big bluestem and indiagrass.

Additional Resources

<http://extension.missouri.edu/explore/agguides/crops/g04673.htm>
http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

Bittersweet (*Celastrus scandens*)

Description

A woody vine, bittersweet can climb over most trees and fence posts. Reaching a full length of 60 feet, this vine produces alternate, ovate leaves that 5-8 inches long and 3-5 inches wide. The flowers are lighter green in comparison to the leaves and bloom from May to late June. Colors of the pedals range from pale-green to yellow. Bittersweet is dioecious, implying there are separate male and female plants. Nurseries recommend 1 male plant to every 6-9 female plants. From the flowers, distinctive red berries are produced and linger on the plant throughout the fall and into the following spring. The berries emerge from spherical orange-yellow fruit that “burst” open when the berries are mature.

Habitat

In light preference, bittersweet is a full sun species that is most often found in well drained areas such as glades, limestone bluffs, forests, and fence rows. This vine species does not need a structure to grow on, rather, it can grow horizontally on the ground and also curl upwards from around old tree stumps. A word of caution, bittersweet is an aggressively fast grower, do not plant this species near young trees or around seedlings because the vine will girdle the younger specimens as it grows.

For growing conditions, the bittersweet thrives in moist environments, but is not able to survive in water logged areas. In terms of temperature, bittersweet can survive the “bitter” cold months of the Midwest and also thrive in the hot, humid conditions of the southeast.

Management Considerations

Well suited for any habitat that is well drained, bittersweet is a great addition to windbreaks, alley cropping, and forest farming. This species does not need to grow vertical, but make sure the plant receives full to partial sunlight during the growing season and is not at risk of being damaged by equipment. Along with being part of an agroforestry practice, bittersweet can also be incorporated into gardens and other landscape use to enhance natural beauty.

Harvesting Conditions

To harvest, simply take a handsaw or pruning shears and cut the desired stem(s). After pruning, the stump may sucker sprout or the root will sucker sprout for a future cutting. Along with using the stems, harvesting the seeds before wildlife has a chance to consume the berries is also another consideration. The seeds can then be used in birdfeed for urban birdfeeders or as a seed source for local nurseries.

Propagation

Regenerations can occur through planting new seedlings, seeds, and also through root suckering. Root suckers are not able to survive the process of being transplanted from one sight to another due to the lack of root structure.

Transplanting a seedling on the other hand, is highly recommended and is a sure way to know the plant has a healthy root system to allow for maximal growth. Before planting, seeds should be kept in a cool, dark place at 3C for up to 3 months before planting.

Economic Uses

Bittersweet is harvested as a wood floral and can be an added touch to wreaths, floral arrangements, or indoor decoration. The berries attract many varieties of wildlife, especially during the winter months when food is scarce. Also during the winter, the deep red berries are a wonderful addition to the long, bleak winter months. The seeds within the berries can be harvested and used as a feed source to attract backyard wildlife or sold to nurseries as a seed source.

Notes

Other common names include American bittersweet, America's bittersweet, and climbing bittersweet. The leaves and stems have the potential to be poisonous to cattle. Use extreme caution and make sure livestock stay away from this species.

Additional Resources

Missouri Botanical Garden.

<http://www.mobot.org/gardeninghelp/plantfinder/Plant.asp?code=A151>

Oklahoma Biological Survey. <http://www.biosurvey.ou.edu/shrub/cesc.htm>

United States Forest Service.

<http://www.fs.fed.us/global/iitf/pdf/shrubs/Celastrus%20scandens.pdf#search='Celastrus%20scandens'>

Black Locust (*Robina pseudoacacia*)

Description

Native to Missouri, black locust, also known as common locust, yellow and white locust. It is a medium sized deciduous tree with an average lifespan between 60 to 100 years. Fast growing with an average height of 30-50ft, spread of 20-35 ft. and diameter average of 1 to 2 ft. Since this species is a nitrogen-fixing legume, the leaves are very high in nitrogen and have been used in animal feeding trials with mixed success.

Flowers are 3/4in. long, white, and extremely fragrant, in a drooping arrangement maturing in late spring. Black locust blossoms provides a good source of forage for honey bees, and makes good honey.

Habitat

This species grows best in full sun, on moist, loamy soils of limestone origin, but establishes on a variety of disturbed sites; and competes well on large forest openings. It is found in cove forests and open, upland slopes, fence rows, disturbed ground, and limestone soils. In natural settings, Deer browse the foliage, birds and small mammals eat the seeds.

Optimum soil pH is between 4.6 and 8.2 and can grow on almost any soil type (sandy and sterile) with the exception of those that are permanently wet. Due to its shade intolerance, it is not found in dense woods except as the dominant tree. Habitat zones are between 3 and 9.

Management Considerations

During establishment, protection from weeds and deer are the main management priorities. Due to the rapid early growth, two years of protection are usually sufficient. Pre-plant site preparation to control weeds with tillage or herbicides is recommended, with continued weed control after planting. Where exceptional deer pressure exists, tubes or mesh sleeves may be required. Once established this species will not require active management unless straight trunks are desired for fence posts.

Harvesting Considerations

Although black locust is not an important timber tree in the United States, it is used for a wide variety of products and is planted for many specialized purposes. The wood of black locust is strong, hard, and extremely durable, it is extensively utilized for fencing, mine timbers, and landscaping ties. This tree also serves as a good erosion control plant on critical and highly disturbed areas, due to its ease of establishment, rapid early growth and spread, and soil building abilities. Pulp with satisfactory mechanical properties can be made and it has potential for use in fuel plantations.

Black locust is widely planted in the United States, Europe, and Asia for erosion control, reclamation of drastically disturbed sites, windbreaks, nurse crops, amelioration of sites, honey production, and ornamental use. Many early plantations on severely eroded old fields were failures, but establishment on spoil banks has been generally successful. Black locust is often broadcast or hydroseeded with a mixture of herbaceous seed. The most commonly used seeding rate is 2 to 3 lb/acre.

Because of its soil-improving properties, black locust is often planted in mixtures. Many species have been underplanted in black locust stands. Success of such planting has been variable and many factors have to be considered carefully. On mine spoil in Illinois, black locust was a valuable nurse crop for black walnut (*Juglans nigra*), silver maple (*Acer saccharinum*), and yellow-poplar (*Liriodendron tulipifera*), but not for cottonwood (*Populus deltoides*), sweetgum (*Liquidambar styraciflua*), or Osage-orange (*Maclura pomifera*). However, on surface-mined land in Kansas, survival, growth, and form of black walnut were impaired when planted with black locust (39).

Propagation

This species propagates easily by root suckers and stump sprouts and also transplants easily. Legumes or pods form and mature in mid-September to October, dropping in late fall. It is a reliable seed producer beginning at age 6 with peak production at age 15 and production decline at age 40. As the leaves fall, decomposition is rapid releasing nitrogen, calcium and potassium into the soil. Due to the impermeable seed coat, the seeds should be scarified in sulfuric acid for 50 min, soaked in hot water or mechanically scarified. Germination rates are very high. If root cuttings are desired, use stock that is 1/4 to 1" diameter, 3 to 8 in. long.

Notes

There are 2 primary insects which inflicting damage on black locust: the locust leaf miner and black locust borer. The leaf miner attacks the tree in spring, turning the leaves brown by mid-summer or early fall. Overall tree growth is impacted, but not seriously. The larvae of the locust borer carve tunnels through the trunk of the tree, weakening it enough for wind breakage. Planting on good quality sites or in conjunction with other hardwood species and shading trunks will discourage infestation by locust borers. Heart rot is the only noteworthy disease effecting black locust.

Additional Resources

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi
http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm

Black Walnut (*Juglans nigra*)

Description

Black walnut, also called eastern black walnut and American walnut, is one of the scarcest and most coveted native hardwoods. Small natural groves frequently found in mixed forests on moist alluvial soils have been heavily logged. The fine straight-grained wood made prize pieces of solid furniture and gunstocks. As the supply diminishes, the remaining quality black walnut is used primarily for veneer. The distinctive tasting nuts are in demand for baked goods and ice cream, but people must be quick to harvest them before the squirrels. The shells are ground for use in many products.

Habitat

Black walnut is sensitive to soil conditions and develops best on deep, well-drained, nearly neutral soils that are generally moist and fertile. Walnut grows best on sandy loam, loam, or silt loam textured soils but also grows well on silty clay loam soils. Soils with these textures hold a large amount of water that is available to the tree during dry periods of the growing season. Internal drainage and depth to gravel are especially important site characteristics for black walnut. As a general rule, black walnut will do best on soils that are at least 3 feet to impermeable layer. Throughout its range, walnut generally reaches its greatest size and value along streams and on the lower portion of north- or east-facing slopes.

Management Considerations

Black walnut can be grown for a variety of reasons, including nut production and high quality timber production. Due to its leaf configuration it is also well suited to being grown, or managed for, in most all the agroforestry practices. However, there are several key things to remember as you become successful in agroforestry while working with Black Walnut trees.

Black walnut is a very intolerant tree. Planted in fairly dense stands or under forest competition the tree develops a tall and well formed, clear bole. This bole form results from the tree putting its resources into competing for sunlight and is ideal for wood fiber production. Logs 10 inches in diameter at breast height can be developed in 35 years under ideal growing conditions.

Weed control is essential in newly established plantings. In order for any tree to reach its growth potential, the tree must be placed on an appropriate site (soils, aspect, etc.) and have good control of competing grasses. This can be accomplished by a number of methods, including proper herbicides, weed barriers/mats, and the use of mulch.

Harvest Considerations

The best known use of black walnut is for its lumber and veneer, and for its nut production. The wood is used for fine furniture of all kinds, interior paneling, specialty products, and gunstocks. Usually markets in the Midwest for black walnut wood tend to be better from the late fall through early spring, after which prices tend to decline.

Black walnut grown for nut production may require the use of specialized equipment. There are companies that make tractor attachments for everything from shaking the tree (in order to cause nuts to drop in a timely fashion) to harvesters to collect the fallen nuts and hullers.

Propagation

The large edible nut ripens in September or October of the same year and drops shortly after the leaves fall. Good seed crops are produced irregularly, perhaps twice in 5 years. Stratification for 90 to 120 days is required for optimum seed germination but the necessity and duration of stratification may vary by seed source. Seeds should be planted in the fall in moist, well-drained, deep soil that is rich in organic matter. Black walnut prefers full sun.

Most seedling nurseries will also have black walnut seedlings available. Seedlings should be established early in the spring and be provided good weed control in order to maximize the sites growth potential.

Economics Uses

It is important for you as the landowner/Agroforester's to keep in mind what the desired results are to be. From the economic stand point Black Walnut has several desirable traits that can make it very profitable to you as long as proper management of these trees is taken. Historically, Black Walnut has kept ahead of inflation and remains one of the most valued hardwood species. Therefore with the proper care and management you can maximize your lands to bring you the most with little effort on your part.

By using grafted stock, in conjunction with proper management, nut harvesting can begin in 6 to 10 years.

Notes

Black walnut produces a toxin, known as "juglone", which inhibits the growth of other plants around it, thereby reducing competition. Juglone deprives sensitive plants of energy needed for photosynthate production. The symptoms of plants being affected by juglone include foliar yellowing, wilting, and eventually death. The largest sources of juglone on the tree are located in the buds, roots, and nut hulls.

Additional Resources

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

<http://www.centerforagroforestry.org/pubs/proppecbw.pdf>

Blackgum (*Nyssa sylvatica*)

Description

Known as one of the most beautiful native trees in the Ozarks and Boothill of Missouri, it is known for consistent fall color changing to fluorescent yellow to orange to scarlet purple. Blackgum, also known as black tupelo, pepperidge, tupelo, tupelo gum, is a medium sized tree with an intermediate growth rate, that when young has a pyramidal shape with with densely set branches but in old age the numerous spreading and open horizontal branches form an irregularly rounded or flat-topped crown. Large trees of this species are typically hollow due to various decay producing fungi and wood-boring insects.

Habitat

Having a wide range it can be seen along swamp borders and dry slopes in full to partial shade areas. Blackgum may be grown as an ornamental or used as a working tree in riparian forest buffers. Blackgum will tolerate brief spring flooding on alluvial sites and is common on the relatively dry upper and middle slopes in the Appalachian Mountains. On the drier uplands, it grows best on loam and clay loam. It is well adapted to fire. Its hardiness zone is 3-9. Optimum soil pH range is between 5.5 and 6.5.

Management Considerations

An easy tree to manage, it averages a growth rate between 12-15 feet over a 10 to 15 year period. This species does not tolerate high pH soils.

Insect and disease problems are common but have little significance to the health of the tree. Heart rot, leaf spots, rust, tupelo leaf miner scales and cankers are common ailments that can be seen but are not serious.

Since this species has been known to have a lifespan greater than 500 years in some areas, it typically hollows as it matures. If managing for wildlife is your main objective, it is known to provide several generations of wildlife species from insects to nesting birds, rabbits, squirrels, possums and hibernating bears due to the tree's usefulness for nesting and shelter.

As a working tree, this species can be used in the design of a riparian forest system since it can tolerate low oxygen sites, and may also be useful for its fall color in applications where aesthetic enhancement is desired.

Harvesting Considerations

In the past, the lumber was harvested for storage containers, pallet boxes, molding and furniture since the wood is tough. Presently, the lumber has low value and is commonly mixed with other low grade lumber at the market. It is difficult to dry and is probable to warping and twisting. It is also hard to split, has below average machining characteristics and is not durable to decay.

Propagation

The oval, soft black to purple fruit that ripens in September to early October is a favorite to deer and eaten by many birds and various mammals but not by humans. Seeds exhibit moderate embryo dormancy and require moist stratification for 60 to 90 days at 41F for optimum success.

Blackgum is usually found in a mix of other species including black cherry (*Prunus serotina*), dogwood (*Cornus florida*), hickory (*Carya* spp.), oak (*Quercus* spp.), eastern hophornbeam (*Ostrya virginiana*), and yaupon (*Ilex vomitoria*), it is shade tolerant and seldom grows as the dominant tree but it usually grows in the intermediate crown class on most sites.

Blackgum will sprout from the stump and from root suckers. Sprout numbers will typically decline as the tree gets large.

Economic Uses

These trees have moderate growth rate and longevity and are an excellent food source for wildlife, fine honey trees, and handsome ornamentals. Black bears, foxes, wood ducks, wild turkeys, robins, woodpeckers, mockingbirds, brown thrashers, thrushes, flickers, and starlings frequently eat the fruit, while white-tailed deer and beavers browse the twigs, foliage, and young sprouts.

Additionally, it provides cavity and nesting sites for a variety of birds and mammals. Black gum is an excellent ornamental plant for its straight bole, shapely crown and attractive autumn foliage.

Additional Resources

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/nyssa/silvatica.htm

Blackhaw (*Viburnum prunifolium*)

Description

Blackhaw is a deciduous shrub or tree from the honeysuckle family. It grows 10 to 20 feet tall with a short trunk that has a diameter of about 6 inches. It has an irregular crown with stiff, spreading branches. The bark is reddish-brown to dark brown or black and has a distinctive blocky appearance. The twigs are smooth, slender, gray or brown, and have orange-colored lenticel. The buds are a ½ inch in length, gray or reddish-gray and sometimes covered with purplish hair. The leaves are oval with short, pointed tips, rounded or tapering to the base, darker green on top, paler green on bottom, and 2-3 inches long. The flowers are white and in clusters. The fruits are shiny, bluish-black, ovoid, berries that occur on bright red stalks.

Habitat

The blackhaw occurs in dry woods and thickets and on rocky hillsides from Connecticut to Florida and west to Michigan and Texas, but is found in greatest abundance in the South.

Management/Harvest considerations

Blackhaw prefers moist, well-drained soils of rich or average composition of alkaline, neutral, or acidic pH. It can tolerate dry soils very well and thrives in full sun to full shade as a native understory or woodland edge shrubs. Blackhaw is a very hardy plant, tolerating temperatures down to about -40 degrees C.

It can be planted densely for a barrier thicket that branches and suckers from the ground-up

In agroforestry, blackhaw has a potential to be used in windbreaks and riparian buffers as a source of habitat and food for wildlife. The bark is collected for medicinal uses. The branch bark can be harvested in the summer and the trunk bark in the fall. Dry the bark in the shade before using.

Propagation

The seed is best sown in a cold frame as soon as it is ripe. Germination is usually slow, taking more than 18 months. Stored seed will require two months warm then three months cold stratification. When the seedlings are large enough to handle they should be put into individual pots in a coldframe or a greenhouse. Blackhaw can be propagated from cuttings of softwood, half-ripe wood, and mature wood. Cuttings of half-ripe wood are difficult to overwinter and should be kept in a greenhouse or coldframe until spring.

Economic uses

Blackhaw is used as an ornamental because it possesses year-round ornamental qualities similar to those of flowering dogwood. The blackhaw is most widely

used for its medicinal properties and as some economical importance. The bark of the root and stems is abortifacient, anodyne, antispasmodic, astringent, nervine and sedative. The root bark should only be harvested in the autumn. Tea is used internally in the treatment of painful or heavy menstruation, prolapse of the uterus, morning sickness, and colic.

Notes

To make a tea from blackhaw bark, use 1 ounce of herb per pint of freshly boiled distilled water. Steep for 15 minutes, and strain. Drink a cup 2-3 times a day.

Bloodtwig Dogwood (*Cornus sanguineum*)

Description

A deciduous shrub that has a rounded form, bloodtwig dogwood is an ornamental shrub that is very hardy. The shrub's name comes from the blood color twigs that are very obvious during the winter months when leaves are absent. During the spring, white flowers bloom and during the fall, a black berry will form. Like all dogwoods, bloodtwigs have a tendency to sucker sprout, causing new shoots to emerge. This species can reach a height of 6 to 8 feet and measure 4 to 6 feet in width.

Habitat

Preferring partial to full shade, this understory species can be found in moist areas that are well drained. When it comes to soil preference, bloodtwig dogwood prefers a loam textured acid soil that is fertile to allow for vigorous growth. In concern with weather, bloodtwig dogwood prefers warmer climates that receive a fair amount of moisture throughout the year and not just in the spring.

Management Considerations

Often referred to as an easy going tree, dogwoods are self reliant and will not require much labor from landowners. Once the shrub has been established, the land owner does not have to worry about providing water or nutrients for the plant. The only precaution is to root prune specimens that you do not want sucker sprouting or else your one dogwood could turn into a whole colony of little dogwoods. Unless this is in your management plan, watch for sucker sprouts and use mechanical means to make sure your dogwood population stays under control. In an agroforestry setting, using bloodtwig in alleycropping, riparian buffers, forest farming, and windbreaks is recommended. It can be used to enhance habitat for bobwhite quail.

Harvesting Considerations

Harvesting bloodtwig as a woody ornamental is as easy as a hot knife going through butter, literally. Most harvest practices involve taking a sickle mower out to the field and simply running the sickle down the rows. The best time to do this is when the shrub is dormant during the winter months.

Growing specimens and then selling them to nurseries, or landscapers, as ball-and-burlap transplants is also an option. Dogwoods are easily transplanted when they are still young.

Propagation

Propagation of bloodtwig dogwoods is very easy to accomplish, especially when transplanting an established plant from one location to a new location. Before digging up a plant to transport it, make sure to prune the roots a season. A direct seeding can be used to establish the species; however, site and environment

conditions must be suitable for germination to take place. The most productive form of propagation comes from the fact the species is a notorious sucker sprouter.

Economic Uses

Woody ornamental species, such as dogwoods, are being incorporated into various floral arrangements to give a touch of the outdoors to any bouquet. Along with using the stems for floral designs, harvesting the seed as a seed source is also an economical benefit. Along with these ideas, some craftsmen enjoy using dogwood as a wood source for furniture and wooden figurines. In European countries, the extract found in bloodtwig is used to make various types of soaps.

Notes

A very beautiful ornamental tree, bloodtwig dogwood can make any landscape breath taking, especially in winter when the red limbs are visible against the bleak background. The market for producing large quantities of bloodtwig and any other dogwood that will be used in landscape design is huge and profitable.

Additional Resources

Dogwood's Internet Connection. <http://www.bright.net/~dogwood/article.html>

Michigan State University Extension.
<http://web1.msue.msu.edu/msue/imp/modop/00001964.html>

Placer County, California.
http://www.auburnweb.com/Destination_Dogwood/Classifications/

Bluebells (*Mertensia virginica*)

Description

A welcoming flower of spring, the bluebells ring their brilliant blue bells as a sure sign that spring is here. These showy plants that can't be missed on a spring walk grow up to 2ft. tall and are usually found in large clusters.

Native to Missouri, this perennial has loose clusters of trumpet-like blue flowers, up to 1in. long. The foliage, easy to identify before the flowers bloom, is smooth, oval and bluish green, averaging 4in. long. Foliage dies to the ground by mid-summer as the plant goes dormant.

Habitat

Found in moist, rich woods, along creek beds, gravel bars and river floodplains. They prefer southern slopes in partial to full shade. It's hardy in Zones 3 to 8.

Management Considerations

This is an easy species to manage since it is cultivated by fresh seed or divided in the spring. It is best left undisturbed. No threatening insect or disease problems are known to occur. As a spring ephemeral, it leafs out in early spring and can easily be identified for purposes of not harming the plant with mechanical equipment.

It prefers moist, cool soils, high in organic matter. If left undisturbed, this species will thrive and form large colonies.

Economic Uses

Pink and white-flowered forms are seen but rare in Missouri. Cultivation of this species could be handsomely rewarded toward sales of native ornamental gardeners. The blue flowers can be sold at local markets or simply be a beautification element on the farm. The seeds can be collected and sold with wildflower seed

Additional Resources

Missouri Botany Organization:

<http://www.mobot.org/gardeninghelp/plantfinder/Plant.asp?code=L200>

Missouri Plants:

http://www.missouriplants.com/Bluealt/Mertensia_virginica_page.html

Missouri Grow Native:

<http://www.grownative.org/index.cfm?fuseaction=plants.main>

Buffaloberry (*Shepherdia canadensis*)

Description

Native to North America, the buffaloberry is a shrub that can grow from 2” to 8” in height, depending on what pruning practices are implemented. Buffaloberry must have both male and female plants in order for fruit/seeds to be produced. Buffaloberry is known in different regions of the United States by various common names. Some of these common names include: russet buffaloberry, buffalo-berry, Canadian buffaloberry, russet red buffaloberry, soapberry, and soopolallie. Another species, *Shepherdia canadensis* var. *xanthocarpa* produces a yellow fruit in comparison to *Shepherdia canadensis*’ red fruit.

Deciduous in nature, the color of spring leaves ranges from a hunter green to a lime green. On the underside of the leaves, a silver lining can be seen and is a key feature in identifying buffaloberry. In the fall, the leaves will turn a neutral yellow and are not very showy. The flowers are very small and will appear shortly after the leaves have emerged. Similar in color to a dandelion, the flowers are not as showy as dogwoods and have no fragrance that can be detected by the human nose.

Habitat

Native to North America, the range for buffaloberry is from Nova Scotia to New Mexico. Understory tolerant, this species is commonly found growing under ponderosa pines, white spruce, balsam fir, and even cottonwoods or willows. Though understory tolerant, buffaloberry thrives in full sun and can grow to be a dominant tree in poor sites that have large amounts of sulfur. Buffaloberry is also a nitrogen fixer, similar to legumes such as beans or black locust.

In regards to soil types, buffaloberry can thrive in all three types: clay, sand, and loam. The site must be well drained since the species cannot tolerate being water logged for a long period. In contrast to nutrients that are available on the site, buffaloberry can thrive in areas that lack nutrients in the soil or have been cleared of all nutrients do to mining, aggressive agriculture practices, and over grazing of livestock.

Management Considerations

In the past, many government agencies have suggested this species to be planted in areas that had been stripped mined, over grazed, or a former dump site. This species is very aggressive once established and has been known to sucker sprout in areas where plenty of precipitation fell and where there was a lack of other competing vegetation.

In agroforestry practices, this species is ideal for areas that have been neglected or abused by being used as dump sites. In particular, this species can be used for windbreaks, silvopasture, forest farming, and alleycropping. A riparian buffer is another option, as long as the species are planted away from the water source. In a

silvopasture environment, cattle do not show any interest in buffaloberry twigs or their fruit, however, sheep and goats have been know to devour a whole thicket of this species. A word of caution, toxins in this species have been know to kill sheep, goats, and feral horses during years of severe drought when buffaloberry was the only vegetation available to consume. This toxin causes the plants to create a fowl taste and most animals (domesticated or wild) will not chew on the branches, but may browse the seeds.

Harvesting Considerations

Due to the size of buffaloberry, timber harvest is out of the question. However, this shrub can be used to make mulch or produce small pieces of wood that can be used by artisans interested in wood carving.

Propagation

The best propagation practices include direct seeding, transplanting young seedlings from one source to another, and using root cuttings. Through these propagations, the species is able to establish a healthy root system and not show any negative impacts of being moved from one site to another.

Economic Uses

The fruit of buffaloberry has been used in many Native American recipes from deserts to a form of fruit punch. Even today, many tribes across the Midwest hold annual pow-wows and will pay a large sum for the seeds to be used in drinks, foods, and decoration. A market can be found through Native American Tribes and also through organic markets that are looking for unique food ideas.

In the field of medicine, research has taken place to determine if an old remedy started by the Sioux Tribe can help calm irritated eyes. Today, many medicine men/women use the bark of buffaloberry to ease the pains of dry eye or cleanse eyes that are come in contact with dust, tree branches, or pollen. Modern medicine has taken an interested in this practice and research prototypes have been developed and are being tested in clinical trials.

Along with being an eye medicine, the Sioux also boiled the bark, leaves, and fruit to produce teas. These teas were used to help cure stomach problems, what we would consider stomach ulcers in today's society. The tea also is thought to have a healing effect on other parts of the stomach and intestines.

Additional Resources

United States Forest Service:

www.fs.fed.us/database/feis/plants/shrub/shecan

University of Connecticut:

www.canr.uconn.edu/plsci/mbrand/s/shecan/shecan1.html

USDA:

www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?33864

Butternut (*Juglans cinerea*)

Description

A relative of the Black Walnut (*Juglans nigra*), this tree is small to medium sized but with a short straight trunk and broad open, somewhat irregular, flat or rounded-topped crown. Butternut is called "white walnut" because of its light-colored wood, which has a natural golden luster that becomes satin-like when polished. Butternut is more valued for its nuts than for lumber. It may mature at 60 feet tall by 50 feet wide when it is found in the open. Its leaves are pinnately compound with 11 to 17 leaflets that have a yellow to brown color in the fall. It has elongated corrugated nuts with flattened and shiny ridges. It has sweet-tasting nuts which gives the common name of Butternut. The Native Americans reportedly boiled the kernels to extract the oil, which was then used like butter. The kernels were also pickled in vinegar by the early settlers.

Habitat

Butternut grows best on streambank sites and on well-drained soils; it is seldom found on dry, compact, or infertile soils. However, it typically grows better than black walnut on dry, rocky soils, especially those of limestone origin. Butternut is found most frequently in coves, on stream benches and terraces, on slopes, in the talus of rock ledges, and on other sites with good drainage. It is generally considered to be more winter-hardy than black walnut.

Management Considerations

Naturally occurring Butternut trees are susceptible to butternut canker disease, but healthy trees found growing among diseased trees may be resistant to the disease. These trees could have potential value for propagation by grafting or breeding. Do not plant seedlings in areas with diseased trees for they will not likely survive.

Young trees may grow in considerable competition, but they are shade-intolerant and mature trees must reach the overstory. Fire easily top-kills butternut and older trees rarely sprout from the root crown or stump. Competing vegetation must be controlled when planting seeds or seedlings to maintain vigorous growth. Properly prune and maintain good tree care to maintain vigor of the trees for seed and nut production.

If trees have less than 70 percent live crown and more than 20 percent of the combined circumference of the stem and root flares are affected by cankers, remove and discard these trees. The wood may be salvaged.

In agroforestry plantings butternut will most likely find application in the riparian forest buffers and/or alley cropping practices. However, due to its susceptibility to butternut canker, plantings are not likely to be long lived unless a canker resistant variety is developed.

Harvesting Considerations

Nuts quickly become rancid and therefore need to be harvested quickly. Butternut is closely related to black walnut so many of the recommendations for seed collection and storage and for planting are similar for both species.

Propagation

Young trees may withstand competition from the side, but will not survive shade from above. The minimum size opening needed to establish and promote early development is about 2 to 3 times the height of the surrounding dominant trees. Seeds germinate in the spring after seedfall and a cold period (34-410 F) of 90 to 120 days to break dormancy.

Economic uses

Timber can be harvested for cabinet work, furniture, paneling, carving and novelties. Butternuts were often planted close to the house on farmsteads for their use as food. Kernels were used in baking and cultivars have been selected for nut size and for ease of cracking and extracting kernels.

Additional Resources

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

Canola (*Brassica napus*)

Description (Common names: rutabaga, Swedish turnip, canola, rape)

Annual or biennial, with a slender or stout, hard, long tuberous taproot; stems are erect, often many branched, and up to 1.5 m tall. Sometimes the stems are purple toward the base. The leaves are lobed, and the petioles are usually 10–30 cm long, with a few bristly hairs. The flowers are pale yellow, 1.2–1.5 cm long. Inflorescence can be many branched, and up to 1 m tall as an elongating raceme.

Canola is grown sparingly for young leaves used as potherb, but is more generally grown as forage for livestock feed, and as source of rapeseed oil. Rape oil is used in the food industry, as an illuminant and lubricant, and for soap manufacture. Residual rapeseed cake, though low in food value, can be used as livestock feed. Rapeseed oil has a potential market in detergent lubrication oils, emulsifying agents, polyamide fibers, and resins, and as a vegetable wax substitute. However, canola is probably gaining its greatest notoriety for use as a cooking oil because it has low levels of saturated fats.

Habitat

Canola requires fertile and well-drained soils. It responds favorably to nitrogen and phosphate fertilizers, but can be injured by direct contact with the fertilizer. Use only low rates of fertilizers in drills where both seed and fertilizer empty into same tubes. Sunny days and cool nights are favorable for growth; dry weather at harvest time is essential. Ranging from Boreal Moist to Rain through Tropical Dry to Moist Forest Life Zones, rape is reported to tolerate annual precipitation of 3 to 28 dm (mean = 8.3), annual temperature of 5 to 27°C (mean = 11.6), and pH of 4.2 to 8.2 (mean = 6.2).

Harvesting Considerations

Because fruit ripens evenly and shatters easily, to avoid shattering, it is recommended to harvest crop when yellow and windrow to ripen until seed inside is just changing from yellow to brown. Dry, mature seed may be harvested directly with combine. To combine standing crop, it is best to leave the crop until seeds are fully ripe, and with reel speed reduced to two-thirds normal speed for cereals, harvest crop during cloudy weather when plants are moist, thus reducing shattering. In some areas the crop is cut by hand and then flailed with sticks after drying in sun for a few days. In humid and temperate regions, artificial drying may be necessary.

Propagation

Seeds are sown in place. Plant canola 4-6 in (10.2-15.2 cm) apart in rows 30 in (76.2 cm) apart. Canola seed is either broadcast at 20 pounds (9 kg) per acre, or planted in rows 28 in (71 cm) apart at four pounds (1.8 kg) per acre.

References

General information:

[http://www.hort.purdue.edu/newcrop/duke energy/Brassica_napus.html](http://www.hort.purdue.edu/newcrop/duke_energy/Brassica_napus.html)

http://www.floridata.com/ref/B/bras_nap.cfm

Jefferson Institute:

<http://www.jeffersoninstitute.org/overviews/canola.shtml>

Catnip (*Nepeta cataria*)

Description

Catnip is an erect perennial herb that grows to three feet in height. The stems are whitish, downy, square in shape, with opposite leaf arrangement. It has many small purple-spotted white, or pale lavender, tubular flowers which are tightly clustered at the end of the floral branches. The leaves are heart shaped with scalloped edges ranging from grey green to green color and are often crowded toward the top of the plant. The fruit on this herb is in the form of a nutlet.

Habitat

Catnip can be found along roadsides, near streams, hedgerows, borders of fields, dry banks, and waste ground, especially on calcareous and gravelly soils. It is native to dry regions of the Mediterranean, Europe, Asia, Eurasia and Africa, was introduced to America by the early settlers as a garden herb, and was later naturalized in North America (1).

Management/Harvest Considerations

Nepeta cataria grows well in well-drained soil with pH ranging from about 5 to 7.5. It grows best in full sun and with an annual temperature of 45-66 degrees F. Fields should be fertilized based on soil test recommendations for field crops, prior to planting. Catnip has very little insect or disease problems. Its major pest is weeds (competing vegetation), which should be controlled by cultivation because there are no herbicides labeled for use in catnip production. A stand of catnip will last for three years, after which time the weeds generally became a problem and a decrease in yield is expected. When growing conditions are good a yield of 4.4 to 6.7 tones/ha of dry weight can be harvested.

Catnip is harvested when it comes into full bloom, sometime in August. It is very critical that it is harvested at that time because after it blooms the aromatic properties of the volatile oils decrease. Plants are harvested by clipping the stems about 10 to 12cm above the crown. This allows regrowth from the adventitious buds. Plantings can generally be cut twice (mid-summer and fall) during the growing season. The thicker stems of the harvested plants can be removed to allow for a leafier, finer stemmed, and aromatic final product. The harvested plants are dried in the shade or with an artificial dryer. Depending on the buyer and its use further drying may be required.

Propagation

Catnip seeds are extremely small, germinate rapidly and produce healthy seedlings at temperature between 68-86 degrees F. The seeds are sown into warm seedbeds sixty to sixty-five days prior to transplanting, which should generally occur between March 1 and April 1. Daily management of the plantbeds is

necessary to produce strong, healthy seedlings. Seeds will typically remain viable for five years.

Economic uses

Catnip is marketed for cats in stuffed toys, catnip filled balls, and compressed pellets and in shaker bottles. The commercial catnip for toys is of lower grade, consisting of dried, ground up stalks, as well as leaves. Marketing possibilities include farmers markets, pet stores and higher-end retail stores. Growers should have an established market available before beginning production. Producers may be able to capture a niche of the pet supplies market, which comprises about 20 percent of the more than 30 billion dollars that the U.S. pet owners spend on their animals.

Catnip is also used in a number of pharmaceutical products and researchers have found a chemical that is highly effective as a natural mosquito repellent. Like other plants from the mint family, catnip has also been used to calm a number of digestive tract disorders.

Notes

Labor requirements per ¼ acre are approximately 75 hours for production, 64 hours for harvest and 8 hours for processing.

Additional Resources

<http://www.sfp.forprod.vt.edu/factsheets/catnip.pdf#search='catnip%20pdf'>

Kit L. Chin, Yadong Qi, Mila Berhane and James E. Simon, Biological Characteristics, Nutritional and Medicinal Value of Catnip, *Nepeta cataria*, No. 302

Chinquapin Oak (*Quercus muehlenbergii* Engelm.)

Description

Moderately tall, slow-growing deciduous tree reaches a mature height of 60 to 80 feet and often has wide-reaching lower branches when grown in the open. Bark is light grey or silvery-white and resembles the white oak (*Quercus alba*). Leaves are broad, flat, and simple (not lobed) with coarse teeth. The Chinquapin Oak is sometimes spelled *Chinkapin* Oak, and is also known as Yellow Oak or Yellow Chestnut Oak (among others). It is a member of the White Oak group and Beech family, and is therefore related to Oaks, Beeches and Chestnuts.

Habitat

(USDA Zones 5 – 8)

Native to most of the Midwest, Chinkapin oak is found in western Vermont and New York, west to southern Ontario, southern Michigan, southern Wisconsin, extreme southeastern Minnesota, and Iowa; south to southeastern Nebraska, eastern Kansas, western Oklahoma, and central Texas; east to northwest Florida; and north mostly in the mountains to Pennsylvania and southwestern Massachusetts. There are local populations in the mountains of southeastern New Mexico, Trans-Pecos Texas, and northeastern Mexico. Chinkapin oak is generally found on well-drained upland soils derived from limestone or where limestone outcrops occur. Occasionally it is found on well-drained limestone soils along streams. It appears that soil pH is strongly related to the presence of Chinquapin Oak, which is generally found on soils that are weakly acidic (pH about 6.5) to alkaline (above pH 7.0). It does well in most light conditions, and prefers upland sites.

Management Considerations

Chinquapin Oak prefers moist, well-drained, deep, rich, alkaline soils, but sometimes is often found near the summit of hills or uplands in dry soils that may be clay, sandy, or rocky. It can tolerate neutral to acidic soils. It thrives in partial to full sun. Moreover, it can withstand moderate shading when it is young but becomes more intolerant of shade with age. It is regarded as a species that performs best on dry, droughty soils, especially those of limestone origin. On more moist sites it performs moderately well. However, many oak-hickory stands on moist sites that contain chinquapin oak are succeeded by the beech, maple, and ash species (which are better suited to those sites). In an agroforestry application, chinquapin oak is especially suited for windbreaks, though it can also serve as an excellent wildlife food source for squirrels, mice, voles, chipmunks, deer, turkey, and other birds.

Because it is related to other Oaks, it is susceptible to vascular diseases such as Oak wilt and to insect pests such as the gypsy moth and acorn weevil. However, it is overall it has very few pest problems and does well even in urban settings.

Harvesting Considerations

Chinquapin Oak can reach 24 to 36 inches in girth at maturity, and is capable of producing a wide range of products in low-value to high-value wood markets. The wood of chinquapin oak is dark brown with a narrow, pale sapwood; it is hard, heavy, strong, and durable. These characteristics make it a valuable wood for many uses. It is commonly used as saw timber and is considered a member of the select white oak group. When properly dried and treated, oak wood glues well, machines very well, and accepts a variety of finishes. It is widely used for cabinets, furniture, pallets, and containers. Higher-value uses include staves used in making barrels. Oak wood was traditionally used for railroad ties and is commonly cut for firewood.

Despite the fact that the wood is of excellent quality, Chinquapin Oak is relatively uncommon over its natural range and moreover it is rarely found in cultivation because it is not a large tree. However, it would make a fine specimen for parks, estates and larger lawns. The sweet acorns are relished by wildlife and are even palatable to humans.

Propagation

Acorns will germinate without any pretreatment as soon as they are mature.

Additional Resources

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/quercus/muehlenberg_ii.htm

Chokecherry (*Prunus virginiana*)

Description

Chokecherry is a native, deciduous, thicket-forming shrub/small tree. Numerous stems, slender and branching at the base, or with upright spreading branches, form the majority of the plant. Average heights may range from 3 feet to 20 feet, Great Basin heights have been recorded to 40 feet with 8 inch diameters. Extensive root systems are common among chokecherry, extending as much as 35 feet laterally and 6 feet of depth. Fruits are a fleshy drupe, containing a stone. Although edible, this stone is toxic to humans and must therefore first be cooked or otherwise treated prior to consumption. This shrub is also an important wildlife plant that provides cover and food to many birds and mammals.

Habitat

Chokecherry is widely found throughout much of the United States, it occurs from a line through Newfoundland to British Columbia south to North Carolina, Tennessee, Missouri, down to northern Mexico. It is found throughout many forest types, including forest edge, under full canopy, and with a variety of species in the overstory. It is shade tolerant, but persists in high percentages of sunlight. Fast growth rates are associated with chokecherry in good sites. Moist soil is required for optimum growth.

Management Considerations

Wildlife values are great with chokecherry, including food and cover. Additionally, chokecherry is widely considered in watershed protection and plantings requiring a diversity of species. The leaves may be used as browse and the fruits can be utilized by small mammals, humans, and other fruit-eating animals.

Very acidic to moderately alkaline soils can support chokecherry. High shade tolerance has been noted, but great densities will be noticed near forest edges. Both open and closed forest canopies can support a stand of chokecherry. Heavy grazing of stands of chokecherry will eventually reduce the number of stems and perhaps cause the species to decline in an area. Fire can be used to top-kill the individuals, with rapid resprouting from surviving root crowns and rhizomes.

Environmental benefits other than wildlife value are for establishing riparian buffers, soil stabilization, early cover, etc. Due to the fast growth and extensive rooting ability of chokecherry, it is useful in Riparian Buffer Strips, areas for increased diversity, and Windbreaks.

Harvesting Considerations

Berry production is a possibility for Agroforestry applications, with berries ripening between August 14 and 22 on average. Ripe berries tend to lose the astringent properties associated with chokecherry, and can be used in wines, syrups, jellies, jams, and in some cases are used for medicinal value (including treatment of cold sores, colds, and rheumatism).

Propagation

Regeneration can occur, with chokecherry, by rhizomes (vegetative) or by planting. Rhizomes can be planted from individuals that are aged enough, lab experiments show about 11 years, and good sprouting should occur. Seeding requires scarification of seeds by acid and/or mechanical means, due to the stony endocarp that surrounds the seed. If not removed, or seeds scarified, some resistance to germination may be noted.

Economic Uses

Berry production is the highest value of chokecherry, economically. The fruit is used for jams, jellies, wines, etc. Some of the wood may be of value, but the reduced size, comparatively is a downfall to high income from wood products. Some traditional archers use chokecherry stems for arrows, but unless a known market is relatively close they are not economically viable.

Notes

Cattle and domestic sheep eat chokecherry and due to its toxicity, poisoning sometimes occurs, though normally fatal quantities are not eaten unless other forage is scarce. A noticeable drop in toxin (cyanogenic glycoside prunasin) seems to occur after first frost. Chokecherry is susceptible to attack by the fungus *Plowrightia stansburiana*, which causes knotlike cankers to develop on stems. This condition eventually kills infected stems. Afflicted plants usually have a shortened life span.

Additional Resources

http://plants.nrcs.usda.gov/plantguide/pdf/cs_prvi.pdf

Dill (*Anethum graveolens*)

Description

Dill is an erect, freely branching annual herb with finely dissected, lacy, blue-green foliage. "Dill weed" refers to the foliage, and the seeds are usually just called "dill." The leaves are about 1 ft (0.3 m) long and divided pinnately three or four times into threadlike segments each about 1 in (2.5 cm) long. The dill plant grows about 3-5 ft (0.9-1.5 m) tall and sometimes gets top heavy and falls over. The flowers are yellow and borne in large, rounded, compound umbels (umbrella-like clusters in which all the flower stems originate from the same point) on stiff, hollow stems. The whole inflorescence can be 10 in (25 cm) across, and several of them on a feathery blue-green framework can be showy indeed. The fruit is a flattened pod about an eighth of 1 in (2.5 cm) long. All parts of the dill plant are strongly aromatic.

Habitat

Dill does best in full sun, as it becomes leggy and prone to topple over in partial shade. This crop does best in well drained soil with adequate moisture and it may bolt quickly to flower during a prolonged dry spell. Dill is an annual that can be grown all summer in USDA zones 3-7, in spring and fall in zone 8, and in the winter in zones 9-11 (see references for map of hardiness zones). In hot weather dill flowers and goes to seed quickly. Again, the plant requires long days and cool weather, and is sensitive to environmental stresses, such as low moisture, hail, high temperatures, strong winds, and hard rains during the flowering and seed maturation period. Again, the plant grows best in deep, fertile loam soils.

Management Considerations

An easily grown plant, Dill prefers a moderately rich, loose soil and full sun. This plant requires a well-drained soil and shelter from the wind. It can tolerate a pH in the range 5.3 to 7.8. Dill is a commonly cultivated herb, especially in warm temperate and tropical zones. It is grown mainly for its edible leaves and seeds, though it is also used medicinally. The plant quickly runs to seed in dry weather and it often self-sows when growing in a suitable position.

Dill is a good companion for corn and cabbages, also in moderation for cucumbers, lettuce and onions, but it inhibits the growth of carrots.

Harvesting Considerations

Grown best as an annual crop, timeliness of harvest is crucial to maximize seed yield, because seeds tend to ripen at different times and seed shattering is a potential problem. Generally, harvesting for dill weed or the essential oil of dill weed is done before the plant flowers. Harvesting for seed is initiated when the bulk of the seed crop is physiologically mature. Plants used for essential oil

production are steam distilled on the day of harvest to minimize volatilization losses.

Additional Information

Dill and other members of the carrot family are the sole food plants for the caterpillars of the beautiful black swallowtail butterfly (see reference below for pictures). Dill flowers attract beneficial insects too. Lacewings and syrphid fly adults eat the pollen of dill and other carrot family plants, and their larvae prey on plant sucking insects such as aphids.

Additional Resources

Black Swallowtail Butterfly

http://www.fcps.k12.va.us/StratfordLandingES/Ecology/mpages/eastern_black_swallowtail.htm

General information (Florida State Extension)

<http://edis.ifas.ufl.edu/MV060>

Dogbane (*Apocynum cannabinum*)

Description

Perennial weed with extensive branched root system with vertical roots that can grow 8 feet or longer. Smooth stems can be 3-5 feet tall and have soft lance shaped opposite growing leaves that are bright green in the spring and summer and yellowish-orange to brown in the fall. Small bell-shaped flowers form from late June to August, which produce two seed pods each 3-4 in. Dogbane is frequently confused with common milkweed because both possess milky sap.

Habitat

Dogbane is native to North America. It occurs naturally along fence rows and roadsides. In Missouri it typically grows in the wild in dry rocky or open woods, glades and prairies. It grows more rapidly on moist sites than arid sites, but persists on both. Due to its capabilities of reproducing by seeds and vegetative buds in the crown region and on horizontal roots, dogbane has been establishing in crop fields and has become a problem. Wisconsin and Nebraska are two states that are under serious infestation.

Management Considerations

Dogbane should not be implemented in all of the 5 agroforestry practices due to its ability to rapid reproduction rate and invasive qualities. Riparian forest buffers could greatly benefit from dogbane because of its extensive root system. Nutrients from crop runoff like nitrogen and phosphorus could be efficiently trapped before reaching the waterway. Since agroforestry practices are intensively managed, the spreading of dogbane could be moderately controlled when practicing riparian forest buffers, but it is not guaranteed.

Dogbane is known to colonize crop fields in regions where no-till crops are grown due to extensive rooting systems that were already established in the soil. Major outbreaks were found in soybean and oat fields, and moderate outbreaks in corn and sorghum fields. Once colonized, the extensive root systems can take over and potentially reduce crop yields. The only known method for controlling outbreaks of dogbane is frequent moving. Since dogbane can reproduce via seeds and vegetative buds, intense tillage is not recommended when attempting eradication.

Dogbane outbreaks were least common where alfalfa and winter wheat were being cultivated. Alfalfa competes very well with dogbane due to frequent mowing which reduce root reserves, limit lateral root growth, prevent flowering, and avoid spreading root segments on tillage equipment. Winter wheat () establishes in the fall and grows rapidly in the spring before the soil is at an appropriate temperature for dogbane growth. Neither alfalfa nor winter wheat actually eradicates dogbane.

The milky sap of dogbane attracts butterflies. The milky juice contains a cardiac glycoside toxin but plants are unpleasant to livestock and cases of poisoning are unlikely.

Harvesting Considerations

Although dogbane is considered a weed, it is a very strong source of fiber. Native Americans called dogbane 'Indian Hemp' and used the roots to make ropes.

Propagation

Propagation of dogbane can be done by seed or by vegetative buds in the crown region and on horizontal roots. Germination is greater in light, but results can be poor if the seeds are not emerged ½ inch below the soil surface. Dogbane shoots will begin to emerge once soil temperatures reach 65 degrees F. After emergence, they grow and develop very rapidly. True seedlings are sensitive to soil disturbance so once seedlings have emerged, it is important to allow at least 10 inches of above ground growth before cultivation.

Economic Uses

Dogbane niches may be established all over. Dogbane can be used in craft projects such as necklace making. Dogbane roots can also be sold to rope makers. Presently, it is not as widely used as the Native Americans did.

Notes

Dogbane was a very important crop in Native American culture. Dogbane can be referred to as 'Indian hemp' or 'hemp dogbane'. The species *cannabinium* translates to hemp. Some humans considered this plant toxic, but the roots were still harvested in the 19th and 20th centuries for a variety of folk medicine and medicinal purposes.

Additional Resources

http://plants.nrcs.usda.gov/plantguide/pdf/cs_apca.pdf

Eastern Cottonwood (*Populus deltoides*)

Description

Fast growing and with a distinct triangular shaped leaf, eastern cottonwood is able to live over 100 years. Along with a long lifespan, this species is also able to achieve heights of 120 feet or more and a base diameter of 5 feet. The bark is a yellow-green color and smooth to the touch as a seedling and as it matures, the bark turns a dark gray and is deeply furrowed. The species is dioecious, meaning male and female trees exist and seed is dispersed through the wind in cotton bundles. In the fall, the leaves turn a pale yellow and are very attractive in the landscape.

Habitat

Found near streams and floodplains, eastern cottonwood is tolerant of both drought and rainy conditions. Eastern cottonwood spans from North Carolina all the way out to Montana and from Quebec down into Mexico and is found everywhere in between. In relation to soil types, this species can be found in sandy, low line areas to loamy conditions and even in clay soils. The only limiting factor in relation to soil that will cause problems with the growth and development of this species is bedrock or some other limiting factor that will interfere with root development. When the soil has no limiting factors, this species, along with others in the *Populus* genus has the ability to sucker sprout from the root and cause a new cluster of seedlings to occupy the base of the tree. Besides bedrock or another soil limiting factor, eastern cottonwood does not do well with fire and is very sensitive to the heat a fire can produce. Other species that are found in the same habitat are willow species, red mulberry, American sycamore, and hackberry.

Management Consideration

When it comes to management practices, this species will need little attention if planted on a good site that receives plenty of sunlight and water. Even though this is a drought or rainy resistant tree, young seedlings/saplings may be dramatically affected with severe drought or rainy conditions. If a drought should occur during the season you plant or a few seasons later, regular watering will need to be implemented for maximum root development. In the future, pruning lower or damaged branches will have to be done in order to keep the tree healthy and also maintain the value of potential timber that can be harvested. Along with eastern cottonwoods comes the cotton seed dispersal that can cause havoc on screens, air conditioning units, and allergies. If any of these factors are a concern to the landowner, seedless hybrids and varieties have been developed and can be used.

In agroforestry systems, eastern cottonwood can be grown in alleycropping to be harvested for timber, pulp, or other economical uses of the wood. Besides alleycropping, eastern cottonwood would be ideal for silvopasture since the species is fast growing and can inhabit various terrains. Windbreaks and riparian

buffers are the two big areas that this species is used in due to its ability to grow in wet areas and also be able to adapt to exist in different habitats across the mid and eastern sections of the United States. Forest farming can also be an option for a management plan consisting of eastern cottonwood because very few chemicals are leached out of the roots and into the soil that can cause damage to the understory crop(s).

Propagation

Mentioned before, eastern cottonwood has a tendency to have suckers, or new seedlings emerging from the roots of an already existing tree. These sucker sprouts can be a nuisance to keep under control. However, with proper equipment, sprouts can easily be detached from the main root and transplanted to another site. A word of caution, the new sucker sprouts are clones of the original plant and if the genetic makeup of the original plant is unable to ward off diseases, the suckers will have the exact same problem. Besides using sucker sprouts or a good seed source, taking recently pruned limbs and reducing them to a two foot stick and simply planting the stick in the ground is also a form of propagation. Also mentioned before, new technology has brought seedless varieties of this species that will not disperse the cotton in late spring/early summer.

Economic Uses

Since eastern cottonwood can grow very rapidly, it is used in the pulp and paper industry as a wood source for many mills across the eastern United States. Along with the pulp and paper industry, growing eastern cottonwood as a biomass source has become an interest to scientists and homeowners looking to produce cheap energy in contrast to the rising prices of fossil fuels. Several facilities across the country have started to use such biomass material as their energy source year round. New research projects are underway to determine if chipping the trees into fine particles and mixing these particles in with hay can be a source of cellulose for beef cattle.

The salicylic acid that is found in the wood is often used as a coupling ingredient in producing certain dyes for cloth. For carpenters, salicylic acid can be used as a currying agent for shell molding compounds. Along with these uses, this chemical can also be used in the production of latex paints, certain glues, and preservative for leather.

Additional Resources

Purdue University:

http://www.hort.purdue.edu/newcrop/duke_energy/Populus_deltoides.html

United States Forest Service:

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/populus/deltoides.htm

Eastern Gamagrass (*Tripsacum dactyloides*)

Description

Native to the eastern United States, eastern gamagrass is a warm season bunch grass. Since this grass is a perennial, with proper management it will come up year after year. A close relative of field corn, eastern gamagrass can have a vegetative width spread from 4-5 feet and reach a height of 5-10 feet. From June to September, the plant will produce orange-yellow flowers that will develop to produce seed.

Habitat

Gamagrass prefers light sands, medium loam, and heavy clay soils. This grass also prefers full to partial sun and will perform poorly in densely shaded areas. When considering where to plant this species, look for areas that receive large amounts of precipitation, riparian areas, or areas that retain good moisture, such as those areas close to woodlots.

Management Considerations

Weed control is very critical in the first year of establishment and can be accomplished using select chemicals or by manually removing weeds by such methods as cultivation. Burning areas with gamagrass is not uncommon and should be done every 5-8 years or so in order to stimulate vigorous new growth.

For riparian buffers, this grass is ideal and will flourish well in extremely moist areas.

Silvopasture and alley cropping are suggested only during the early stages of tree growth. Once the trees begin to shade and crowd out the grass, it may become necessary to establish another species that is more shade tolerant.

Inserting gamagrass in windbreaks may also be desirable, but make sure the shade produced by the dominate tree species in the windbreak does not interfere with the amount of sunlight the grass receives.

Harvesting Considerations

To harvest this species for hay or silage, wait for the second year of growth before going forwarding with harvesting. It is not uncommon to get 2 to 3 hay cuttings in a growing season. The ideal time for harvest is when the stems are 24 – 36 inches in height from the base to the tip of the tallest blade. Another harvest can take place 4-6 weeks following the first harvest of the year, as long at the same height criteria mentioned above is present. Leave about 6-8 inches of stubble to optimize regrowth for the plant.

Harvesting just the seeds can be a tedious job. Seed harvesting should be done around mid September when the seed heads are heavy and drupe from the plant.

Propagation

A down side to eastern gamagrass is the difficulty found in establishment. With new technological advances in the field of genetics, varieties that are much easier to establish in comparison to the original eastern gamagrass have come about with in the last 5-10 years and more are sure to come in the future. In any case, stratification of the seed is necessary. For improved success in establishment, place seeds in a wet environment at 35F for 10 weeks before planting. When planting the seeds, make sure soil temperature reaches around 65F. For planting the seeds a corn planter is the easiest method; however, new research has shown that drilling the seed can cause the seeds to germinate faster. Always control competing grasses.

Economic Uses

Seeds that are harvested can be sold as planting seeds for the next growing season. Along with selling seeds for production, the seeds are also edible for humans. The seeds are used in various backing recipes and in some cases, can take the place of corn in certain situations. The seed can also be popped and enjoyed as an alternative to popcorn. Other than the seed, the stems and seeds can be harvested in the fall and sold later on in the winter when pastures are low of forage for livestock.

Additional Resources

Other common names for gamagrass is “Sesame grass,” “fakahatchee grass,” “northern gamagrass” and “gama grass,”

Missouri Botanical Gardens:

<http://www.mobot.org/gardeninghelp/plantfinder/Plant.asp?code=R220>

Plants For A Future:

http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Tripsacum+dactyloides&CAN=LATIND

University of Missouri Extension:

<http://muextension.missouri.edu/explore/agguides/crops/g04671.htm>

USDA:

http://plants.nrcs.usda.gov/factsheet/pdf/fs_trda3.pdf

Common Elderberry (*Sambucus nigra* ssp. *canadensis* (L.))

Description

Common elderberry is a large upright, deciduous shrub or small tree with multiple stems that are spreading or arching. This shrub/tree can reach up to 12 feet tall. The bark is smooth and brown becoming shallowly furrowed and rough with age. The twigs are stout, silvery-to yellow-gray with obvious, warty lenticels. The buds are very small, red-brown and pointed. The leaves are opposite, 6 to 11 leaflets, dark green above and much paler below. The flowers are small, white, and in flat-topped clusters that are up to 8 inches across. The fruit is a small, berry like drupe, purple-black, and very juicy, borne in flat-topped clusters.

Habitat

Elderberry can be found in Eastern United States-Nova Scotia to Florida, west to Manitoba and Texas. It can be found in rich moist soil along streams and rivers, woodland margins and waste ground. It is a nitrogen loving plant and thrives near places of organic waste disposal.

Management/Harvest Considerations

The common elderberry is adaptable to either wet or dry sites and prefers neutral to acidic soils. This shrub/tree can withstand extended flooding. It grows best in full sun but will tolerate moderate shade. Pruning is needed on a regular basis in order to keep it looking its best. Its tendency to sucker and the displacement of the stems, due to the weight of the fruit, is what makes it necessary to prune, if a formal appearance is desired. Its capabilities to spread out, tolerate competition, withstand extended flooding, and withstand high concentration of nitrogen makes it useful in riparian buffers.

The elderberries can be harvested by hand in late summer. They fruit more heavily when you plant two different varieties close together, such as Adams and York, as examples.

Elderberry makes a good shrub for wildlife plantings and may be planted in combinations with other trees in practices such as alley cropping or windbreaks. Game birds, squirrels and other rodents, and several kinds of browsers also feed on the fruit or foliage of elderberry. Bears love to eat the elderberry fruits while deer, elk, and moose browse on the stems and foliage. The elderberries are important sources of summer food for many kinds of songbirds. Additionally, when used in combinations with other trees elderberry provides a structural layer often used by songbirds for nesting.

Propagation

Elderberry produces a good seed crop almost every year. The seeds are dispersed by birds and other animals that eat the fruit. The seeds have a hard seed coat and embryo dormancy and may remain viable for up to 16 years in storage. Without pretreatment, seed germination may be delayed from 2 to 5 years after planting. Plants may flower and fruit after only 2-3 years and can reach full size in 3-4 years.

Although cuttings will have lower survival than otherwise planted, cuttings are an optional propagation method. Cuttings of half-ripe wood with a heel, or cuttings of mature wood of the current season's growth may both be used. Elderberry may also be propagated by division of suckers in the dormant season.

Economic Uses

Elderberry is most effective in shrub borders, roadside plantings, in wet or low areas, or as a screen. It is heavily used as a food source for all kinds of birds and other wildlife.

Its economic importance is in the production of the berries to make jellies and jams. Only the blue or purple berries of elderberry are edible. Edible berries and flower are used for medicine, dyes for basketry, arrow shafts, flute, whistles, clapper sticks, and folk medicine. It is well spoken of in ancient times for its medicinal values. The active alkaloids in elderberry plants are hydrocyanic acid and sambucine. Both alkaloids will cause nausea so care should be observed with this plant. Elderberries are high in Vitamin C. The red berries of other species are toxic and should not be gathered. The leaves and inner bark of young shoots are used as an insect repellent, the dried flowering shoots are said to repel insects and rodents. It has also been known to treat various fungal infections such as leaf rot and powdery mildew. Cattle tend to rub up against this shrub/tree to help repel insects. The bark, leaves and berries can all be used for making dyes.

Notes

To use elderberry as an insecticide follow the following steps; boil 3-4 handfuls of leaves in a liter of water, then strain and allow to cool before using.

Additional Resources

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

<http://springvalleyroses.com/catalog/sambucus-york.html>

<http://sacredearth.com/Ezine/May2002/Beltain2002.html>

Faba Bean (*Vicia faba*)

Common names

Broad bean, horse bean, English bean, tick bean, field bean

Description

Broad beans get their name from the seeds which are large and flat. The seeds are variable in size and shape, but usually are nearly round and white, green, buff, brown, purple, or black. Pods are large and thick, but vary from 2-12 inches in length. The plant is an erect, stiff-stemmed, leafy legume reaching 2-5 feet when mature. They are quite different from common beans in appearance because the leaves look more like those of English peas than bean leaves. The flowers are 0.4 – 1.0 inches in length, with five petals.

Habitat

The faba bean requires a cool season for best development and is usually grown as a winter annual in warm temperate and subtropical areas. It can be grown anywhere it does not winterkill, or except where temperatures fluctuate rapidly. It is well-adapted to wetter portions of cereal-growing areas of western Canada. The faba bean tolerates nearly any soil type, but it grows best on rich loams.

Moderate moisture supply is necessary since this legume is not drought resistant. Moisture requirement is highest at approximately 9–12 weeks after establishment. The faba bean is more tolerant to acidic soil conditions than most legumes and thus can be grown in nearly all parts of the United States without liming. Hardier bean species can tolerate winter temperatures of 14.0 °F without serious injury. Winter types fare well when kept within an average temperature of 35 °F, without severe frost. Growing season should have little or no excessive heat.

Because they can over-winter well, they are often grown as a cover crop to prevent erosion. Additionally because they are a legume, they fix nitrogen in the soil and make a good “green manure”.

Management Considerations

Beans mature 90–220 days after planting. Harvest can be delayed a little longer for hand than for mechanical harvest. In either case, crop should not be cut until the lower pods are matured and the upper ones fully developed. If harvest is delayed until the upper pods are ripe, loss from shattering is great. An ordinary mowing machine can be used, but the drop-rake reaper is more satisfactory and reduces shattering. Crop should be cut on cloudy day and maybe cut at night and shocked early the next day. Large-seeded types are threshed with a common bean thresher with special adjustments to the cylinder. Small-seeded types can be thrashed without difficulty. After threshing, seeds are cleaned with ordinary fanning mills. For canning, beans are allowed to swell and then are picked by

hand before they become hard. As a dried vegetable, they are prepared the same way as other common beans.

Propagation

In areas that do not have hard frosts, planting may be done in the fall. In areas that have hard frosts, planting can be done in the early spring. Seed size will dictate method of planting, with larger seeded cultivars sown with a lima bean planter and smaller cultivars sown with a corn planter. Other regions of the world will often have plants in cultivated fields. In any event, seed should be planted to a depth of 2-4 inches. Row spacing may be varied from 24 inches apart, to wider, with about 6 inches between seed in a row.

When used as a green manure, seed may be broadcast. In all cases if proper Rhizobia are not present in the soil, then it is desirable to inoculate the seed prior to planting. Weed control may be accomplished in a fashion similar to other bean crops, whether by chemical or by cultivation is a personal preference.

Economic Uses

Pollination is critical to optimizing yields. Faba beans may be grown for personal consumption or as feed for livestock. Opportunities likely include local farmers markets.

Additional Resources

General information

<http://www.hort.purdue.edu/newcrop/cropfactsheets/fababean.html>

<http://edis.ifas.ufl.edu/MV017>

USDA

http://plants.usda.gov/cgi_bin/topics.cgi?earl=plant_profile.cgi&symbol=VIFA

Photographs of crop

<http://www.fao.org/ag/AGP/AGPC/doc/gallery/pictures/viciafaba/viciafaba.htm>

Market information

<http://www.kitchengarden.co.za/favabeans.html>

Gray Dogwood (*Cornus racemosa* Lam)

Description

Gray dogwood has a wide range and may be found across most of the northeastern United States. It is highly adaptable to a wide range of soil and climatic conditions. It is a low growing shrub that seldom exceeds 8 feet in height. Individual plants may be 5 feet wide, yet root suckering may initiate further spreading of individual plants. As a shrub that tends to form thickets, it is widely used by wildlife for summer food and cover. Fruit will typically develop by September or October from loosely clustered flowers that were formed in June or July. Often these white fruit are highly visible and set off as they are born on red to reddish-brown colored twigs.

Habitat

Gray dogwood grows well in poor soil. It is also quite tolerant of wet soils and is hardy to zone 3. It has intermediate tolerance to shade.

Management Considerations

Gray dogwood may be viewed as invasive due to its thicket forming/spreading properties. As with all tree and shrub plantings, the single best management that can be applied is control of weed competition. Most often herbicide or cultivation is used.

Uses for gray dogwood can include riparian buffers and windbreaks. Essentially it may be used anytime a hardy shrub is needed. Its medium height can effectively augment taller plant materials in zones of a windbreak. And, in all cases the fruit and twigs have been know to be used by several wildlife species including: robins, cedar waxwings, rabbits, and deer.

Additional uses may include urban screens and highway beautification projects.

Harvesting Considerations

The fruit matures between August and September and is a favorite for birds and mammals that eat the berries. Additionally, harvest of fruit laden stalks may be added to floral arrangements. Cut stems must be kept moist and fresh prior to selling. Although local markets should be considered prior to planting as a commercial venture, the wildlife values and rooting ability make this an excellent shrub selection for use in riparian area.

Propagation

Gray dogwood has fibrous roots and seedlings planted early in the spring should have good survival. Once well established, branches can be pulled and staked horizontally and covered with soil in order to encourage filling of a site. This may be especially useful where erosion concerns dictate filling an area with plant materials.

Although cuttings have been used successfully, they are much less reliable. To use cuttings, collect dormant material that is 3/8-inch to 1/2-inch in diameter on the small end and about 9 to 12 inches in length. These cuttings must be kept in cold storage, or planted right away. They can then be driven into the ground (or placed in preset holes) with about 2 inches protruding above the soil. Soil must be in firm contact with the cutting.

Economic uses

Primarily used as a conservation shrub for erosion control or wildlife enhancements, the gray dogwood also has additional profit opportunities when grown as an ornamental to enhance or create a naturalized look around buildings. It may also have opportunities within floral markets due to the color contrast of autumn berries on reddish brown twigs.

Additional Resources

http://plants.nrcs.usda.gov/factsheet/pdf/fs_cora6.pdf

<http://plantfacts.osu.edu/pdf/0247-320.pdf#search='gray%20dogwood%20pdf'>

Green Ash (*Fraxinus pennsylvanica*)

Description

Green Ash belongs to the Olive family (Oleaceae) and is a medium sized tree that produces an irregular to somewhat rounded crown, with heights of up to 70 feet. It is also known as red ash, swamp ash, and/or water ash. It is widely distributed across the Midwest and Eastern United States. Green ash and White ash have similar wood properties and are often marketed as the same. Ash are used by many wildlife species as browse and the seed is eaten by many birds and small mammals.

Habitat

The westerly range of green ash is dictated primarily by moisture limitations. Although a fairly successional tree that will grow on many sites, stands of green ash will most often be found in bottomland soils where good moisture is available. It is somewhat tolerant of flooding. The northern limits to its range are defined by frost free growing days. On average, green ash needs 120 to 280 frost free days per year.

Management Considerations

Green ash is relatively intolerant of shade and may be out-grown by other tree species associated with sites that have good soils and moisture. Therefore, without timely thinning of forest environments green ash typically begins to die out. Thin such that the crown of green ash has plenty of available light.

On the other hand, green ash has been planted with other hardwoods that have a higher value wood, such as eastern black walnut (*Juglans nigra*), and used as a trainer tree. In that case, as the trees develop the green ash assist in the upward growth and natural pruning of the lower limbs of the black walnut, and then begin to die back as the black walnut trees take over the site.

Green ash has been used in many windbreaks. It has a good crown, relatively quick growth, and is widely tolerant of many sites and soils. However, the greatest windbreak benefits will come by combining green ash with other species.

Propagation

As with most trees, the best growth and development of seedlings will occur when weed control is provided to eliminate competition from grass. Ash can be naturally propagated from seed of trees adjacent to a given site. Seed starts to fall from trees as soon as they ripen, and will continue into the fall and winter months. The seed is most often spread by the wind, but may also move with flood waters. Seed will naturally germinate in the spring. However, collected seed can be started through a process called stratification. Cold and moist conditions are

necessary in order to stratify and break the seeds dormancy, but they may then be started and grown in beds or containers.

Economic Uses

Primarily Green Ash is logged or used as a shade tree species. Therefore, most of the economical value for this species is tied up in lumber production. Such items as baseball bats, as well as tool handles, have in the past principally been made from Green Ash due to its strength, hardness and high resistance to shock. Another key fact is that Green Ash has excellent bending capabilities. However, when comparing Green Ash to White Ash in terms of durability as well as marketability White Ash is considered the better wood for such items that were just mentioned.

Interesting enough, Green Ash is now being used in the regeneration of spoiled banks that were created from strip mining. It is also often used as a species in riparian buffer plantings.

As previously mentioned Green ash is also very popular as a shade tree in residential, thus giving it potential as a nursery ball-and-burlap tree. Adding to its desirability is quick growth and the ability to adapt to its surroundings.

There are several diseases of green ash that limit its long-term use in most situations. However, its quick growth make it desirable from a marketing standpoint, as well as an environmental perspective where a site needs stabilization or protection that can be afforded by trees. For more on the diseases that might affect green ash please see the additional resources section.

Additional Resources

http://plants.nrcs.usda.gov/factsheet/pdf/fs_frpe.pdf

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/fraxinus/pennsylvania.htm

Illinois Bundleflower (*Desmanthus illinoensis*)

Description

Illinois bundleflower is an upright, deep-rooted, warm season perennial, legume. It grows from two to four feet in height with twenty to thirty seedpods curving to form a bundle or cluster. The stems are light green and angular. The leaves are alternate, bipinnate, and yellowish green or medium green, and narrowly ovate in shape. The bundleflower has small, white to greenish white flowers. The fruit is sickle-shaped, flat, many in dense clusters, dark brown and about 1/6 of an inch long.

Habitat

The Illinois Bundleflower can be found on pastures, rocky prairies, waste areas, open wooded slopes, stream banks, ditches, and roadsides. It is most abundant in clay or sandy soils. It occurs primarily in northeastern Illinois, along the Illinois River valley, and along the Mississippi River valley in southwest Illinois. Populations can be found in Kansas, Oklahoma, Alabama, Texas and north as far as Minnesota.

Management/Harvest Considerations

Illinois Bundleflower is rated by some authorities as our most important native legume and is included in range revegetation programs. The plant is highly palatable to cattle and other herbivores and has a high protein content that compares to that of soybeans. The plant prefers full or partial sun, and moist to average conditions. Illinois Bundleflower is an excellent reclamation species, adapted to harsh dry conditions. Fire, broken sod, or patches of bare mineral soil are necessary to maintain self-sustaining population's. The crop is quite easy to establish but requires early weed control to reduce competition with other plants, such as little and big bluestem and indiagrass. Bundleflower fixes high amounts of nitrogen in the soil, and can rejuvenate worn-out-soil. Its nitrogen fixation potential could reduce nitrogen fertilizer needs in perennial agroecosystem. When bundleflower is established it should be used as part of a rotation system and not continuously grazed bundleflower is harvested for its hay to feed livestock. Research is being done on how often it can be cut for hay and how well it yields. It's a very heavy seed producer, producing about 800lbs/acre.

Propagation

Bundleflower is best-grown in areas receiving fifteen inches or more of annual rainfall. Bundleflower should be planted at a rate of thirteen pure live seed pounds per acre, at a depth of 1/4 inch to 1/2 inch in a firm seedbed. Once the seed is established it requires very little attention.

Economic use

Illinois bundleflower seed is being evaluated, by food scientist, for its potential nutritional and nutraceutical properties. The seed is being tested for both animal and human consumption. The research shows that it has high levels of anti-oxidants and a high protein content (30-38%). It could possibly be a multi-use species, grazed in some years and harvested as a grain crop in other year's. Its economic use is primarily as a hay/forage crop and has potential for use as a seed crop.

Notes

The common name "bundleflower" derives from the densely flowering, puffball-like heads. Livestock prefer it to any other plant, including alfalfa, often grazing it out of pasture (3).

Additional Resources

<http://nativeplants.for.uidaho.edu/Content/Articles/5-2NPJ152-159.pdf#search='illinois%20bundleflower%20pdf'>

<http://www.forage.okstate.edu/text/ill-bundleflower.htm>

<http://www.mda.state.mn.us/ESAP/greenbook2004/cropsysseaffer.pdf#search='illinois%20bundleflower%20pdf'>

Missouri Department of Natural Resources, Warm-Season Native Grasses on Reclaimed Minelands-Landowners management guide, 7/2003.

Indiangrass (*Sorghastrum nutans*)

Description

Indian grass is a tall, bunching sod-former, 3-8 ft. in height, with broad blue-green blades and a large, plume-like, soft, golden-brown seed head. It is an important associate in the tallgrass prairies and is relished by livestock. It appears to be favored by occasional flooding and repeated burning and sometimes forms nearly pure stands in the lowlands.

Habitat

Indian grass is rather adaptable and once established as it will tolerate wet, dry, or poor soil. Best growth occurs in a moist soil where the plant is exposed to full sun. Found on open prairies, bottomlands, and open woods, in deep, moist soils. This grass is fairly tolerant to drought conditions, leading it to invade disturbed areas.

Management Considerations

Although it is good forage for livestock, Indiangrass, like any warm season grass, cannot tolerate heavy grazing for extended periods of time. It is best to use rotational, or management intensive, grazing and thereby let the grass respond following grazing sessions with adequate new growth prior to again grazing the area. Indiangrass is can also be rejuvenated with fire, and after times of grazing, it is good to prescribe burn these acreages.

Harvesting Considerations

Warm season grasses can provide more tonnage per acre than many other types of forage. Cutting for haying purposes can be done in over the summer and in the fall prior to flowering. Indiangrass mixed with Big Bluestem provides some of the best quality prairie hay.

Propagation

Indiangrass propagates from both seed and rhizomes, it is also known to self-seed and this will lead to volunteer plants. Planting practices similar to big bluestem are adequate for this warm season grass since they are co dominants in many tallgrass prairie systems. Planting can occur in late April and early May with no-till being the main practice. Dormant seeding can be done in December through February.

Economic uses

When practicing rotational grazing, it is shown that cattle will gain more weight in less amount of time when using warm season grasses as the primary forage.

Kentucky bluegrass (*Poa pratensis*)

Description

Kentucky bluegrass (*Poa pratensis*) grows 18 to 24 inches tall and is readily identified by its boat-shaped leaf tip. It spreads by rhizomes and tillers and forms a dense sod. New shoots (rhizomes and tillers) are produced primarily in the spring and late summer. Most shoots produced in the spring remain vegetative. Shoots produced in late summer often terminate in an inflorescence the following spring. The lifetime of a Kentucky bluegrass shoot that terminates in an inflorescence ends soon after the seeds mature. During late spring and summer, the shoots of Kentucky bluegrass grow in an erect, or upright, position; whereas, in early spring and fall they become more decumbent. This pattern of growth is a response to day length rather than temperature. During long days shoots grow upright; during short days they become decumbent. Day length also influences the number of shoots that develop. Significantly more shoots are produced during the short days of early spring than during long summer days. It is a cool-season grass.

Habitat

Kentucky bluegrass is found most abundantly on sites that are cool and humid. It has become naturalized across North America and often occurs as a dominant species in the herbaceous layer. Kentucky bluegrass grows best on well-drained loams or clay loams rich in humus and on soils with limestone parent material. It needs large amounts of nitrogen during active growth stages. The optimal soil pH is between 5.8 and 8.2. Root growth is greatest in fall and spring and slows dramatically in summer. Root growth of Kentucky bluegrass peaks at soil temperatures of 60°F and declines sharply as temperatures rise above 70°F. Root growth practically ceases at temperatures above 80°F.

Management Considerations

Begin mowing young grass when it grows above a 2-inch cutting height. Either rotary or reel type mowers may be used but blades must be sharp and reels properly adjusted to prevent pulling up young seedlings. The initial cutting should be at a 2-inch height. Subsequent mowing should be frequent enough so that no more than one-third of the leaf is removed at each mowing. At a 2-inch mowing height the grass needs mowing before it reaches 3 inches. Weekly mowing is usually satisfactory at the 2-inch mowing height. At lower mowing heights more frequent mowing is required.

Propagation

Where bluegrass is established from seed, plant 2 to 3 pounds per 1,000 sq. ft. of lawn. When seed is broadcast over the soil surface, they may take a longer time to develop. However, when seed is drilled into the top inch of soil, the seedlings will most likely develop faster. Kentucky bluegrass can be seeded year round, but best results are obtained in the spring and fall. New seedlings require light and

frequent watering (2 to 3 times per day for the first 2 weeks). After seedling emergence, watering frequency can be reduced.

Economic Uses

Kentucky bluegrass is suited for a variety of applications, though silvopasture and riparian buffers may be ideal. However, the market for bluegrass seed may also provide opportunities in the alley cropping practice where bluegrass seed becomes the product harvested.

Additional Resources

Turfgrass Specialist (Texas Cooperative Extension)

<http://aggie-horticulture.tamu.edu/plantanswers/turf/publications/bluegrass.html>

Basic information and pictures

http://www.fcps.k12.va.us/StratfordLandingES/Ecology/mpages/kentucky_bluegrass.htm

USDA

http://plants.nrcs.usda.gov/factsheet/pdf/fs_popr.pdf

Kentucky Coffeetree (*Gymnocladus dioicus*)

Description

Kentucky coffeetree may also be known as American coffee berry, Kentucky mahogany, nicker tree, or stump tree. It is a medium to large deciduous (max 100ft) tree with stout branches forming a narrow round-topped crown. It is intermediate shade tolerance, preferring full sun. Leaves are alternate and bipinnately compound (feather-like arrangement), 12 to 32 inches long; leaflets 2 ½ inches long by 1 inch wide. Leaf out early in the spring, turn yellow and drop early in autumn. Bark is gray to brown and shallow grooved with scaly ridges that curl away on the edges. Large uninspiring greenish-white flowers May to June. Fruit occurs in October persisting through the winter in pods 4 to 7 inches long and 2 inches wide. Pods contain 3 to 5 seeds inside; seeds ¾ inch blackish and hard-shelled. Pods drop unopened in late winter.

Habitat

Most often Kentucky coffeetree will be found in bottomland forests along streams, in moist woods at the base of bluffs, in mixed woods. Kentucky coffee tree is never common and has no common associates, but it does have similar site preferences as black walnut.

Management Considerations

In agroforestry applications, Kentucky coffee tree can be used in riparian buffers, alley cropping, silvopasture, and windbreaks. Prolific root sprouter. Very little wildlife uses this tree for food. However, it is used by nesting birds. The raw leaves and raw seeds are potentially toxic to mammals, but squirrels and deer have been reported to eat pods and seeds. Kentucky coffee tree grows best in rich, moist soils in full sunlight, but is very adaptable to heat, drought, basic soils, soil compaction, and wet sites.

Due to the structure and sparseness of the crown, Kentucky coffee tree may not need to be pruned much for alley cropping and silvopasture, but should be pruned to 17 feet or more if quality lumber is an objective. As with all legumes the tree bears root nodules containing nitrogen-fixing bacteria.

Harvesting Considerations

Kentucky coffee tree is considered an intermediate to fast growing tree and should reach a harvestable size of at least 16 inches in approximately 50 years. Growth is always site dependant. If thinning a stand the stumps of Kentucky coffee tree may need to be sprayed to reduce the likelihood of stump sprouting.

Ring shake (defect in quality; rings separate) in Kentucky coffee tree is a common problem.

Propagation

Root cuttings 4cm long and 1cm thick in a greenhouse in December. Plant the roots horizontally in pots.

Propagated primarily by seed. Seed is best sown in a greenhouse as soon as it is ripe. The seed can also be sown in early spring in a greenhouse. Scarification and pre-soaking the seed for 24 hours in warm water, especially if it has been stored, will improve germination. As soon as they are large enough to handle, prick the seedlings out into fairly deep individual pots and grow them on in the greenhouse for at least their first winter. Plant them out into their permanent positions in late spring or early summer, after the last expected frosts. Consider giving them some protection against the cold for their first couple of winters outdoors.

Economics Uses

Economic uses are limited in number as Kentucky coffee tree is not a common tree and has few regular markets other than propagation for use as an ornamental. The wood is used for cabinet work, furniture, construction, fencing etc... Not a primary lumber species, but can be sawn for high and low value lumber. Check with potential buyers (loggers and mills) before planting a monoculture of Kentucky coffee tree to produce lumber.

Notes

Although poisonous when raw, roasted seeds were once used as a substitute for coffee by native Americans and then European settlers, hence the common name.

First introduced into cultivation in 1748. 'Expresso', 'J.C. McDaniel' (Prairie Titan®) and 'Stately Manor' - At the current time, these cultivars are rarely offered in the trade. They are all male (fruitless) selections selected for their upright branching habit which is elm-like and much taller than wide (<http://www.hort.uconn.edu>).

Additional Resources

http://www2.fpl.fs.fed.us/TechSheets/HardwoodNA/pdf_files/gymnomet.pdf#search='gymnocladus%20dioicus%20pdf'

<http://edis.ifas.ufl.edu/pdf/ST/ST28700.pdf#search='gymnocladus%20dioicus%20pdf'>

<http://plantfacts.osu.edu/pdf/0246-487.pdf>

Lespedeza

Common (*Kummerowia striata*)

Korean (*Kummerowia stipulacea*)

Description

Annual lespedeza is an acid tolerant, drought resistant, summer annual legume useful for pasture, hay and soil improvement. There are two main types of lespedeza grown in Missouri, Common Lespedeza and Korean Lespedeza. They have broad to long, heart shaped leaflets that are distinctly veined and have small hairs on the stems.

Habitat

Korean is better adapted than common lespedeza in the North because of its shorter life cycle. Both types grow in a pH range of 4.5-7.0, but do best at 6.0-6.5. Seed early in the spring, and as with all legumes, the correct species rhizobial bacteria inoculant should be used. Germination occurs in early spring but grows very little until early summer. Dry conditions may reduce growth but recovery following rain is very quick.

Management Considerations

With proper management, annual lespedezas are easy to establish, and will reseed themselves, but should be mechanically reseeded at some point in order to maintain an adequate stand.

Used with grasses, lespedeza will produce nutritious feed for most classes of livestock. The forage from lespedeza is fine-stemmed, with a high percentage of leaves, and does not cause bloat. Proper management, plus some summer rain, will allow lespedeza to produce quality pasture during midsummer when companion cool-season grasses are of low quality and not very productive. Lespedeza pasture can be used by all types of livestock but is especially valuable for sheep and cattle operations. Lespedeza can be grown with all of the adapted cool season grasses but performs best with orchardgrass. It also has an added value where quail production is important because annual lespedeza seed is an excellent quail food.

Harvesting Considerations

Missouri farmers can produce 1-2 tons of lespedeza per acre depending on variations in weather and management. Some studies have been shown to have gains in steers grazing on lespedeza to have 1.8 lbs gain per day. Early Missouri grazing trials also reported more pounds of beef produced from lespedeza and orchardgrass mixes than from lespedeza-fescue.

Propagation

For pure lespedeza stands, seed 20 pounds of seed per acre. In mixed stands, seed 15 pounds per acre of either type as a dormant seeding into established cool-season grasses. When drilling as a companion legume with cool season grass, seed 10 lbs per acre with the proper amount of grass seed per acre. One pound of lespedeza contains about 236,000 seeds. Mow or lightly graze the lespedeza in summer to ensure that the seedling grass plants survive. Do not plant lespedeza in the fall. It may then be killed by freezing if it germinates too late.

Economic uses

The use of lespedeza may reduce production costs. Lespedeza will produce less forage per acre than properly managed alfalfa or clover but can be maintained with lower production costs. Feeding trials report that lespedeza hay is only slightly less valuable than alfalfa for wintering calves and dairy heifers. However, lespedeza hay is inferior to alfalfa when fed to lactating dairy cows. It makes excellent hay for sheep and all types of beef cattle.

Additional Resources

<http://extension.missouri.edu/explore/agguides/crops/#Forages>

http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

Loblolly pine (*Pinus taeda*)

Description

Loblolly pine is a large, evergreen tree that can reach heights of 90-110 feet. It has a long, clear trunk (bole) that is sometimes buttressed and a round spreading crown. Self-pruning is common among this species, which helps to develop a clean, branch free, bole. Young trees retain low branches longer than slash and longleaf pine. The needles are 4 to 9 inches long, in fascicles (groups) of three, stiff, and a bluish-green color. Fruits are produced in large quantity, and consist of dark brown, oblong to cylindrical cones, from 3 to 6 inches long, and they persist on the trees for more than one year. The main problems associated with loblolly pine include fusiform rust, bark beetles, pine engraver beetles, and prolonged flooding.

Habitat

The native range of loblolly pine includes most of the southeastern United States, although it can be grown in Missouri, it does not produce seed due to cool winter temperatures. Acidic soils are preferred as well as full sunlight. Many different sites are adaptable, including fertile, upland fields, moist forests, mixed hardwoods, and in association with shortleaf pine (*Pinus echinata*). The main factor limiting northward expansion of loblolly pine is the low winter temperature that damages flowering, and the damage that may develop in association with ice, snow and sleet as it accumulates on the long needles (may result in trees or branches being broken).

Management Considerations

Full sunlight is required for best growth, and a moist site is desired, though drier soils are adaptable. Main cause of mortality in seedlings is drought, especially during the growing season. Silvopasture, Forest Farming, and Alley Cropping are all good agroforestry applications for loblolly pine. The main products produced by loblolly pine include lumber, utility poles and pine straw. Young trees are somewhat tolerant of shade, but increasing age reduces the shade tolerance. Understory invasion of pine stands, by more tolerant species, can allow for succession of more hardwoods, which can then share dominance with loblolly pine, but the numbers and basal area of the pine will decline over time.

The majority of the root system of loblolly pine is within the top 18 inches of soil, so consideration at the base of the individual trees must be taken, as the competition between the tree and any other crop at this root zone will be quite high.

Harvesting Considerations

If lumber is desired, maturation is considered 150 years with diameters between 36 and 48 inches and height of 90 to 110 feet. Mean annual board-foot growth culminates at about age 50. Growth during a shorter time period, such as 25 year

rotation, may allow for greatest economic benefits even with the reduced size. Trees with 9.6 inch and larger diameter at breast height at age 20, can range from 2,100 fbm/acre to 40,000fbm/acre(most likely plantation style growth). Some other applications, such as pulpwood growth, can lead to even shorter rotations, but the implementation in agroforestry must be carefully scrutinized. Control of competing vegetation and fertilization will allow for best growth and maximum results.

Other intermediate products, such as pine straw (used as a mulch), can be harvested as timber crops mature. Pine straw develops as needles are dropped/cast as a natural process of tree growth and development. Over time these needles accumulate beneath rows of loblolly trees, and the accumulated needles can then be raked into rows and baled into small square bales. These square bales, weighing approximately 30 lbs in order to facilitate transport and use by urban homeowners, can then be used in flower beds and other settings where pine straw is desirable as a mulch material. The soil acidity created when needles begin to break down is often desirable for flowering plants that do better with acidic soils.

Propagation

Seeds can be used for propagations, but a stage of dormancy after seedfall is normal. This dormancy lasts the longest of any southern pine. To break dormancy cold, moist stratification of the seed for 30 to 90 days is recommended. Vegetative reproduction can be accomplished with cuttings from seedling up to 3 years of age. Sprouting occurs from buds in the primary needle axils when the tops are clipped off, the rooting is related to a trees age so attention to this factor is extremely important. Seedbed scarification or burning, to open up direct mineral soil contact, greatly increases chances of seedling survival.

It is often most feasible to order seedlings from a nursery. Best growth is presented from genetically enhanced seedlings, available from most nurseries, although the increased cost may be prohibitive. Seedlings from specific regions react differently to certain conditions, such as east Texas loblolly pines are more drought resistant, northerly sources of pine result in more cold-hardiness, etc. A nursery in the local area should have plenty of options for different sources of seedlings.

Economic Uses

Loblolly pine can be implemented for a number of products, including lumber, non-timber forest products, low-value wood products, and sometimes Christmas/ornamental trees. Non-timber products could include pine straw, in conjunction with forest farming operations.

Additional Resources

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/pinus/taeda.htm

<http://www.centerforagroforestry.org/profit/pine/pine.asp>

Ninebark (*Physocarpus opulifolius*)

Description

Ninebark is a shrub that can grow from 3 to 10 feet tall with a widely spreading crown. Its bark is yellow, orange, or red-brown and appears shredded and exfoliating in long strips, especially on older stems. The twig is slender and red-brown. The young twigs have tight bark but on older twigs the bark splits and exfoliates in long strips. The leaves are alternate, deciduous, maple-like, and almost circular in outline, 1 ½ to 3 ½ inches in diameter, dark green above and paler below. The fruit is a ¼ inch pointed follicle that is in dense, upright hemispherical clusters and are red, turning into a bright reddish brown when mature.

Habit

Ninebark occurs on gravel bars, rocky banks and bluffs along streams and moist thickets, often overhanging the water. It is adaptable to a very wide range of soil and site conditions, from moist to dry, acid to alkaline, and gravelly to heavy clay. It will grow in partial shade to full sun. Its range is from Quebec west to Minnesota, South Dakota and Colorado, south to Oklahoma, east to Georgia and north to New York.

Management / Harvest Considerations

Ninebark is a shrub that is very adaptable to dry sites and is pollution tolerant. Because of these characteristics it is relatively a problem-free plant. It needs to be pruned right after flowering to remove crossed branches or dead wood. Thin out overcrowded stems by cutting stems back to ground level. In Missouri, fruits ripen from August to early October and are small, dry pods hanging in drooping, papery clusters that resemble bellows (1). Each pod contains 2 to 5 yellowish, shiny seeds. The seeds should be collected in late September. To allow them to further ripen and dry, they need to be placed in elevated wooden boxes with standard house screen on the bottom.

Ninebark's ability to tolerate pollutants makes it a valuable species in the development of riparian buffers. It is also selected for its rapid growth and its ability to reproduce vegetatively by stump or root sprouts.

Propagation

The seed should be sown as soon as it is ripe, if possible, in a cold frame. If sown in the spring it is likely to require a period of cold stratification. When they are large enough to handle, prick the seedlings out into individual pots and grow them in the cold frame for at least their first winter. Plant them out into their permanent positions in late spring or early summer, after the last expected frosts.

Economic Uses

Ninebark can form dense thickets, which provide good shelter and cover for a variety of wildlife species from small birds to large mammals. Ninebark's economic importance is in the production of seeds for sale. The importance of this shrub is for borders, massing, and bank covering. This shrub has no value for medicinal or timber production.

Additional Resources

Native Plant Network,

http://www.nativeplantnetwork.org/network/view.asp?protocol_id=432,461

University of Arkansas, http://www.uark.edu/campus-resources/cotinus/plants3_html/physopul.html

Virginia Tech University, <http://www.ext.vt.edu/pubs/forestry/420-153/420-153.html>

Northern Red Oak (*Quercus rubra*)

Description

Northern red oak is a moderate to fast growing tree that can be found on a variety of soils and site conditions. It is easily transplanted and is one of the more important lumber species of red oak.

Habitat

Because of the wide range of the northern red oak, its growing season varies from on average of 100 days in the north to 220 days in the south. Its native range extends from Nova Scotia to Arkansas, and it can be found growing primarily on moist, well drained soils throughout Missouri

Management Considerations

While northern red oak grows on a variety of soil types and site conditions it will always grow best on deep, well-drained loam to silty, clay loam soils. Northern red oak requires less growing space than those of other oak species with the same diameter, which makes it a good candidate for use in agroforestry plantings.

Northern red oak should be considered as one of the fastest growing native oak species in Missouri. Other fast growing species that have more limited ranges in the state include shumard oak, nuttall oak, and cherrybark oak.

Major risks to managing northern red oak include its susceptibility to a number of defoliating insects and diseases, including Gypsy moth and oak wilt. In addition, the red oak stem borer can become a serious problem in older northern red oak stands in southern Missouri. The loss of northern red oak acorns due to insect and disease predation, especially in poor seed years, is an ongoing problem in the state.

Propagation

Northern red oak is easily planted and transplanted. It is also a very prolific sprouter. These new sprouts will generally grow faster than younger trees of seedling origin due to the presence of a previously formed, well-developed root system.

Northern red oak acorns can quickly lose viability if allowed to dry out. Timely collection of sound acorns that are fall free from their caps is of paramount importance. Newly collected seeds should be soaked in water overnight to insure their soundness. Defective acorns will float and can be discarded. Floated seeds can be stored in plastic bags in the refrigerator and sown in the very early spring, or can be directly sown following collection. If sown outside seeds should be protected from mice, squirrels, and other rodents. The seedling tree produces a fairly fibrous root system, which allow for improved transplanting success rates.

If started in a nursery bed they should not be left there for more than two growing seasons.

Economic Uses

Red oak is an important lumber species and is used in a variety of applications from lumber, firewood, flooring, etc. Heavy acorn production is also important for many wildlife species including squirrels, turkeys, blue jays, deer and other mammals and birds.

Osage-Orange (*Maclura pomifera*)

Description

Osage-orange can be either a shrub or a tree, depending on its surroundings. It grows between 10 and 40 feet tall, but can reach up to 60 feet. Standing alone in full sun it will become a multi-stemmed shrub; with neighboring competition it can become a single-stemmed tree. The bark, up to ¾ inches thick, is light gray-brown with slight orange. On large trees it separates into shaggy strips. The leaves of the osage-orange are thick, shiny, and simple, alternating along twigs, dark green on top and light green underneath. Branches growing in full sunlight have sharp, stout thorns. Twigs in the shaded portions of the crown of mature trees are thornless. The leaves of the osage-orange turn bright yellow in autumn. The trees are either male or female, and only the females produce a large fruit from their small flowers. Flowers are produced from May to June. The fruit, commonly known as a hedge apple, is a large, green-yellow wrinkled ball up to 6 inches in diameter. As it ripens in the fall (September to October), the fruit often hangs in the tree after all the leaves have fallen off. It does not have recognized associates, but can sometimes be found near eastern red cedar, hickories, black walnut, and elms.

Habitat

Osage-orange is native to a relatively small area in eastern Oklahoma and portions of Missouri, Texas, and Arkansas. Preferring open sunny areas, the tree can grow in a variety of soils and with a variety of species.

Management Considerations

Osage-orange can be used in windbreaks and provides valuable cover and nesting sites for quail, pheasant, other birds, and animals. The bitter-tasting fruit is hardly eaten by wildlife. It is a medium sized tree and will not reach the heights of other windbreak trees, but it can be planted very densely to increase wind filtering. Pole-sized and larger osage-orange trees are practically immune to deer browsing, but seedlings and tender sprouts are highly susceptible. Livestock should initially be kept out of the windbreak with fence, although osage-orange can become a fence itself with time and minimal maintenance. It does best on moist well-drained soils, but tolerates extreme drought. The tree is cold hardy to northern Iowa and Nebraska.

Harvesting Considerations

When harvesting from a windbreak, be sure not to create a wind tunnel where it is not wanted. Do not make corridors parallel to prevailing winds. Create corridors at angles or with crooks to curb and slow the wind.

Propagation

The best way to propagate osage-orange is through stem or root cuttings, although the seeds will grow and you can reproduce trees from root sprouts. To

successfully collect seeds and grow seedlings you must locate fruiting females with several neighboring males. Fruits can be collected from the ground anytime after they fall until just before spring. Natural regeneration requires exposed mineral soil and full sunlight.

In pioneer days, people used to crush a number of osage-orange fruits and make them into slurry that was then poured into a plowed shallow furrow and covered with about 1/2 inch of soil. This method was used to start hedgerows.

Economic Uses

Osage-orange produces no sawtimber, pulpwood, or utility poles. The heartwood, bark, and roots contain many extractives of actual and potential value in food processing, pesticide manufacturing, and dye making. Osage-orange heartwood is the most decay-resistant of all North American timbers and is immune to termites. Some places grow osage-orange specifically to produce fence posts. After the post material is harvested, the plants resprout and in five to 10 years produce more fence posts. Several male thornless varieties (*Maclura pomifera* var. *inermis*) of osage-orange are now on the market, used in home landscapes, along city streets, and in institutional settings. Osage-orange staves are used in bow making. The wood is valuable for firewood, rating almost as high as coal in producing heat.

Notes

Known also as hedge, hedge apple, bodark (from the French bois d'arc, meaning wood of the bow), and bowwood, the osage-orange's name comes from the Osage Indian tribe, which lived near the tree's home range, and from the orange-like aroma of the ripened fruit.

Passion-flower (*Passiflora incarnata*)

Description

Passiflora incarnata is a fast growing perennial woody vine that employs tendrils to grab hold of adjacent shrubs, structures and other supports to lift itself to heights of eight to twelve feet. This flower is also known as Maypop. It has large serrated leaves that grow five to six inches wide by six to eight inches long. The flowers are single, arising on stalks from the axils of leaves. The individuals are up to three inches across, with several petals and a purple fringe. The fruit is oval, smooth, yellow when ripe, up to two inches long, and contains many seeds with gelatinous coverings.

Habitat

Passionflower is native to southeastern United States and is often seen growing on the edges of fields, along side ditches and other sunny, moist and fertile places.

Management and Harvest Considerations

Passion-flowers are drought tolerant and can be grown in different soils. It prefers a light, rich soil, and does well in dry areas. The plant requires a position in the landscape that receives full sun for best flowering. This plant is noted for not having any serious insect or disease problems. The roots of this flower spread invasively. Root rot is one of the most common problems associated with the passion-flower. Root rot can occur in wet poorly drained soils, particularly in winter.

The leaves, stems and flowers may be harvested at any time. This is a good way to keep the plant from crowding itself. Each year before the frost kills it, the entire vine may be cut back to the ground, yielding great quantities of herb. It may be dried in the sun or at a low heat.

Propagation

Maypop is the hardiest of all the passion-flowers. If the roots are protected it will survive as far north as the Pennsylvania border. Maypop grows readily from the seed, but takes several weeks to sprout. It is best sown on the surface of light soil or peat moss with bottom heat. After six months the young plants may be planted in the open. It may be propagated easily by cutting off half-ripened growth. These should be about 6 inches long; they will root easily in sand and do not require bottom heat. The vines may eventually overgrow and tangle themselves. Thin them out by cutting branches back to their beginnings. Passion-flower dies back at the first frost.

Economic Uses

The primary economic value of the Maypop is its medical use. It is used to treat nervous restlessness and gastrointestinal spasms. It is also used as a sedative and

painkiller. The use of this plant for medical purposes did not begin until the late nineteenth century in the United States.

The passion fruit is edible but seedy. It can be used to make jelly, but its best usage is for being a food source for several species of butterfly and their larvae.

Notes

It derives its common name, Maypop, from the way it just seems to pop out of the ground in May.

Additional Resources

The Garden Helper, <http://www.thegardenhelper.com/passion.html>

Paulownia (*Paulownia tomentosa*)

Description

Native to China, paulownia (aka Princess tree) is a small to medium sized tree that may reach 30 to 60 feet in height, and up to two feet in diameter. The bark is rough, gray-brown, with olive-brown to dark brown stems that are hairy and flattened at the nodes. Leaves are large, oval to heart-shaped, and hairy on the lower leaf surface, arrangement is in pairs along the stem. Flowers are upright clusters of pale violet color with noticeable fragrance. Fruits consist of a dry brown capsule with four compartments that may contain several thousand winged seeds. The capsules mature in autumn and open to release the tiny, wind-borne seeds, though the capsule remains attached to the tree all winter, which is handy for identification.

Habitat

Paulownia can be found in 25 of the United States, from Maine to Texas, along roadsides, stream banks, and forested edges. It is a very adaptable species, tolerating infertile and acidic soils and drought conditions. It can be found in disturbed habitats, including previously burned areas, forests defoliated by pests, landslides, rocky cliffs, and riparian zones. It has an ability to sprout prolifically from adventitious buds on stems and roots, which help it to survive fire, cutting, and bulldozing.

Management Considerations

Quick to establish, paulownia can be used to establish a canopy in a considerably short time period, the ability of the species to sprout from stem and root buds, gives it an advantage in areas of increased disturbance. These factors can prove to be a problem with native competition, so care should be taken to consider all alternatives. Naturally seeded or planted paulownia survives and grows best on moist, well-drained soils of steep slopes or open valleys, but it will germinate and grow on almost any moist, bare soil. A highly adaptable Paulownia is found in many site, soil, and forest type conditions. Princess tree needs bare soil, sufficient moisture, and direct sunlight for good seedling establishment. Seedlings are very intolerant of shade.

Harvesting Considerations

On good sites royal paulownia grows rapidly. Plantation spacings of 4 by 4 or 6 by 6 ft have been recommended; saw logs can be expected in 15 years. Heights at maturity range from 30 to 70 ft. Heights of 43 feet in 11 years have been reported in Russia. On poor sites, such as surface mine spoils, growth is considerably slower. The ability of paulownia to survive, grow, and reproduce on such harsh, exposed sites, however, has made it a favorite for re-vegetating surface mine areas. The tree thrives on dry southern aspects, even though it generally has a shallow root system. The species is valued as an ornamental and for wood carving.

Propagation

When severely coppiced, paulownia can re-grow to a mature tree within a single season, and millions of small fluffy seeds can be produced. Difficulty in propagation has been noted, though the species can be found naturally occurring in degraded, exhausted soils.

Economic Uses

In China, paulownia leaves and bark are used to promote hair growth, reduce swelling in feet, and various other medicinal applications. Other uses include sawlog production, low-value wood production, and perhaps seed production, to be sold to nurseries. The quick growth of this species on good sites allows for fast production of biomass, and with the coppicing ability of the species, re-propagation may not be necessary. Future stands could be grown from the roots of established trees once they are harvested for pulpwood, etc.

Agroforestry Uses

Possible agroforestry uses for paulownia include windbreaks, alley cropping, and riparian forest buffers. The adaptability of the species makes it a valuable asset in situations requiring adaptive growth and sites that are unusable to many species. Care must be taken to keep spread of paulownia in check, it has become considered a highly invasive species in many states and without management to keep it contained, rare/endangered plant species may lose habitat to it.

Additional Sources

Forest Service Silvics Manual. Royal Paulownia Website,
http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/paulownia/tomentosa.htm

Paw paw (*Asimina triloba*)

Description

Reaching a height of 15 – 23 feet, the paw paw is a native, deciduous species of the United States. This slow growing understory tolerant species produces 12 inch leaves that are a dark green color and droop, giving the tree a “tropical themed” appearance. In autumn, the leaves turn mustard yellow and begin to fall in mid to late October. After the flowers have bloomed and been pollinated, the tree leafs out in late spring.

The flowers are protogynous, meaning that the tree has both male and female reproductive organs, however the female organ will mature sooner than the male. This allows the tree not to pollinate itself. However, since many natural stands of paw paws are sucker shoots, self fertilization is possible. The flowers are chocolate brown in color and have a velvety texture to them. Fruit begins to form after pollination has occurred and becomes ripe between mid-August to early October. When fully ripe, the light green fruit can weigh from five ounces to one pound and be three to six inches in length.

Habitat

Primarily an understory tree, paw paws usually exist in clumps or thickets due to their ability to sucker sprout and the hardiness of the seeds to survive through animal digestive tracts. During the early years of life, paw paws must be placed in shaded areas. After five years or once they begin to produce fruit, they are capable of being in full sun and will actually produce more fruit in comparison to being in half to full shade. Even though it can survive in full sun, some form of a windbreak must be present because of the large leaves that are susceptible to being shredded from winds and severe forms of weather.

Surviving in temperatures of -15F, the paw paw requires hot, humid summers and 32 inches of moisture falling in spring and summer to survive. Even with the large amount of precipitation that is needed, paw paws are unable to live in waterlogged areas. In reference to soil types, paw paws thrive in all forms of soil, especially silty soils that are acidic.

Management Consideration

Irrigation is critical during the growing season. Fertigation, mixing a form of fertilize into the irrigation water when watering, is highly recommended and is very beneficial during seasons of drought. Irrigation can be enforced through drip irrigation or sprinklers.

Pruning is not required for paw paws, unless you wish to remove dead or damaged limbs. Due to the size of the species, pruning is not a factor and this can be beneficial to landowners who will not have time to do pruning on a seasonal bases.

In agroforestry settings, paw paws are ideal for forest farming, windbreaks, and alley cropping. Besides being part of agroforestry, paw paws are also a good addition to any garden or landscape.

Harvesting Considerations

In the timber industry, paw paw is not a prized specimen. The tree does not reach a tall height and the circumference around the trunk is too small to produce lumber. To harvest the fruit, picking the fruit while it is still on the trees is recommended. Fruit that has already fallen can be cleaned on the spot and the seeds removed for future propagation or to sell to a local nursery as seed stock.

Propagation

Paw paw can be grown from seed and seedling plantings. Seeds should be removed from the fruit, washed with a 20% Clorox Bleach mixture, rinsed several times with distilled water, and be stored at 2-4°C for 60-100 days. For the first three years of growth, the seeds and seedlings should be placed in a shaded area that receives around 20% direct sunlight during the summer. Paw paws are primarily an understory tolerant tree and extended periods of direct sunlight may cause the young seedlings to die. Taking trees from the wild and transplanting them into a new setting is not recommended. Most paw paws that are found in the wild are often sucker sprouts and do not have adequate root development to survive after they have been transplanted. The ideal time to plant seeds or seedlings is when the tree is dormant, such as early spring and late fall.

Economic Uses

With a low timber value, paw paw is redeemed for its fruit that has been referred to as having a blended cantaloupe and banana taste. The fruit, when refrigerated, is edible for up to three weeks. Due to the short shelf-life, paw paws are not a commercial importance to the United States as an edible crop. Many housewives and bakers use the paw paw as a substitute for bananas in many recipes and have found that the fruit makes a wonderful jam/jelly. Along with being an edible fruit, the plant naturally manufactures a natural chemical (annonaceous acetogenins) that acts as a pesticide to keep insects from colonizing or eating the tree. Not only does this chemical act as a natural insecticide, researchers have found that this chemical has a positive effect on reducing various forms of cancer in the human body.

Notes

Other common names for the paw paw include: Poor Man's Banana, Indiana's Banana, the Hosier Banana, and the Poor Farmer's Banana. The seeds, when crushed, can cause digestive problems in mammals (humans and wildlife) but when left in tact, the seeds pass through the digestive system and cause no harm.

Additional Resources

California Rare Fruit Growers, INC. <http://www.crfg.org/pubs/ff/pawpaw.html>

Purdue University. <http://www.hort.purdue.edu/ext/HO-220.pdf>

Peppermint (*Mentha piperita* L.)

Description

The leaves of this kind of mint are shortly but distinctly stalked, 2 inches or more in length, and 3/4 to 1 1/2 inches broad, their margins finely toothed, their surfaces smooth, both above and beneath, or only very slightly, hardly visibly, hairy on the principal veins and mid-rib on the underside. The stems, 2 to 4 feet high, are quadrangular, often purplish. The whorled clusters of little reddish-violet flowers are in the axils of the upper leaves, forming loose, interrupted spikes, and rarely bear seeds. The entire plant has a very characteristic odor, due to the volatile oil present in all its parts, which when applied to the tongue has a hot, aromatic taste at first, and afterwards produces a sensation of cold in the mouth caused by the menthol it contains. Peppermint blooms from July through August, sprouting tiny purple flowers in whorls and terminal spikes. Peppermint is native to Europe and Asia, is naturalized to North America, and grows wild in moist, temperate areas.

Habitat

Peppermint thrives best in a fairly warm, preferably moist climates and in deep soils rich in humus and retentive of moisture, but fairly open in texture and well drained, either naturally or artificially. These conditions are frequently combined in effectively drained swamp lands, but the plants may also be commercially cultivated in well-prepared upland soils, such as would produce good corn, oil or potatoes. Though a moist situation is preferable, peppermint will succeed in most soils when started into growth and carefully cultivated. It flourishes well in what are known in America as muck land, that is, those broad level areas, often several thousand acres in extent, of deep fertile soil, the beds of ancient lakes and swamps where the remains of ages of growth of aquatic vegetation have accumulated.

Management Considerations

The area selected for peppermint growing should be cropped for one or two years with some plant that requires a frequent tillage. The tillage is also continued as long as possible during the growth of the mint, for successful mint-growing implies clean culture at all stages of progress. A rich and friable soil, retentive of moisture is selected, and the ground is well tilled 8 to 10 inches deep. The usual method of mint cultivation on farms in America is to dig runners in the early spring and lay them in shallow trenches, 3 feet apart in well-prepared soil.

Harvesting Considerations

The herb is cut just before flowering according to local conditions. With new plantations the harvest is generally early in September. Harvesting should be carried out on a dry, sunny day, in the late morning, when all traces of dew have disappeared. The first year's crop is always cut with the sickle to prevent injury to the stolons. The herb of the second and third years is cut with scythes and then raked into loose heaps ready for carting to the stills.

The growing crop is kept well cultivated and absolutely free from weeds and in the summer when the plant is in full bloom, the mint is cut by hand and distilled in straw. A part of the exhausted herb is dried and used for cattle food, for which it possesses considerable value. The rest is cut and composted and eventually ploughed into the ground as fertilizer.

Propagation

The plants are propagated in the spring, usually in April and May. When the young shoots from the crop of the previous year have attained a height of about 4 inches, they are pulled up and transplanted into new soil, in shallow furrows about 2 feet apart, lightly covered with about 2 inches of soil. They grow vigorously the first year and will generate numerous stolons and runners on the surface of the ground. After the crop has been removed, these are allowed to harden or become woody, and then farmyard manure is scattered over the field and ploughed in. In this way the stolons are divided into numerous pieces and covered with soil before the frost sets in, otherwise if the autumn is wet, they are liable to become sodden and rot, and the next crop fails.

Economic Uses

The main marketable use of peppermint is for distilled oils used in flavorings and fragrances. Peppermint also contains a form of menthol that is added to many medications for both its smell and for its effectiveness as a carminative.

Additional Sources

International information (England and France)

<http://botanical.com/botanical/mgmh/m/mints-39.html>

General information and history

<http://www.diet-and-health.net/articles.php?cont=peppermint>

Common Persimmon (*Diospyros virginiana*)

Description

Native to the United States and spanning in distribution from Connecticut to Kansas, Common Persimmon is a deciduous tree that will never grow above 50' in height and 18" in diameter at breast height when fully matured. The leaves are dark green and appear glossy. Mature bark is dark gray to black and breaks into blocks that are separated by deep furrows that are a dark red color at the bottom. Persimmon is dioecious, meaning separate male and female trees. The females will produce a flower that appears yellow to white in the early spring and edible berry fruit can be harvested from the tree in October or November the following fall. The fruit is red to yellow in color and averages about 1" in diameter.

Habitat

Persimmon can occur naturally along streams, in bottomland swamps, and upland forests. In consideration, it can withstand short periods of drought and flooding along with being in the understory of a forest during its germination, but after ten years, it will start to lose its understory tolerance. The ideal niche for persimmon is areas that will receive full sun and have adequate drainage properties. The roots of this species can grow very deep and may cause problems with underground pipes and wires.

Management Considerations

As stated above, the best site for this species is an area that will receive full sunlight and soils that are well drained. The first two to five years will be the most crucial for the seedlings and may require the owner to irrigate and do proper weed control.

From an agroforestry standpoint, persimmon can do exceptionally well in alley cropping, riparian buffer systems, and windbreaks. In alley cropping, the deep roots should not compete with shallow rooted grasses or forages. Harvest of the berries will take place after the crops in the alleyways have been collected as long as an alley crop such as summer wheat, alfalfa, or corn is chosen. With a deep root system, persimmon is a good addition to any riparian buffered area and will help control the amount of sediment movement from a field into a water source. Not only will the species aid in preventing soil erosion but will also be a great wildlife tree providing food for wildlife. The same is true in regards to windbreaks, the tree has deep root system that will allow for soil stability and the fruit that is produced will also provide wildlife food.

Harvesting Considerations

The fruit of persimmon is a delicacy in Asian communities that are established here in the United States. Outside of these communities, many rural areas have harvested this fruit for use in jams, cobbles, and homemade wines. Along with

using the berry, the seed is often dried and used as a substitute for coffee grains. Many Native American tribes brewed a form of persimmon coffee centuries before European settlers came to North America.

Along with the fruit, the wood can be just as valuable due to its strength, color, and sturdiness. At the turn of the 20th century, persimmon wood was used in manufacturing golf club heads and shuttles. Today, a market can be found for persimmon golf clubs, for enthusiasts who are more into traditional golfing. Along with golf clubs, persimmon wood was once used in the production of planes and in particular propellers and rudders.

Propagation

Seedlings can be obtained through seed source, grafting techniques, and also can be propagated through root cuttings. Cultivars of Persimmon are used in regards to characteristics that are desired in wood patterns and stability. Some cultivars have come about due to particular flavors in the fruit and also good fruit bearing traits. In regards to the deep root system, this species is not a good candidate for transplanting or hydraulic spading to new sites.

Economic Uses

As stated before, the wood and fruit are highly valuable in the right niche markets. Besides these uses, pharmaceutical companies use unripe fruit and inner bark as an ingredient for drugs that ease headaches, diarrhea, and stomach ulcers. The flowers that are produced by the tree are also useful in honey production.

Additional Resources

Henriette's Herbal Homepage:

<http://www.ibiblio.org/herbmed/eclectic/kings/diospyros.html>

North Carolina State University:

http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/trees-new/diospyros_virginiana.html

Ohio State University: http://ohioline.osu.edu/b700/b700_62.html

Purdue University: <http://www.hort.purdue.edu/newcrop/ho/HO-108.html>

[*Uncommon Fruits Worthy of Attention*](#) by Lee Reich

Plains Coreopsis (Calliopsis) (*Coreopsis tinctoria* Nutt.)

Description

Calliopsis belongs to the Asteraceae family and is an annual forb which usually germinates in late summer or fall (after the first frost happens). In spring, the height of calliopsis can reach up to 4 feet. The leaves are opposite and are deeply divided, with the top portion being narrower than the rest. The flowers of this species are numerous and are usually 1-2 inches in diameter, and generally are yellow with rays that have a base which are red-brown in color.

Habitat

Plains Calliopsis can be readily seeded and grows rather quickly. Germination generally speaking takes between 10-15 days after seeding. Best time to seed is between August and September. Calliopsis likes moist soils and therefore is ideal for hard to drain areas including roadside ditches. Plant this species in full sunlight; however, plain calliopsis can withstand partial shade once it's established.

Management Considerations

Stands will reseed prolifically for several years on their own. However, there will be a gradual decline in floral production if the area does not undergo any form of soil disturbance. Therefore, about every two or three years the site/area should be disked or mowed to help control the perennial weeds from becoming established and to help promote calliopsis germination.

Economic Uses

As for the economic importance of this species it comes in the form of aesthetical value rather than dollars and cents. Due to its abilities to grow in areas that are hard to drain and its fibrous roots it also has the ability to aid in the prevention of soil erosion. Also plain calliopsis is an important Mid-Summer nectar source for many different butterflies as well as other nectarivores. A tea made from the root was used by Native Americans to treat diarrhea.

Notes

If your goal is to have a more serene and beautiful landscape then implementing these floral's into your system will work terrifically. If you were considering such an investment proper planting as well as management of these plants is highly recommended and should be monitored to maximize your benefits.

Additional Resources

Missouri Department of Conservation, www.mdc.mo.gov

Red Clover (*Trifolium pratense* L.)

Description

Red clover (*Trifolium pratense* L) is a short-lived perennial and is the most widely grown of all the true clovers. The classification of red clover is sometimes confusing, but the red clovers grown in the United States may be grouped into two divisions -- early flowering and late flowering. This plant is native to the north Atlantic and central Europe, the Mediterranean region, Balkans, Asia Minor, Iran, India, Himalayas, Russia from Arctic south to east Siberia, Caucasus, and the Far East. It spread to England around 1650 and was carried to America by British colonists where it is currently widely distributed and cultivated.

Habitat

Red clover is native to wet and to dry meadows, open forests, forest margins, field borders, and paths. It grows best on well-drained loam soil, but also adapted to wetter soils. Most soils that produce good crops of corn, tobacco or small grains will also produce a good crop of red clover. Loams, silt loams, and even fairly heavy soils are better than light sandy or gravelly soils. Some of these soils may need lime or fertilizer, or both. Red clover is most productive on soil that is within a pH range of 6.6 to 7.6. It also needs P and K to produce good yields; the amount needed can be determined by soil tests. Red clover is reported to tolerate annual precipitation of 3.1 to 19.2 dm (mean = 8.6 dm), annual mean temperature of 4.9 to 20.3°C (mean = 10.6°C), and pH of 4.5 to 8.2 (mean = 6.3). Maximum yields are obtained at pH >6 with adequate calcium.

Management Considerations

For seed production, most growing areas require pollination with bees, using 5 to 8 strong colonies of bees per hectare. Best seed yields occur when there is an abundance of bees, and soil fertility and moisture are adequate to promote good growth, and when the weather is warm and clear during the flowering period.

Harvesting Considerations

Harvest the seed crop when the greatest numbers of seed heads are brown, usually 25–30 days after full bloom. Cut seed crop with mower. Let it cure in the swath or in small windrows. During rainy weather, the mowed crop cures better in swaths than in windrows.

Economic Uses

Red clover is extensively grown for pasturage, hay and green manure, and is considered excellent forage for livestock and poultry. Compared with alfalfa, red clover has about two-thirds as much digestible protein, slightly more total digestible nutrients, and slightly higher net energy value. Red-clover flowers are reported to possess antispasmodic, estrogenic, and expectorant properties.

Additional Resources

Basic forage information

http://www.agry.purdue.edu/ext/forages/publications/legumes/red_clover.htm

Special usage in medicine

http://www.pdrhealth.com/drug_info/nmdrugprofiles/herbaldrugs/102330.shtml

UMC Extension

<http://muextension.missouri.edu/explore/agguides/crops/g04638.htm>

General to applied information

http://www.hort.purdue.edu/newcrop/duke_energy/Trifolium_pratense.html#Description

Red Maple (*Acer rubrum*)

Description

Red maple is also known as scarlet maple, swamp maple, soft maple, Carolina red maple, Drummond red maple, and water maple. Many foresters consider the tree inferior and undesirable because it is often poorly formed and defective, especially on poor sites. On good sites, however, it may grow fast with good form and quality for saw logs. Red maple is a subclimax species that can occupy overstory space but is usually replaced by other species. It is classed as shade tolerant and as a prolific sprouter. It has great ecological amplitude from sea level to about 900 m (3,000 ft) and grows over a wide range of microhabitat sites. It ranks high as a shade tree for landscapes. The flowers are small, with slender stalks, red or rarely yellowish, with petals; they appear from March to May depending upon elevation and latitude. Trees can flower and bear seed at an early age; 4-year-old trees have produced seed. Flowering occurs on all branches in the well-lit upper portion of the crown. Characteristically, the non-flowering branches are slow growing and lack vigor. The fruit, a double samara, ripens from April to June before leaf development is complete. After ripening, seeds are dispersed for a 1- to 2-week period during April through July.

Habitat

Red maple is one of the most abundant and widespread trees in eastern North America. It grows from southern Newfoundland, Nova Scotia, and southern Quebec to southern and southwestern Ontario, extreme southeastern Manitoba, and northern Minnesota; south to Wisconsin, Illinois, Missouri, eastern Oklahoma, and eastern Texas; and east to Florida. Red maple can probably thrive on a wider range of soil types, textures, moisture, pH, and elevation than any other forest species in North America. It develops best on moderately well-drained, moist sites at low to intermediate elevations.

Management Considerations

Red maple browse is toxic to cattle and horses, particularly during the summer and late fall. Red maple is relatively tolerant of landfill-contaminated gases, but ambient air pollution can damage the foliage. Red maple is often poorly regarded as a timber species due to its susceptibility to defects and disease, and poor form of individuals of sprout-clump origin. Red maple usually grows rapidly after heavy cutting or high-grading, and crop tree release may be a low-cost management option. Mechanical thinning of clumps can produce good-quality sawlogs on good sites.

Harvesting Considerations

Large enough quantities of low-value wood products, such as pulp wood, and biomass can be gained in a short amount of time. Sawlogs from soft maple are valuable enough to allow extended rotation periods for these products. Other harvest considerations include nursery stock, which would have a short rotation

time, about 3-5 years. The markets for nursery stock should be thoroughly checked before attempting to start growing.

Propagation

It is possible to stimulate red maple seed production through fertilization. The stimulation often lasts 2 years and may yield up to 10 times more seeds than an unfertilized stand. The seed does not require pre-germination treatment and can germinate immediately after ripening. Red maple has few germination requirements. The seed can germinate with very little light, given proper temperature and some moisture. Most seeds generally germinate in the early summer soon after dispersal. Shading by a dense overstory canopy can depress first-year germination; then second-year germination is common. Red maple stumps sprout vigorously. Inhibited, dormant buds are always present at the base of red maple stems. Within 2 to 6 weeks after the stem is cut, these inhibited buds begin to extend. Regeneration by seedling sprout may be especially successful. Generally, the species' great sprouting capacity makes it suitable for coppicing and accounts for its tendency to be found in sprout clumps. Red maple is difficult to propagate from cuttings and success varies considerably.

Economic Uses

Red maple is known in the lumber industry as soft maple. The wood is close grained and resembles sugar maple but is softer in texture, not as heavy, lacks the figure, and has somewhat poorer machining qualities. Red maple in the better grades is substituted for hard maple, particularly for furniture. Red maple lumber shrinkage from green to oven-dry moisture content is slightly more than shrinkage for hard maple. Red maple is widely used as a landscape tree. Low-value timber products and ornamental applications are the major products from Red Maple.

Agroforestry Uses

Red maple can be useful for riparian forest buffers, because of the adaptation of the species to moist sites. It is also useful in alley cropping, windbreaks, and forest farming. The adaptive capabilities of the species must be taken into account when planning an agroforestry application and used to the full benefit.

Additional Resources

Crow, T.R. Red Maple. Forest Service Website.

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/acer/rubrum.htm.

Red Maple. Website for Red Maple fact sheet.

<http://www.fw.vt.edu/dendro/dentrology/syllabus/factsheet.cfm?ID=1>.

Redtop (*Agrostis alba*)

Description

Redtop is a long lived perennial grass that grows to a height of 3 feet. It produces 1/4" leaf blades of 4 to 24 inches in length. Redtop has a shallow root system and forms a loose, coarse turf. It grows both by seed and by a creeping habit that can grow as much as 3 feet in diameter. Redtop grows from Canada to the Gulf Coast and from the East to West coasts of the USA.

Habitat

It does best in moderately well-drained loamy soils; tolerant to high water table and periodic irrigation. It will grow on acidic soils, and is moderately salt tolerant. Open disturbed areas, such as roadsides, old fields, and pastures; wet meadows; riparian habitats; open woodlands.

Management Considerations

Redtop is the most widely adapted commercial grass species used. Redtop is an excellent wet-soil grass and can even remain alive for short period of time within flooded areas. It also is adaptable to dry soil conditions on both acid and alkaline soils. Used for pasture mixtures, mixed-hay production and for erosion control as a nurse crop in low input turf areas. It also is occasionally used for over-seeding as a winter lawn grass in the South East.

Harvesting Considerations

Redtop provides fair to good forage for big game in the spring and summer. The dense cover can provide cover for small mammals, waterfowl, and other birds. It is an important commercial forage species, providing good to very good forage for horses and cattle, fair to good for sheep. The species is often cultivated as hay because of its tolerance to mowing and grazing, good cold resistance, and heat tolerance. Grazing usually favors this species.

Propagation

Redtop grows from both seed and by creeping and one plant can cover as much as 3 feet in diameter.

Economic uses

Because it provides good forage for cattle and horses, farmers can look to this as an alternate to fescue. This species also provides needed cover for wildlife and will also have some palatability for deer and other big game. Redtop forms a dense sod which provides good surface erosion control, but because the roots are shallow, redtop provides limited protection to streambanks.

River birch (*Betula nigra*)

Description

River birch is a deciduous medium to large-sized native tree. The leaves are alternate, double serrated, wedge-shaped, and sharp pointed. The flowers are unisexual, borne in separate male and female catkins on the same tree. The bark is light brown to buff, paper-like; exfoliating on young trees, turning to scaly bark on older trees.

Habitat

River birches are generally seen along side stream banks, wet floodplains, and in forests. [River birch](#) requires an acid soil pH 6.7 or less. Since it can tolerate wet conditions as well as full sunlight it can grow rather quick eventually reaching heights ranging between 40 to 70 feet tall with large canopies. River birch can successfully be grown from New York to the southern U.S to the Midwestern states.

Management Considerations

River birch can survive on drier soils, although it is best adapted to moist soils that are periodically flooded. Maximum development is reached in fertile areas with a pH of 6.5 to 4.0. It is intolerant of shade and requires full sunlight. Fertilize young trees in late winter before new growth begins to ensure faster growth. Don't prune this birch and other birches until summer because they are "bleeders" and should not be cut when the sap is flowing. River birch is quite disease resistant but has severe problems in early spring with aphids and is favored by gypsy moth larvae.

The principal leaf disease of river birch is anthracnose leaf blight caused by *Gloeosporium betularum*. Minor problems may exist with leaf miner and iron chlorosis which commonly occurs when grown on calcareous soils and other high pH soils. River birch has no serious insect pests and is considered borer resistant. The tree is not very vulnerable to deer browsing

Propagation

Seed ripens and sheds in the spring and should be directly sown. A seeding density of 25 to 44 per square foot is desirable, lightly covered or without covering if seedbed is kept moist. Stratification of birch seed is usually counter-productive. Seedlings have moderate growth rate and are usually outplanted as 2 year old bareroot stock. Given effective grass and weed control, river birch is easy to establish

Economic Uses

River birch sap can be fermented to make birch beer or vinegar. The wood is used to manufacture inexpensive furniture, woodenware, wooden shoes, basket materials, toys, staves, and fuel. The leaves were chewed, or used as an infusion

in the treatment of dysentery. An infusion of the bark was used to treat stomach problems and other medical uses.

Agroforestry Uses

River birch is a very attractive ornamental tree. It is a desirable specimen for estates, golf courses, parks, and public grounds. Many species of birds eat the seeds including wild turkey and grouse. The leaves are browsed by white-tailed deer. River birch is used for strip mine reclamation and erosion control. It is used in forested riparian buffers to help reduce stream bank erosion, protect water quality, and enhance aquatic environments.

Additional Resources

Virginia cooperative extension program

<http://www.ext.vt.edu/departments/envirohort/factsheets/trees/rvrbir.html>

USDA silvics manual volume 2

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/betula/nigra.htm

United State Department of Agriculture Natural Resources Conservation Service
Plants Database http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

Sassafras (*Sassafras albidum*)

Description

Small to medium sized deciduous tree, but can grow to be 6 feet in diameter and 100 feet tall. Saplings have smooth orange-brown bark, while mature trees become deeply furrowed and reddish-brown in color. Leaves are polymorphic with three different forms of leaves: (1) Somewhat elliptical and unlobed (typical of older trees), (2) Right or left handed mitten shaped, & (3) symmetrically three lobed (Rarely 4-5 lobed). When leaves are crushed they have a distinct smell of fruit loops cereal. Small fragrant yellow-green flowers born on separate plants (dioecious) open in early spring before leaved emerge. Fruits are blue drupes on a thick reddish pedicel. In autumn the leaves turn vibrant shades of orange, red, and yellow. All parts of the tree are spicy and aromatic.

Habitat

Sassafras native range in the United States extends from southwest Maine to Iowa and southeast Kansas, southward to Texas and central Florida. Sassafras can be found on virtually all soil types like clay loams, poor gravelly soils, and pure shifting sand, but grows best in open woods on moist well-drained, sandy loam soils. It is a pioneer species on abandoned fields, along fence rows, and on dry ridges and upper slopes. Sassafras is commonly associated with tree species such as sweetgum, flowering dogwood, elms, eastern red cedar, hickories, and American beech. In fields with deeper soils it grows with elms, ashes, sugar maple, yellow poplar, and oaks. Minor noteworthy trees associated with sassafras are American and eastern hophornbeam, and pawpaw. In the Appalachian Mountains, it is associated with black locust, red maple, sourwood, and several oak species. On the northern edge of its range, it makes up part of the understory of aspen and northern pin oak.

Management Considerations

Sassafras is classified as intolerant of shade at all ages. In forest stands, it usually appears as individual trees or in small groups and in best site conditions is in the dominant overstory. In the understory it may live along the edges of heavy stands, but generally does not reach merchantable size. In mixed stands if it becomes overtopped, it is one of the first species to die. Sassafras is also very susceptible to foliage diseases and fire damage. On a plus side the growing plant repels mosquitoes and other insects, so it is a beneficial companion plant in the garden.

Harvesting Considerations

Sassafras should be harvested for the roots. The soil may be cleared away from a portion of the roots and the root-bark peeled away. The inner bark should not be damaged, so that the roots can grow new bark. Another method is to harvest the entire root, as the pith of the root, although weaker, has the same properties as the bark. With any method the tree should be given time to recover and grow new roots before harvesting again.

Propagation

Propagation is fairly simple from seed. If you can obtain it, fresh seed will give the best results and this should be sown immediately in a cold frame. It should germinate in the spring. If you can only obtain stored seed then this will need four months cold stratification at 4°C. Soaking the seed for 24 hours in warm water and then mixing it with some damp compost and placing it in the salad compartment of the fridge for 3 - 4 months should suffice. As soon as they are large enough to handle, prick out the seedlings into individual pots and grow them on in the greenhouse for at least their first winter before planting them out. Give the young trees some protection for at least their first winter outdoors.

Economic Uses

The whole plant is saturated with an aromatic essential oil and it is still commonly used as a food flavoring with considerable health benefits. The dried root bark can be boiled with sugar and water until it forms a thick paste used as a condiment. The root and the berries can also be used as flavorings. A tea is made from the root bark, and is considered to be a tonic. Teas are made from various other parts of the tree. In spring the leaves and roots are used together and in early summer the flowers are used. Sassafras oil used to be used as the basis of root beer, now synthetic flavoring is used.

Notes

Native Americans within range of *Sassafras albidum* used it extensively for many purposes. Infusions were used to kill parasitic worms, to treat syphilis, colds and measles, to reduce fever, control diarrhea, and relieve constipation. The Cherokee, Choctaw and Chippewa made tea from the bark and roots and used the dried leaves as a spice to flavor foods. Early European settlers quickly adopted sassafras tea. Research in the 1960's showed that safrole, a principle constituent of oil of sassafras, caused abortion in pregnant women and liver cancer in mice.

Additional Resources

Plants for a Future, Plant Portrait – *Sassafrass albidum*
<http://www.pfaf.org/leaflets/sassafra.php>

Floridata Marketplace, http://www.floridata.com/ref/s/sass_alb.cfm

USDA Forest Service Silvics
<http://forestry.about.com/library/silvics/blsilsasalb.htm>

Scarlet Curls Willow (*Salix matsudana* 'Scarcuzam' or 'Scarlet Curls')

Description

Reaching 25 to 30 feet height, this willow species will also measure 15 feet or more across from one side of its crown to the opposite side. Similar to a weeping willow, the golden branches will begin to droop but they also have a cork screw effect. The new twigs are a bright red and after the first frost of the season, fall or spring, the red twigs turn into a dark scarlet red that is very flashy and stands out from the rest of the tree. Scarlet curls is a fast growing species that is well suited to wet or moist areas.

Habitat

Similar to other members of the willow family, scarlet curls prefers environments that are moist and receive full sun. The ideal area for this species is in riparian areas or close to some source of water such as a backyard pond. This species is native to China and is not able to handle extreme cold temperatures or winter conditions such as ice storms or heavy, wet snow.

Management Considerations

A word of caution, never plant scarlet curls near any buried pipes or wires. The roots have a tendency to choke underlying obstacles, including other floral species. Keep a close eye on the conditions of the other plants that are close to the scarlet curls and perform regular root pruning. In an agroforestry setting, the best place to establish scarlet curls is in a riparian buffer area since the species is adaptive to wet growing conditions. Planting scarlet curls in windbreak and alleycropping management systems is also a wise management decision. In terms of soil conditions, scarlet curls can adapt to any soil texture but has problems with alkaline soils and extensive periods of drought. The branches are very susceptible to ice and extremely cold temperatures.

Harvesting Considerations

Primarily used as a decorative woody floral, the best way to harvest this product is by using a sickle saw or going in by hand and cutting each limb/twig individually. Scarlet curls are a very sensitive specimen and if a severe amount of damage occurs around the base the tree, the plant will die. When harvesting, make sure that all parties involved do not trample or compact the soil near the base of the tree because this may cause the roots to not be able to function correctly and cause stress on the tree.

Propagation

Never rely on a seed source as a form of propagation. Instead, use rooted cuttings that already have an established taproot. This species is also easily transplanted from site to site and can easily be grown to be used as a transplant tree that can be sold to landscapers and nurseries.

Economic Uses

The most popular economic use for scarlet curls is as a woody floral that can be added to any bouquet of flowers. Since the leaves are not present when the stems are harvested, to many people, the stem simply looks like a decorated piece of wire that has been added to the arrangement to add color.

Notes

This species is not native to North America so it is not resistant to some native cankers and insect interactions. If you do decide to use this in your agroforestry management plan, keep a close eye on the specimens during the first 3 years they are planted.

Additional Resources

Stadler Nursery and Garden Center.

<http://www.stadlergardencenters.com/trees/trees.php?tid=1051>

University of Nebraska-Lincoln Extension Forestry.

<http://snrs.unl.edu/forestry/woodyfloralmarketcharacteristic.asp?cultivarnumber=22#top>

Wisconsin Public Television.

http://www.wpt.org/garden/about/template.cfm?program_seg=URL1004

Scarlet Oak (*Quercus coccinea*)

Description

A member of the Beech family, scarlet oak is a deciduous tree growing 50 to 80 feet tall and 1 to 3 feet in diameter. It has deeply lobed, glossy bright green leaves with bristly tips. The 5 to 6 inch long leaves are alternate and simple and turn a brilliant scarlet color in the autumn. The fruit is an acorn that measures up to 1 inch in diameter which takes two years to mature. This species can be readily distinguished from other oak species by the presence of a distinctive set of 2-3 concentric rings at the base of the acorn. The thin bark is moderately ridged and shallowly furrowed, with a dark gray to black color. The upper canopy is spreading and opens at maturity.

Habitat

Scarlet oak has an extensive native range, stretching from southwestern Maine to southeastern Oklahoma. It can also be found in most counties in southeastern Missouri. Scarlet oak inhabits drier, upland ridge soils that are normally acidic. Because of its superior drought tolerance and hardiness it can be found on a variety of soils, especially dry ridges, bluffs, and hills.

Management Considerations

Scarlet oak is commonly planted in Europe and the United States as a shade tree. It thrives in full sun to partial sun and is shade tolerant when young. It grows well on poor, dry, sandy, or gravelly soils. It also likes moist, well-drained soils, but does not tolerate alkaline soils and does not do well in neutral soils. Chlorosis and stunted growth are consequences of being planted on soils that are neutral or alkaline.

The tap root system of the scarlet oak is quite coarse, which makes it very difficult to transplant successfully. Major risks to growing scarlet oak include its susceptibility to a number of defoliating insects and diseases, including Gypsy moth. The loss of scarlet oak acorns due to insect and disease predation, especially in poor seed years, is an ongoing problem in Missouri.

Harvesting Considerations

Scarlet oak wood is of inferior grade and commonly labeled with other red oaks as red oak lumber used for products such as pallets and flooring materials. Acorns are an important food source for numerous wildlife species, such as squirrels, chipmunks, mice, wild turkeys, white-tailed deer, blue jays, and woodpeckers. These trees are good for cavity-nesting species and are recommended for such use over hickories and white oak because of its high number of cavities.

Propagation

Scarlet oak acorns can quickly lose viability if allowed to dry out. Timely collection of sound acorns that are free from their caps is of paramount importance. Newly collected seeds should be soaked in water overnight to insure their soundness. Defective acorns will float and can be discarded. Floated seeds can be stored in plastic bags in the refrigerator and sown in the very early spring, or can be directly sown following collection. If sown outside seeds should be protected from mice, squirrels, and other rodents. The seedling tree produces a deep taproot and needs to be planted out into their permanent positions as soon as possible. If started in a nursery bed they should not be left there for more than two growing seasons.

Economic Uses

Edible uses- the seed can be cooked or dried, and ground into a powder and used as a thickening in soups and stews. The powder can also be put into the ingredients for making bread. The seeds contain bitter tannins, which can be leached out by washing the seed in running water. Washing whole seeds can take several days and an easier way would be to leach the powder instead.

Other uses-the mulch of the leaves repels slugs, grubs and many other bugs that are harmful to garden plants. The wood is used in construction and in the making of some furniture.

Serviceberry (*Amelanchier arborea*)

Description

Shadblow serviceberry belongs to the family Rosaceae. Serviceberry is a native shrub or small tree that grows to 10 meters tall, with a narrow, rounded crown. The twigs are often red-brown to purplish, becoming gray. The bark is smooth, grayish, "striped" with vertical fissures and very ornamental. Leaves of the serviceberry are deciduous, alternate, simple, oval to oblong, 5-13 cm long, glabrous above, pubescent and paler beneath. The white flowers are 3-15 in elongate clusters at the branch tips, before the leaves appear. The fruit is 6-12 mm wide, on long stalks, red-purple at maturity; seed 5-10 per fruit.

Habitat

Serviceberry is typically found in the upper regions of North America where it is found throughout areas that are considered as temperate forests and has higher elevations that are associated with them. Serviceberry grows in a variety of habitats – swampy lowlands, dry woods, sandy bluffs, rocky ridges, forest edges, and open woodlands and fields. It is a late successional to climax species in mixed-hardwood forests of the central U.S., commonly as an understory species. In the southern Appalachians, downy serviceberry grows in red spruce-Fraser fir forests at elevations of 1500-2000 meters with yellow birch, mountain ash, elderberry, and hobblebush. Flowering (March-)April-May, among the first of the early spring trees and shrubs to bloom; fruiting June-August.

Management Considerations

Maintenance for this species is rather low; however, one of the most significant problems that is associated with this species is the fact that the roots produce suckers which left unchecked can cause you more problems than benefits. Therefore, it is recommended that proper pruning and or wiring of these trees/shrubs takes place to prevent future problems. Fire top-kills downy serviceberry, but it can sprout from root crowns and stumps following fire. Gypsy moth larvae (*Lymantria dispar*) feed selectively on downy serviceberry.

Propagation

Propagation from seed is highly desirable and can be done successfully if you follow the directions that are given. Principal consideration for planting and establishing is to plant this species in full sun or, if desired, it can be planted in areas that are partially shaded. The overall height of the tree should also be kept in mind. This tree/shrubs species can reach as tall as 15 to 20 feet. Typically speaking these trees will bloom in between April-May time frame producing a white flower.

Economic Uses

Trees of downy serviceberry are generally not large enough for sawtimber but they have been used for pulpwood. The wood is extremely heavy and hard and is occasionally made into tool handles. Cree Indians prized it for making arrows.

At least 40 bird species (for example, mockingbirds, cardinals, cedar waxwings, towhees, Baltimore orioles) eat the fruit of *Amelanchier* species. Mammals that either eat the fruit or browse the twigs and leaves of downy serviceberry include squirrels, rabbits, chipmunks, mice, voles, foxes, black bears, deer, and elk. The fruits taste similar to blueberry – they are eaten fresh or cooked in pastries or puddings.

Additional Resources

United State Department of Agriculture Natural Resources Conservation Service Plants Database, http://plants.nrcs.usda.gov/cgi_bin/topics.cgi?earl=fact_sheet.cgi

Shellbark Hickory (*Carya laciniosa*)

Description

The shellbark hickory is a slow growing long-lived tree that is sometimes hard to transplant because of its long taproot. It produces sweet, edible nut that is the largest of all the hickories. However, heavy crops are usually not seen until trees are around 40 years old and best crops are between 75-200 years. Good crops are usually every other year and can produce 2-3 bu of nuts per tree in a year.

Habitat

Shellbark hickory is widely distributed but not common. It grows best on deep, fertile, moist soils and generally on neutral or slightly alkaline soils. Mean length of growing season within its range is from 150-210 days. Precipitation varies between 30-59 inches per year including 3-35 inches of snowfall. Land that is subject to shallow flooding for a few weeks early in the growing season is favorable for shellbark.

Management Considerations

Shellbark hickory grows best on deep, fertile, moist soils, most typical of alfisols; but also grows well on heavy loams or silt loams. It is essentially a bottomland species and land that is apt to flood in early spring is favorable for growing shellbark. Good bottomland farm ground that is suitable for beans and corn is perfect for shellbark. Because of its deep taproot, it can be favorable in many agroforestry practices. Alley cropping and Silvopasture can implement the planting of shellbark because its deep root system does not interfere or compete with the companion crop or forage. Additionally, nut production can be enhanced by grafting, which should then cause trees to bear nuts sooner.

Shellbark hickory grows slowly in diameter, as do all hickories. When open grown, it can have a problem with epicormic branching but can produce a clear bole with careful pruning.

Harvesting Considerations

Because of its slow growth, saw logs would not be produced for about 40 years. But at this point, a harvestable nut crop could be obtained. On good sites, saw logs may be produced earlier and nut crop production can be improved.

Propagation

Shellbark hickory is most generally propagated from seed, but it readily sprouts with cut and coppice management has been recommended for this practice of regeneration. Otherwise, many nurseries produce shellbark hickory seedlings that may be purchased and out planted in the spring. However, good weed control is essential for enhanced early growth and survival, and do not plant if you suspect that flooding is likely to yet occur on a site.

Economic Uses

Most economic opportunities center on the wood or nut production. Because its wood is hard, heavy, strong and flexible, hickories are a favored wood for making tool handles. The nuts of the shellbark are the largest of all the hickories and are sweet and edible. Wildlife and people harvest most of the nuts.

Notes

Shellbark has the fastest height growth of all the hickories. This may cause some problems with alley cropping and what can be grown as a companion crop. But this could also be an opportunity to switch to a silvopasture practice and create a microclimate favorable for some forage production.

Additional Resources

http://plants.nrcs.usda.gov/plantguide/pdf/pg_cala21.pdf

http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/carya/laciniosa.htm

Skullcap (*Scutellaria lateriflora*)

Description

Skullcap is a member of the mint family. It is an herbaceous perennial with a four angled, smooth stem with many branches, attaining a height of between 30-cm to 160-cm when mature. Skullcap has small hairless leaves that are about two to five centimeters long by one to one and a half centimeters wide, ovate, with a rounded base, an acute tip, and the leaf margin acutely serrated. The flowers are on only one side. They are pale blue, blossoming in summer, comprised of a fused upper and lower sepal. The upper sepal has a raised appendage that looks like a helmet or hood. The flower has four small nutlets.

Habitat

Skullcap can be found from July to August on shores, stream banks, springs, meadows, swampy places, and moist woods. It is very common in the eastern and central United States. It can be found from Newfoundland to British Columbia, south to Florida and Ontario.

Management and Harvest Considerations

To grow to its full potential, skullcap requires areas of constant moisture, such as moist thickets or marshlands. It prefers a fertile soil, is hardy to zone four, and grows well in full sun or partial shade. When growing in a hot, dry area, shade and moisture must be provided. Once harvesting begins, fertilize with a high nitrogen compost. Once flowering begins the plant is cut with shears or a mower. A light cutting the first year is possible, followed by two cuttings each consecutive year. When harvesting skullcap, keep the freshly cut herb in the shade until harvesting is complete or take immediately to the drying area. Do not allow the plant material to heat up. Skullcap will grow in very select areas throughout eastern and central North America. There are natural areas in these regions that are suitable for cultivating high-quality skullcap. This crop may be a viable alternative for some growers who have land less suited for other crops.

Propagation

Skullcap can be grown through direct seeding, transplanting, or dividing the roots. The preferred method is to start seeds indoors. Skullcap seed requires a cold stratification period and light to germinate. Sow seeds shallowly in flats with a prepared soil mix. The seeds should be moistened and refrigerated at about 40 to 50 degrees F. for one week or they can also be placed outside where the seeds will be exposed to nighttime cold temperatures. After the stratification period, put flats in the greenhouse for germination. Seeds should be started six to eight weeks before setting out in the field. In late spring, transplant outside in well-prepared soil. Space plants eight to twelve inches apart in rows one and one-half to three feet apart or in three-foot wide beds. The plants will spread quickly when established. It is very important that the planted area should be kept weeded.

Economic uses

Skullcap is a very important medicinal plant. Buyers can be found worldwide for this botanical. Both wild harvested and cultivated material is sold for the medicinal trade. Small producers use established brokers to bring buyers and sellers together. Some customers will deal directly with growers and harvesters, but most have specific harvest protocols. Many buyers require that the material be harvested at a certain time of the year or during a particular stage of bloom.

Notes

The Cherokee Indians used skullcap as part of a concoction given to women to promote menstruation. It was also used for diarrhea and breast pain. In the early 18th century in America, Skullcap was used in the treatment of rabies and was given the nickname “Mad Dog”, though it is unclear as to its success for treating rabies.

Additional Resources

American Nutrition website

http://www.americannutrition.com/store/now_foods/NF9165.html

Alternative Nature Online Herbal, medicinal herbs descriptions, uses and pictures,
<http://altnature.com/gallery/skullcap.htm>

Smooth Sumac (*Rhus glabra*)

Description

The smooth sumac is more frequently found as a shrub 2 to 12 feet high, with smooth, brownish-gray trunk and branches. Its leaves are very long from 1 to 3 feet, and consist of from 11 to 31 leaflets, each leaflet being about 2 to 4 inches in length and about half as wide, lance-shaped, pointed, sharply toothed and whitened beneath. From June to August the plant bears greenish yellow flowers in dense clusters at the ends of the branches. These are followed by roundish, flattened fruits or berries, covered with short, crimson hairs.

Habitat

Smooth sumac occurs in dry soil thickets and waste grounds from Nova Scotia to British Columbia and south to Florida, Mississippi, and Arizona. Smooth sumac is moderately drought tolerant. Available water determines mature plant height.

Management Considerations

Smooth sumac is often used in naturalizing urban areas and for providing fast cover for bank stabilization. It lends a tropical effect in landscape because of its reddish fall color. It is also good for windbreaks and riparian plantings and is excellent for wildlife cover.

Harvesting Considerations

Smooth Sumac can have uses other than stabilization. Its leaves and roots are used in dyeing and tanning leather. The drupes are eaten fresh or processed into a lemonade drink. Its extracts are used as a tonic, astringent, and antiseptic. The drupes are also used as refrigerant and diuretic, and root bark as a tea to stop hemorrhaging.

Propagation

When planted, smooth sumac takes root quickly and develops a suckering habit. This helps with total use of the area to this unique plant. But it does shade out anything that is to grow beneath it.

Economic Uses

Because of its unique properties as an herbal medicine, possible markets may be found in areas that are to use them as such. It also is a cheap cover plant for erosion control and bank stabilization for riparian areas.

St. John's Wort (*Hypericum perforatum*)

Description

St. John's wort is a perennial non-native herbaceous plant 1-5 ft tall. Leaves are oppositely arranged no more than 1 inch long and elliptically shaped. Tiny characteristic glands are present on the leaves. Branches are rust colored and woody at the base. Flowers are bright yellow with five petals.

Habitat

St. John's wort likes well-drained sandy or gravelly soils and open areas, like rangelands, with plenty of sun exposure.

Management Considerations

This plant has the tendency to kick native plants out of their natural range, a typical characteristic of non native species.

St. John's wort can be implemented as a specialty crop in a forest farming system, silvopasture, or in an alley cropping configuration. St. John's Wort is unappetizing to wildlife and livestock because it has a traumatic effect on their immune system. Wildlife and livestock may suffer severe blistering and itching on light colored areas, and may lose weight or even die of dehydration. St. John's wort crops have a good chance of high yields if the animals desired forage is present.

Harvesting Considerations

St. John's wort can be harvested for leaves and flowers. Flowers of St. John's wort can be harvested when in full bloom. Leaves can be harvested when needed.

Propagation

St. John's wort can be propagated by seed and cuttings. Plants can develop seed with or without pollination. Seed and capsules disperse with wind and water and adhere to machines, tires, shoes, clothing, animal feathers and fur. Seeds have thick coats, and if consumed by animals they remain undamaged and usable. Germination occurs fall through spring. Brief contact with fire can increase germination. In soil, some seed can remain viable for up to 10 years. Seeds soaked in water can remain usable for at least 5 years.

Economic Uses

St. John's wort has not been proven yet as an anti-depressive plant. Homeopathic medicine and tinctures are made from the flowers and leaves. St. John's wort is highly consumed in Europe and is coming into fashion here in the United States. Future studies of St. John's wort may progress the plant to a higher economic status.

Notes

St. John's wort is also known as common goatweed or klamath weed. The native range for St. John's Wort was in Asia, Europe, and North Africa. It was introduced to North America in 1696 for its medicinal and ornamental properties. In 1893 it was recorded on grazing land in the west and is now growing in most of the greater 48 United States. In Montana alone, St. John's wort covers less than half a million acres.

Sugar Maple (*Acer saccharum* Marshall.)

Description

Sugar maple grows 75 to 100 feet tall and 2 to 4 feet in diameter. Trees grown in crowded woods have a long, branchless trunk with narrow crowns. Trees grown in the open have trunks that branch near the ground, forming crowns that spread 60 to 80 feet. The bark on young trees is dark gray, but as the tree ages the bark develops rough vertical grooves and ridges and may appear dark brown. The leaves are opposite of each other and are 3 to 6 inches long with 5 rounded lobes. The clusters of small flowers are light yellow-green, hanging from a long, slender (1-3inches) stem appearing with the leaves in the fall. The sugar maples seldom flower until they are at least 22 years old. The fruit is horseshoe shaped and matures in the fall. The sugar maple is the largest and most abundant American maple.

Habitat

Sugar maple in North America extends from Nova Scotia and Quebec at its northern edge, west to Ontario, southeastern Manitoba, and western Minnesota, south to southern Missouri, and east to Tennessee, and northern Georgia. It grows best in areas with cool, moist climates. Sugar maple can survive in a wide variety of soil types. It grows on sands, sandy loams, loam's, and silt loam. It grows on soils ranging from strongly acidic to slightly alkaline. Sugar maple is often associated with beaked hazel, redberry elder, American elder, red raspberry, blackberries, spring beauty, and jack-in-the pulpit.

Management Considerations

Sugar maple is rated as very tolerant of shade, exceeded among hardwoods only by a few smaller species. Even-age and uneven-age silvicultural systems are available for managing stands in which sugar maple is a principal component and desired species.

A sugar maple stand managed for the production of maple sap requires a different type of stand than that desired for timber production. For the production of maple sap the following characteristics should be considered; leaves exposed to direct sunlight, large stem diameters, and wide, deepcrowns. Therefore, in a closed stand heavy thinning is recommended.

A good sawtimber stand of sugar maple has trees with tall, straight stems and no branching below the growing crown. In dense stands of sugar maple the inferior trees need to be removed with out promoting open grown characteristics in the remaining trees.

Harvesting

The sugar maple is an economical importance both in the production of maple syrup and as a timber species. Natural regeneration through seed establishment and prolific sprouting is generally successful in replenishing the amount of growing stock in a stand even after heavy cutting. The harvesting season for the syrup can last anywhere from four to six weeks. Maple trees should be approximately 12 inches in diameter before they can be tapped. The sugar content of the sap is higher in late winter than late fall, so it is recommended to be harvested in February and early March. It is harvested in late winter because of the rising temperatures that creates pressure within the trees, which causes the sap to run.

Propagation

Sugar maple is propagated from seeds. The seeds have an extremely high germination rate, with averages of 95% or more. For germination to occur the temperature must be slightly above the freezing point and not any warmer than 50 degrees. The seed develops a very strong radicle that has the strength and length to penetrate heavy leaf litter. The seeds can be harvested green and sown immediately. When large enough to handle they need to be planted into individual pots and then transplanted into their permanent positions when reaching 20cm or more tall.

Economic Uses

Sugar maple is used in the production of maple syrup and timber. The wood is one of the hardest of the maples and is highly valued for the making of furniture and flooring. Bowling alleys and bowling pins are commonly manufactured from sugar maple. The sugar maple is a favorite street and garden tree, because it is easy to propagate and transplant.

Notes

The sap is mostly water (97% on average) and contains a small amount of natural sugar. The sap is collected and boiled to evaporate much of the water, concentrate the sugar content, and to produce the characteristic maple flavor and color.

Swamp White Oak (*Quercus bicolor*)

Description

A member of the Beech family, swamp white oak is a long-lived, fast growing species that can reach up to 70 feet in height and 2 to 3 feet in diameter. Its native range extends from Quebec into eastern Kansas, and can be found growing throughout most of the northern half of Missouri. Its botanical name is based on the two toned appearance of the foliage, which is a glossy dark green above and nearly white beneath. Another distinctive feature of this species is that it bears acorns on very long (3-5 inch) stalks.

Habitat

Swamp white oak can be commonly found growing with other species such as red maple and pin oak on more acidic soils that are very poorly drained. It is known to be tolerant of flooding even when young. It will also grow well on many soil types once established including upland sites and can be found in association with bur oak on such sites. Swamp white oak can be transplanted rather easily, and is relatively fast-growing especially when young. Maximum growth rate will be achieved when it is planted in full sunlight.

Management Considerations

Swamp white oak is intermediate in tolerance and seedlings can become established under moderate shade. As the tree matures, it will develop a high quality, straight bole with a narrow crown if grown in a forested condition. In contrast, open grown trees will normally produce a short bole with a broad, spreading crown. Lower branches tend to be persistent and will require pruning to improve stem quality.

Major risks to managing swamp white oak include its susceptibility to a number of defoliating insects and diseases, including Gypsy moth, oak anthracnose, and occasionally oak wilt. The loss of swamp white oak acorns due to insect and disease predation, especially in poor seed years, is an ongoing problem in the Missouri.

Swamp white oak can also be used in landscape plantings, especially in urban areas where it is tolerant of both poor soil conditions as well as air pollution. It produces a large crop of acorns every 3-5 years, and this seed production is normally initiated at a fairly young age in comparison to other native oaks in Missouri. Therefore, this species is an excellent food base for whitetail deer, wild turkeys, woodpeckers, sapsuckers, wood ducks, squirrels and other small rodents.

Harvesting Considerations

Swamp white oak is similar to other oak species in terms of its growth and development. In general, white oaks reach economic maturity when they are about 16 to 22 inches in diameter at breast height depending on the quality of the

site. It will take 60 to 90 years to produce such trees on good sites and 90 to 120 years on poor sites.

Propagation

Swamp white oak is easily planted and transplanted. It is normally propagated by seed. Like other oaks, swamp white oak acorns can quickly lose viability if allowed to dry out. Timely collection of sound acorns that are free from their caps is of paramount importance. Newly collected seeds should be soaked in water overnight to insure their soundness. Defective acorns will float and can be discarded. Floated seeds can be stored in plastic bags in the refrigerator and sown in the very early spring, or can be directly sown following collection. If sown outside seeds should be protected from mice, squirrels, and other rodents. The seedling tree produces a fairly fibrous root system, which allows for improved transplanting success rates. If started in a nursery bed they should not be left there for more than two growing seasons.

Economic Uses

The wood of swamp white oak is of high quality and is normally labeled as white oak. It is used for furniture, cabinets, high quality veneer, and barrel staves. Poorer quality wood products would include fuel wood and fence posts.

White Oak (*Quercus alba*)

Description

Tall deciduous tree can grow 80 to 120 ft tall with a straight trunk and rounded crown. Its native range extends from southern Maine to east Texas. Some individual trees may exhibit fine fall colors of yellow, red, or purplish brown. Acorns ripen in autumn (September to October) of the first year and occur solitary or in pairs and do not require cold treatment before germination in late autumn.

Habitat

White oak occurs throughout Missouri over an array of sites from dry ridges to ravine bottoms. While it is found on many types of soils, white oak exhibits its best growth is on higher bottomlands where soils are deep and moist, with good internal drainage. It will commonly be found with hickories, other oaks, basswood, white ash, and black cherry. It is also known for forming even-aged stands after clear-cutting.

Management Considerations

In agroforestry applications, white oak can be used in alley cropping, silvopasture, windbreaks, and forest farming. With white oak's broad spreading crown, pruning or thinning of the stand will be necessary to sustain the light requirements of the ground vegetation in alley cropping, silvopasture, and forest farming applications. Growers need to be aware of its tendency to sprout from the trunk when it is opened up to light after a pruning or thinning. Sprouts are a defect in the timber quality. White oak has an intermediate shade-tolerance becoming less tolerant with age, having best growth in full sun. Blue jay, woodpeckers, wood duck, wild turkey, ruffed grouse, bobwhite quail, mice, squirrels, raccoons, and white-tailed deer eat the acorns.

Major risks to managing white oak include its susceptibility to a number of defoliating insects and diseases, including Gypsy moth, to which it is especially susceptible. Other pest problems include oak anthracnose, and rarely, oak wilt. The loss of white oak acorns due to insect and disease predation, especially in poor seed years, is an ongoing problem in the Missouri.

White oak is a relatively slow growing in comparison to other Missouri white oak species such as bur oak and swamp white oak. Good site selection will expedite the time to harvest of this long-lived tree. The terminal buds may need to be protected from livestock a year or two longer than faster growing species. Wind damage is rarely a concern, as white oak is known for strength from its deep roots to its strong limbs.

Harvesting Considerations

White oaks reach economic maturity when they are about 16 to 22 inches in diameter at breast height depending on the quality of the site. It will take 60 to 90

years to produce such trees on good sites and 90 to 120 years on poor sites. Allowing white oak to reach 19 inches or greater can create a sizable jump in price due to the ability of the mill to saw it differently or veneer the wood.

If white oak is desired to replace harvested or dead oaks in forest farms or windbreaks then large enough openings (greater than ¼ acre) must be created with adequate light to fulfill the relatively shade-intolerant white oak seedlings/sprouts. White oak, unless very old, will sprout from the stump after harvest. Replacement may be as simple as choosing which stump sprout to leave. Seeds in the forest seedbed should not be relied upon to regenerate oak, due to shading and moisture limitations that can dramatically impact seed regeneration success rates of this species.

Propagation

White oak trees are normally propagated by seed. Like other oaks, white oak acorns can quickly lose viability if allowed to dry out, especially since the acorns will readily germinate immediately after seed fall. Therefore, timely collection of sound acorns that can easily be removed from their caps is of paramount importance. Newly collected seeds should be soaked in water overnight to insure their soundness. Defective acorns will float and can be discarded. Floated seeds can be temporarily stored in plastic bags in the refrigerator prior to sowing. While root elongation rates will be somewhat retarded if the seeds are placed in the refrigerator, this root development cannot be arrested until spring. As a result, the acorns must be sown immediately and protected from mice, squirrels, and other rodents. Most seedling trees will produce a moderately fibrous root system, which allows for improved transplanting success rates. If started in a nursery bed they should be grown as a two year old seedling prior to outplanting.

Economic Uses

White oak is a very valuable timber species. Its wood is second only to black walnut in value. It is used for interior furnishings, veneer, cabinets, flooring, general construction, pallets, fence posts, railroad ties, fuel, and tight cooperage. Numerous overseas markets have a high demand for white oak. Some of the most important white oak exports from the Midwestern U.S. are used for high quality veneer and staves for wine barrel manufacturing.

Wild Plum/American Plum (*Prunus americana*)

Description

Grown as a shrub, wild plum has alternate leaves that are 2 – 4” in length. The full height can vary from 3 feet in the form of a shrub to over 20 feet when the plant is pruned as a tree. The twigs can appear spine like when the leaves have been dropped and the new buds for the coming season are present. In the early spring, before the leaves appear, fascicles of white flowers in groups of 2-5 are found at the end of spine like branches.

In the fall, red drupes form at the end of the spines. the size of the drupes can range from .5 cm to 2 cm in length and have a circumference of .5 to 1 cm. The drupe, or plum, has a thin edible layer on the outside and the inside is made up of a yellow, edible fleshy core that surrounds a cluster of hard, round seeds.

Habitat

Wildly distributed across America, the natural range of wild plum stretches from Maine all the way out to Arizona and has a wide range of habitats from dry sites to marsh areas. Even though this species can live in a range of habitats, it seems to do the best in areas that receive adequate amounts of rain during the early to late spring and possess soils that are well drained. With these well drained soils, wild plum can thrive in all three soil types (clay, silt, and sand).

In respect to what aspect the species should be planted on, the wild plum can thrive on all four aspects and can thrive on any part of a slope ranging from the shoulder all the way to the foot of a hill. Temperature wise, the wild plum can handle severe summer droughts and mid-winter blizzards. Even though the species can take a beating from Mother Nature, it will not handle repeated years of such abuse.

Management Considerations

Wild plums are the “mustangs” of the Prunus family. they are able to care for themselves and do not require constant attention from the landowners. With this said, wild plum would make a great addition to areas that are isolated from the rest of the homestead or are remote and hard to access via roads or trails. This species is also ideal for landowners who do not have enough time to devote to watering, weeding, or pruning the trees on their land.

In agroforestry settings, wild plum can be used in windbreaks, alleycropping, and riparian buffers. In a silvopasture setting, wild plum may be used, but be warned that the seeds can be toxic to livestock when consumed in large numbers. Also in consideration with silvopasture, the wild plum use to be used as a hedge between property boundaries due to the thick spines that are found on the branches.

For hunters, wild plums can act as shelterwood for many species of game during all four seasons. Along with providing shelter, the fleshy fruit and seeds can act as a food plot that would attract game to an area, especially during hunting seasons.

Harvesting Consideration

Due to the lack of height obtained at full growth, wild plum is not a timber tree. With this said, the small amount of wood that is produced from a grown tree can be sold in the niche market of wood carvers and other individuals who enjoy carving trinkets out of wood. However, with the beautiful flowers that are produced in early spring, these limbs may be harvested and sold to a local florist and be used in arrangements of flowers. The only drawback would be the spines and the danger of someone hurting themselves while harvesting the limbs or moving the floral arrangement around.

Propagation

A very aggressive sucker sprouter, wild plum is also a good species that propagates rather easily through grafting. Along with grafting, transplanting seedlings and saplings is very common and will cause no harm to the root system after the transplant has been complete.

Economic Uses

Wild plums are best known for being edible and besides eating the plum right off the tree, many people enjoy jams, pies, and turnovers with fresh picked plums. Along with these traditional ideas, wines, dried plums, and potpourri can be crafted from the fruits. Native Americans would boil the bark to produce a mild tea that was used to ward off colds, help fight diarrhea, and ease kidney or bladder ailments.

For medical purposes, medical research has been conducted using wild plum twigs as an ingredient to help people with asthma and other breathing problems. Many scientists believe the chemical cyanide or prussic acid that is found in the tree has the potential to help fight against lung diseases, influenza, and digestive problems that occur within humans and possible animals as well.

Additional Resources

North Carolina State University.

http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/trees-new/prunus_americana.html

Oklahoma University. <http://www.biosurvey.ou.edu/shrub/prun-ame.htm>

Plants For a Future. http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Prunus+americana

United States Forest Service.

<http://www.fs.fed.us/database/feis/plants/tree/pruame/>

Witch-Hazel (*Hamamelis virginiana*)

Description

Witch-hazel is an intermediate growing, coarse-textured, broadly rounded shrub with a short trunk and numerous crooked branches. It can grow into a 5 to 15 feet tree with a trunk diameter of up to 10 inches and a large, open crown. The smooth thin bark is light brown, developing rough patches and becoming scaly as the tree ages. The slender brown zigzag twigs arise from forked flexible branches. The alternate leaves emerge from scaleless, stalked hairy buds. The leaves are oval to nearly circular in shape, and irregularly round-toothed along their wavy edges. The leaves are 2-6 inches long, nearly as broad, and have 5-7 prominent veins. The upper surfaces are usually smooth, but both sides of the leaf may be hairy and the veins typically are. The leaves are a medium green above and paler below during the growing season, then turn a clear yellow in the fall. The fruits are hairy brown, half-inch oval capsules. After ripening the following summer, they split open explosively and shoot small shiny black seeds up to 30 ft in all directions. There are two botanical varieties of witch-hazel: the widespread *H. virginiana* variety *virginiana*, and the "prairie peninsula" form, *H. virginiana* variety *parvifolia*. There is also a horticultural cultivar called 'Rubescens' which has reddish flowers.

Habitat

(USDA Zones 3 – 9).

Witch-hazel is currently found in the Eastern half of the United States and Canada (and is a Missouri native). It occurs in a wide variety of wet to dry woodlands, growing on bluffs, steep ravine slopes, floodplains, and along boggy or rocky streams. It is commonly found along forest edges, often between the dry uplands and the wet slope forests. It sometimes forms a near continuous under story beneath the canopy on rich old growth sites. Vernal witch-hazel (*Hamamelis vernalis*), which is found in the wild only along rocky streams in the Ozarks, blooms in late winter to early spring.

Management Considerations

Although the most beautiful specimens are found on deep rich soil, witch-hazel is generally content with an ordinary sandy loam with moderate fertility. This species prefers a neutral to slightly acid soil pH, but will tolerate somewhat calcareous soil if it is kept moist. This is a mid- to late-successional species with a moderate growth rate. It is low in fire resistance due to its thin bark, shallow roots, and low branching habit. Witch-hazel prefers sun, but tolerates shade. Plants grown in heavy shade will have a more open form and less intense fall color. This shrub is shallow rooted and does not tolerate drought well, and thus can be hard to establish.

Witch-hazel can be used in a variety of agroforestry applications including alley cropping, forest farming, windbreaks (and to increase diversity of the forest).

Propagation

In the wild, reproduction is primarily from seed. The mature capsules burst open explosively discharging the seeds up to 30-40 feet from the parent plant. Some seeds are dispersed by birds. Witch-hazel seeds should be harvested as soon as the fruits mature in late summer to early fall and sown promptly. Fresh seeds may take up to 18 months to germinate. Seeds allowed to dry on the plant or stored after maturity will require two months of warm stratification, then one month of cold, followed by another two weeks warm and another four months cold - then a long wait for germination. Scarification may improve germination speed and percentage. When the seedlings finally appear, pick them out of the ground and place them into pots in a greenhouse for over wintering. They can be planted out late the following spring and will reach flowering size in about six years. Witch-hazel suckers freely and also can be propagated by layering in early spring or fall. Layering works well, but the process will take a year. Softwood cuttings can be rooted under mist in the summer. Volunteer seedlings can also be potted up and transplanted. It is also possible to purchase seedlings from nurseries.

Economic Uses

Beyond use as a shrub for wildlife, witch hazel has long been recognized as a healing herb. Its primary uses were for skin disorders, having astringent and anti-inflammatory properties. Both leaves and bark have been used. Use of herbal products may also cause adverse reactions in different people. So, find a good book explaining benefits and cautions that should be exercised prior to use of witch hazel. It can however, be stored as an alcohol extract for sale.

Additional Resources

http://www.floridata.com/ref/h/hama_vir.cfm

<http://www.herbalgram.org/bodywise/herbclip/pdfs/101283-150.pdf>