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 occur 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 *Tilia americana*	1 - 8	RB, FF	HV, LV, E	B-U	M	F	75-130'	● - ◗	Missouri native Sprouting habit
American holly *Ilex opaca*	1, 3 - 7	WB	NT, W	B	W-M, X	S	40-50'	◗	High tolerance to flooding Missouri native
American sycamore *Platanus occidentalis*	1 - 8	RB	LV, W	B	M-W	F	100'+	○ - ◗	Coppice regeneration Missouri native Disease prone
Austrian pine *Pinus nigra*	1 - 6, 8	WB	O, NT	B	M, X	F-I	70-120'	○	Diseases: foliar fungus/blight
Baldcypress *Taxodium distichum*	1 - 8	WB	O, W	B-U	W-M	S-I	100'+	○ - ◗	Missouri native
Black cherry *Prunus serotina*	2, 3, 5, 7, 8	RB	LV, HV		D-M	I	80-100'	○ - ◗	Missouri native
Black locust *Robinia pseudoacacia*	1 - 8	RB, AC, SP, WB	LV	U	M-D	F	40-60'	○	On MDC noxious plant list Missouri native Nitrogen fixing
Black oak *Quercus velutina*	1 - 8	AC, WB	LV, W	U	D-M	I	50-60'	◗	Missouri native
Black walnut *Juglans nigra*	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 *Salix nigra*	1 - 8	RB	LV, E, W	B	M-W	V	30-60'	○	Missouri native
Blackgum *Nyssa sylvatica*	7, 8	RB	LV	B-U	W-D, X	I	50-100'	● - ◗	Missouri native
Blue spruce *Picea pungens*	1 - 6, 8	WB	O, W	U	M-W, D	I	70-100'	◗ - ○	Disease & insect problems
Bur oak *Quercus macrocarpa*	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 *Quercus pagoda*	6 - 8	AC, RB	HV, W, O	B	M, X	I-F	100'+	◗ - ○	Excellent market Missouri native
Chinkapin oak *Quercus muehlenbergii*	1 - 5, 7, 8	WB	LV, HV, W	U	D-M	S	60-80'	◗	Lumped with white oak for sale Missouri native
Common hackberry *Celtis occidentalis*	1 - 8	RB, WB	LV, NT	B-U	W-D	S-F	100'	◗ - ○	Can be hard to sell Missouri native
Eastern cottonwood *Populus deltoides*	1 - 8	RB, AC, SP, WB	W, LV	B	M-D	V	80-100'	○	Missouri native
Eastern redbud *Cercis canadensis*	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 *Juniperus virginiana*	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 *Pinus strobus*	1 - 8	WB, AC	O, NT	U	D-W, X	I-F	<80'	◗	Disease and insect problems Preferred deer browse
Flowering dogwood *Cornus florida*	2 - 8	O	W, O	U	M, X	I-F	10-30'	◗ - ●	Problem with Armillaria root rot Invader or pest species Missouri native
Green ash *Fraxinus pennsylvanica*	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) *Gleditsia triacanthos var. inermis*	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) *Ostrya virginiana*	1, 3, 8	O	W, LV	U	M-D	S	<30'	● - ◗	Very hard wood Missouri native
Kentucky coffeetree *Gymnocladus dioicus*	1 - 8	RB, AC, SP, WB	LV, HV, O	B	M	I-F	100'	○ - ◗	Ring shake can be a problem Missouri native
Loblolly pine *Pinus taeda*	3 - 8	SP, AC	NT, LV, O	B-U	W-D	F-V	60-110'	○	Does not produce seed this far north Susceptible to ice damage
Northern red oak *Quercus rubra*	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 *Thuja occidentalis*	1, 4, 5, 7	WB	O	U	D-W	S-I	40-50'	◗	Wood is resistant to decay
Norway spruce *Picea abies*	1 - 8	WB	O	B-U	M	I-F	60-90'	○ - ◗	Good WB substitute for other conifers Disease & insect problems
Nuttall oak *Quercus texana*	8	RB	LV, HV, W	B	W-M	F	100'	◗ - ○	Self prunes better than pin oak High flood tolerance
Osage-orange *Maclura pomifera*	1 - 3	WB	LV, HV, W	B-U	W-D	I-F	10-40'	○ - ◗	Sometimes a pest tree
Overcup oak *Quercus lyrata*	8	RB	LV, W	B	W	S	100'	○	High flood tolerance Missouri native
Pawpaw *Asimina triloba*	3	FF	W, F	B	M	F-I	15-30'	◗ - ●	Site specific Missouri native
Pecan *Carya illinoensis*	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 *Diospyros virginiana*	1 - 8	AC, SP, WB, FF	W, F, LV, HV	U-B	D-M, X	S	30-50'	● - ○	Missouri native
Pin oak *Quercus palustris*	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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Red (slippery) elm *Ulmus rubra*	3, 4	RB	LV, NT	B	M-D	I	40-70'	○	Missouri native
Red maple *Acer rubrum*	1 - 8	RB, AC, WB, FF	LV, O	B-U	W-D	F	50-70'	◗	Missouri native
Red mulberry *Morus rubrum*	3, 5	RB	F	B	M, X	I	40-50'	○ - ◗	Missouri native
Red pine *Pinus resinosa*	1 - 5, 8	WB	W, NT, O	U	M-D, X	S	<50'	◗ - ○	Short-lived
River birch *Betula nigra*	1, 3, 8	RB	LV, O, E	B	M	I	50'	○ - ◗	Missouri native
Sassafras *Sassafras albidum*	2 - 4, 8	D	W, NT	U	D-M, X	I	30-50'	○	Missouri native
Scarlet oak *Quercus coccinea*	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 *Pinus sylvestris*	7	WB, AC	O	B-U	M-D	S-I	35-60'	○ - ◗	Many disease and insect problems Short-lived
Shagbark hickory *Carya ovata*	1 - 8	RB, WB	W, LV, F	U-B	D-M	S	70-80'	◗ - ●	Missouri native
Shellbark hickory *Carya laciniosa*	1, 3, 8	RB	W, LV, F	B	W-M	S	80-100'	● - ◗	Missouri native
Shingle oak *Quercus imbricaria*	1 - 8	WB	LV, HV, W	U-B	M-D	S	50-60'	○ - ◗	Susceptible to oak wilt & insects Missouri native
Shortleaf pine *Pinus echinata*	2 - 8	WB, SP, AC	HV, LV, W, NT	U	D-M, X	F-I	70-100'	○	Missouri native
Shumard oak *Quercus shumardii*	3, 7	AC, SP	LV, HV	B-U	M, X	I	100'	○	Susceptible to oak wilt & insects Missouri native
Silver maple *Acer saccharinum*	1 - 8	RB, WB	LV, O	B	W-M, D	F-V	60-80'	◗ - ○	Prone to ice and wind damage Missouri native
Sugar maple *Acer saccharum*	1, 3	FF	NT, LV	U	M, X	F	60-80'	● - ○	Syrup ration - 50:1 Missouri native
Swamp chestnut oak *Quercus michauxii*	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 *Quercus bicolor*	1 - 5, 8	AC, RB	LV, HV, W, NT	B	W-M	S	60-70'	○ - ◗	Common in CRP Missouri native
Sweetgum *Liquidamber styraciflua*	1 - 8	RB, WB	LV, HV, O, NT	B-U	M, X	I	80-120'	○	Recommended for southern areas Missouri native
Tulip-poplar *Liriodendron tulipifera*	2 - 8	AC, WB	LV, HV, O	B	W-M	F	100'	○	Site-sensitive Suffers some wind damage Missouri native
Virginia pine *Pinus virginiana*	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

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Washington hawthorn *Crataegus phaenopyrum*	1 - 8	D	W, O	U	M-D	I-S	15-25'	○	Susceptible to rust diseases Thorns
Water oak *Quercus nigra*	1, 4, 7	RB, WB	LV	B-U	M-W	I	60-70'	○ - ◗	Poorer quality than other red oaks Missouri native
White ash *Fraxinus americana*	1, 3, 4 7	AC, RB, WB	LV	U-B	M, X	I	70-100'	◗ - ○	Disease problems Missouri native
White oak *Quercus alba*	1 - 8	AC, SP, WB, FF	HV, W, LV	B-U	D-M	S	50-100'	◗ - ○	Can be hard to regenerate/establish Missouri native
White spruce *Picea glauca*	1 - 5, 8	WB	O, W	B	M-W	S	50-80'	○ - ◗	Not drought tolerant
Willow oak *Quercus phellos*	3, 7, 8	AC, SP, RB	O, LV, HV	B-U	M	S	50'	○ - ◗	Missouri native
Common Name *Scientific Name*	Region	Agroforestry Application	Markets	Site	Soil Moisture	Growth Rate	Height	Light Preference	Notes
Shrubs									
American cranberrybush *Viburnum trilobum*	6, 8	D	W	B-U	M-W, X	F-I	8-12'	○ - ◗	Minimum root depth 1-4''
American plum *Prunus americana*	1 - 8	RB, WB, FF	W, F	B	M	S-I	<15'	○	Thicket forming Missouri native
Arrowwood *Viburnum dentatum*	1 - 4, 6, 8	D	W	B-U	M-D, X	I-F	<5'	○ - ◗	Adaptable to varying site conditions
Blackberry, raspberry *Rubus spp*	1 - 3, 5	AC, RB, WB	W, F	B-U	D-M, X	F	6-10'	○ - ◗	Thicket former Missouri native
Blackhaw *Viburnum prunifolium*	1 - 8	D	W	B-U	M-D	I	12'	○ - ●	Missouri native
Buckthorn *Rhamnus cathartica*	5	RB, WB, D	W	B-U	W-D	F	10-20'	◗ - ○	Alternate host for Oak Rust Can be invasive
Buttonbush *Cephalanthus occidentalis*	1 - 8	RB	W, E	B	W-D	F	6-10'	○	Wetland invasive problem Missouri native
Common chokecherry *Prunus virginiana*	1 - 8	RB, D	W, F, E	B	M	F	3-20'	○	Foliage toxic to livestock Natural wetland species Missouri native
Common elderberry *Sambucus canadensis*	2, 5	RB, D	W, F	B-U	M-D	F	<10'	○ - ◗	Edible Good wildlife food source
Coralberry (Buckbrush) *Symphoricarpos orbiculatus*	1, 2, 5, 8	D	W	U	M-D	I	4-10'	○ - ◗	Holds berries late in the season Missouri native
Cornelian cherry dogwood *Cornus mas*	1, 4, 8	D	W, O	U	M, X	I	10-20'	○ - ◗	Few disease or insect problems
Deciduous holly *Ilex decidua*	1 - 8	D	W, O	B-U	M-W	S-I	<20'	● - ◗	Adaptable to varying site conditions
Fragrant sumac *Rhus aromatica*	1 - 8	D	W	U	D	F-I	<10'	◗ - ●	Missouri native

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Gray dogwood *Cornus racemosa*	1 - 8	D	W, O	B-U	W-M,X	I-F	10-15'	●	Thicket forming Can be invasive
Gooseberry *Ribes spp.*	1 - 3, 8	AC, RB, D	W, F	B-U	M	F	3'	○ - ◗	Thicket forming Missouri native
Hazelnut *Corylus americana*	1 - 3B	AC, FF, RB	W, F, O	B-U	M	F	7-15'	○ - ◗	Difficult to establish from seed Missouri native
Nannyberry viburnum *Viburnum lentago*	1 - 6, 8	D	W	B-U	M	F	10-15'	◗	Thicket forming
Ninebark *Physocarpus opulifolius*	1 - 8	RB	W, E	B-U	W-D	F	10'	○ - ●	Missouri native
Pussy willow *Salix discolor*	1, 3 - 7	RB, D	W, NT, E	B-U	W-D	I	<15'	○	May be propagated by cuttings
Redosier dogwood *Cornus stolonifera*	1, 3 - 6, 8	RB, WB	W, O, NT	B	M	I	6-10'	◗ - ○	Thicket forming
Rusty blackhaw *Viburnum rufidulum*	3, 7	D	W	B-U	M-D	S	<30'	◗ - ●	Missouri native
Serviceberry *Amelanchier spp.*	3, 7, 8	FF	W, O	U	M-D	I-F	<30'	◗	Missouri native
Shrub lespedeza *Lespedeza bicolor*	3	RB, SP, WB	W, E		M-D	F	4-8'	○ - ◗	Good cover and food for game birds and small mammals
Silky dogwood *Cornus amomum*	1 - 4, 6	WB, RB	W, NT, O, E	B-U	M	F-I	6-10'	●	Thicket forming Missouri native
Wahoo *Euonymus atropurpureus*	1 - 8	D	W	B-U	M	I	<25'	○ - ◗	Susceptible to foliar diseases Missouri native
Winged sumac *Rhus copallina*	5, 7, 8	D	W, O	U	D-M	F	5-10'	○	Missouri native
Witch-hazel *Hamamelis virginiana*	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/
- Plant Resource Guide: Materials and Management – http://www.centerforagroforestry.org/pubs/training/appendix6.pdf
- 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