NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

ALLEY CROPPING

(Acre)

CODE 311

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DEFINITION

Trees or shrubs planted in a set or series of single or multiple rows with agronomic, horticultural crops or forages cultivated in the alleys between the rows of woody plants.

PURPOSE

- Produce tree and/or shrub products (wood, nuts, berries, fodder, mulch, etc.) along with crops or forages.
- Improve crop or forage quality and quantity by enhancing microclimatic conditions.
- Reduce surface water runoff and erosion.
- Improve utilization and recycling of soil nutrients.
- Reduce subsurface water quantity or alter water table depths.
- Provide or enhance wildlife habitat.
- Create habitat for biological pest management.
- Improve crop diversity, quantity, quality and economic returns.
- Decrease movement offsite of nutrients or chemicals.
- Enhance the aesthetics of the area.
- Increase carbon storage in plant biomass and soils.
- Improve air quality.

CONDITIONS WHERE PRACTICE APPLIES

On all lands where trees, shrubs, crops and/or forages can be grown in combination.

CRITERIA

General Criteria Applicable to All Purposes

Comply with applicable federal, state and local laws and regulations, during the installation, operation (including product harvesting), and maintenance of this practice.

The trees or shrubs will be protected from fire and livestock damage.

The location, layout, species and density of the trees and shrubs will accomplish the purpose and intended function for both the agronomic, horticultural, or forage crop as well as the trees or shrubs.

Plant species selection will be based on the following:

- Combinations of alley crops and woody plants shall be compatible and complementary, and provide the products and crops that meet landowner objectives and financial goals.
- Alley crops shall be adapted to the climatic region and the soil resource, marketable and suited to the landowner's equipment and management capabilities.
- Alley crop sequence and woody species selection shall be determined using an acceptable nutrient balance procedure. Select crops, forages and woody species to maximize the utilization and recycling of soil nutrients, livestock manure's and plant residues and to maintain soil organic matter content.
- Alley crops and woody plants shall be selected for compatible rooting depths and water requirements not to exceed available soil water.

- Select pest resistant plant varieties.
- Avoid selecting tree or shrub species that provide habitat to animal, bird, and insect species or diseases considered being pests of the accompanying crop or forage.
- For optimal carbon storage, select plant species that are adapted to the site to assure strong health and vigor. Plant/manage the appropriate density for the site that will maximize above and below ground biomass production.

System design. The distance between the sets of trees or shrubs will be adequate for the inter-crops in the alleys and be determined by the following management objectives:

- Light requirements and growth period of the crops or forages in the alleys.
- Erosion control needs.
- Machinery widths and turning areas.

Soil erosion will be controlled by vegetative or other means until the alley cropping design is fully functional.

Follow acceptable planting dates and use care in handling and planting the seed or seedlings.

Avoid planting trees or shrubs where they will interfere with structures and above or below ground utilities.

Only viable and high quality planting stock or seed of adapted woody species will be used for establishing the tree or shrub rows.

Site preparation shall be sufficient for establishment and growth of selected species and appropriate for the site.

Additional Criteria to Reduce Excess Surface Water Runoff and Erosion

A herbaceous strip (follow CONTOUR BUFFER STRIPS - 332) will be developed immediately upslope and parallel to each woody planting row set.

Use multi-row woody planting sets.

Tree or shrub rows will be oriented on or near the contour to control water erosion or perpendicular to the prevailing wind erosion direction to control wind erosion or wind damage.

Selected species of trees and shrubs will be relatively deep rooted to encourage infiltration.

Additional Criteria to Reduce Excess Subsurface Water or Control Water Table Depths

Choose woody species that are deep rooting and have rapid growth rates such as hybrid poplar, cottonwood, black willow, green ash, and silver maple.

Use multi-row woody planting sets.

Additional Criteria to Provide Food and Cover for Wildlife Habitat

Maximize plant diversity. Use multi-row woody planting sets with plants of different sizes, growth forms, and densities.

Maximize wildlife food availability. Leave edge rows between the woody planting and inter-crop for wildlife food. Use plants with food-bearing capabilities.

Additional Criteria to Improve Air Quality

Use plant species in the alley that provide full ground coverage during establishment and harvest operations.

Residue from the alley-crop shall be left on the surface. Select and maintain tree/shrub species with foliar and structural characteristics that optimize interception, adsorption and absorption of air-borne particulates.

Tree or shrub rows will be oriented as close to perpendicular as possible to prevailing wind direction during the critical air period.

CONSIDERATIONS

Select alley crops and tree/shrub varieties that are tolerant to herbicides that will be used in the management of the crops, forages, trees or shrubs.

Spacing between the rows of trees or shrubs may be adjusted, within the limits listed above, to accommodate equipment widths, turn-rounds and maintenance needs of the woody planting.

Species diversity including use of native species should be considered to avoid loss of function due to species-specific pests.

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High value trees or shrubs and alley crops should be selected to maximize economic returns.

Establish plant species that enhance the biomass collection opportunities.

Increasing the number of rows in the tree/shrub set will increase the potential for carbon sequestration.

Consider the interaction between tree, crop, and forage including maintenance, size of farming area, and impacts on wildlife.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

The trees, shrubs, and crops will be inspected periodically and protected from adverse impacts including insects, diseases, damaging wildlife activity, livestock activity, fire or competing vegetation.

All other specified maintenance measures and techniques of tree/shrub establishment will be continued until plant survival and establishment are assured. (90 % of all trees and shrubs planted with no two adjacent within row plants missing.) This includes replacement of damaged, dead and dying trees or shrubs and control of undesirable competing vegetation.

Any removals of tree or shrub products and use of fertilizers, pesticides, and other chemicals shall be conducted in a manner that maintains the intended purpose.

The type, use and timing of maintenance equipment will be appropriate to accomplish operation and maintenance tasks while not damaging or degrading the site, existing crop species, and soil conditions.

After the fifth year following establishment, woody lateral roots may need to be pruned. See TREE/SHRUB PRUNING (660).

Pesticide use will be compatible with the trees, crops grown and local wildlife concerns.

PRACTICE SPECIFICATIONS

Site Preparation

Use FOREST SITE PREPARATION (490), General Specifications for guidance.

Planting Methods

Use TREE/SHRUB ESTABLISHMENT (612). Control competing vegetation for a minimum of 3-4 feet on either side of the woody row.

Woody Species Selection

Base plant selection on soil types, site characteristics, site limitations, landowner objectives, projected canopy characteristics, and sunlight and moisture requirements for the inter-crop. Tables 1a, 1b, and 1c list selected woody species that may have potential as an alley cropping system choice. Other species may be used providing they meet the selection criteria list above.

See WILDLIFE UPLAND HABITAT MANAGEMENT (645) for additional woody species recommendations.

Spacing/Layout

See TREE/SHRUB ESTABLISHMENT (612) for within row spacing guidance. When multiple row woody planting sets are used, stagger row plantings.

Use Table 2 as a guide for woody planting rates when row sets and alley widths of 15 to 40 feet are used.

Use the CONTOUR BUFFER STRIPS (332) standard as a guide for determining the spacing distance between woody plant rows when erosion control is a concern.

When erosion control is not a concern, spacing distance between woody plant rows should be based on landowner management objectives, tree and shrub environmental requirements, light requirements and growth periods of the crops in the alleys, and machinery width needs.

REFERENCES

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North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy. 2000.

Alley Cropping: An Agroforestry Practice. Agroforestry Note 12. 1999.

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Table 1a. Examples of potential hardwood tree species for use in alley cropping

Common Name	***Upland***	***Bottom Land***	***Wood Products***	***Biomass/ fuelwood***	***Food Products[1]***	***Wildlife Food***	***Leaf[2] Initiation***	***Leaf Drop[3]***	***Canopy Shade***	***Comments***
Basswood	X		X				early	mid	full	*Wood used for carving*
Black locust	X			X			mid	mid	light	*Excellent fuelwood*
Black walnut	X	X	X		X	X	late	early	light	*Deep well-drained sites*
Bur oak	X	X	X			X	late	late	full	*Drought and flood tolerant*
Chestnut	X		X		X	X	mid	mid	medium	*Use disease resistant varieties*
Ginko	X				X		late	mid	light	*Herbal/medicinal uses*
Green ash	X	X	X				mid	mid	medium	*Adapted to a wide range of sites*
Honey locust	X	X		X		X	mid	early	light	*Use thornless variety*
Hybrid poplar	X	X	X	X			mid	early	light	*Rapid growth; deep rooting*
N. red oak	X		X			X	late	late	full	*Widely used for wood products*
Paulownia	X	X	X	X			early	early	medium	*Wood prized in the orient*
Pecan		X	X		X	X	mid	mid	medium	*Use native stock for grafting*
Sugar maple	X		X		X		early	mid	full	*Maple syrup and quality wood*
Sycamore		X	X	X			late	mid	medium	*Tolerates wet sites*
White oak	X		X			X	late	late	full	*Fine hardwood; deep rooting*
Yellow poplar	X	X	X				mid	mid	medium	*Fast growing*

1 Includes fruits, nuts, jellies, jams, wine, syrup, honey, herbals, etc.

2 Start of leaf growth. **Early**: by mid-April; **Mid**: mid-April to May 1; **Late**: after May 1.

3 Begin of leaf drop. **Early**: before mid-October; **Mid**: mid-October to Nov 1; **Late**: after November 1.

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Table 1b. Examples of potential shrub/small tree species for use in alley cropping

Common Name	***Upland***	***Bottom Land***	***Human Products***	***Wildlife Food***	***Showy Flowers***	***Plant size (feet)***	***Comments***
American plum	X	X	X	X	X	15 to 20’	*Jellies, preserves, and wine*
Apple/pear/cherry	X		X		X	Variable	*Use commercial varieties*
Blackberry/ Raspberry	X		X	X		6 to 8’	*Use commercial varieties*
Blueberry	X		X	X	X	6 to 8'	*Use commercial varieties*
Crabapple	X	X		X	X	20 to 25’	*Jellies, preserves*
Hazelnut	X		X	X		3 to 10’	*Sweet nuts*
Pawpaw	X	X	X	X		Up to 30’	*Large, edible, nutritional fruit*
Serviceberry	X			X	X	20 to 30’	*Excellent for wildlife*
St. John’s Wort	X		X		X	Up to 6’	*Herbal remedies; nectar source*
Witch hazel		X	X			Up to 30’	*Numerous medicinal uses*

Table 1c. Examples of potential conifer species for use in alley cropping

Common Name	***Wood Products***	***Christmas Trees***	***Wildlife Food & Habitat***	***Nursery Material***	***Windbreak Value***	***Comments***
Concolor fir		X		X	X	*Beautiful foliage color*
E. redcedar	X	X	X		X	*Adaptable to a wide range of sites* *Alternate host for cedar-apple rust*
Loblolly pine	X					*Tolerates wet sites*

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Shortleaf pine	X		X			*Only native pine. Tolerates dry sites*
White pine	X	X		X	X	*Needs well-drained sites.*

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Table 2. Alley Cropping Planting Rates Based on Row Set Type and Alley Widths *

	Single Row Set				Double Row Set				Triple Row Set			
		In Row Spacing				In Row Spacing				In Row Spacing		
Alley Width	Row Spacing	6 ft	8 ft	10 ft	Row Spacing	6 ft	8 ft	10 ft	Row Spacing	6 ft	8 ft	10 ft
15 feet	*Row spacing and alley width are the same for single row sets.*	484	363	290	6 feet	691	518	414	6 feet	807	607	484
					8 feet	631	473	378	8 feet	703	528	422
					10 feet	580	435	348	10 feet	622	468	374
					12 feet	537	403	322	12 feet	558	418	335
20 feet		363	272	218	6 feet	558	418	335	6 feet	680	512	409
					8 feet	518	388	311	8 feet	605	455	363
					10 feet	484	363	290	10 feet	545	409	327
					12 feet	454	340	272	12 feet	495	372	297
30 feet		242	182	145	6 feet	403	303	242	6 feet	512	390	311
					8 feet	382	28	229	8 feet	473	356	284
					10 feet	363	272	218	10 feet	435	328	262
					12 feet	345	259	207	12 feet	403	303	242
40 feet		182	136	109	6 feet	315	237	189	6 feet	419	315	252
					8 feet	303	227	182	8 feet	389	292	234
					10 feet	290	218	174	10 feet	363	273	218
					12 feet	279	209	167	12 feet	340	256	204

* Field shape and planting design may cause some variation in plants/acre.

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