United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

TREE/SHRUB ESTABLISHMENT

CODE 612

(ac)

DEFINITION

To establish woody plants in non-forested areas by planting seedlings, container/potted plants, cuttings or by direct seeding.

For existing forested areas, see Prescribed Forestry (409).

PURPOSE

This practice may be applied as part of a conservation system to support one or more of the following purposes:

- Establish woody plants for forest products
- Provide erosion control
- Produce woody biomass for energy
- Improve energy conservation and beautification
- Improve water quality through uptake of soil and water borne chemicals and nutrients
- Beautify an area (Aesthetics)
- Protect a watershed
- Improve air quality
- Provide wildlife habitat
- Control drifting snow
- Storing carbon in biomass

CONDITIONS WHERE PRACTICE APPLIES

In non-forested appropriately prepared areas where woody plants can be grown.

CRITERIA

General Criteria Applicable to All Purposes

State and local regulations must be followed in locating plants adjacent to roadways; avoid creating blind corners at road intersections.

Species will be adapted to soil-site conditions and suitable for the planned purpose.

Planting or seeding rates will be adequate to accomplish the planned purpose.

Planting dates and care in handling and planting of the seed or seedlings will ensure that planted materials have an acceptable rate of survival.

NRCS, IA
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Only viable, high quality and adapted planting stock or seed will be used.

All planting stock and seed should be purchased from nurseries that are known to be using regionally adapted seed, seedlings, or cuttings.

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

Adequate seed or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.

Choose a planting method that is appropriate for existing site conditions and species capabilities.

Timing and use of equipment will be appropriate for the site and soil conditions.

The planting will be protected from adverse impacts such as livestock damage and fire.

Additional Criteria for Improving Water Quality

Give preference to species that are native to the area.

If in a riparian area, use species adapted to local flooding conditions.

Additional Criteria for Wildlife Habitat

Use multiple native species (minimum of 3 species.) No single species should make up more than 33% of the total number of trees and shrubs planted.

Select species that best meet wildlife and ecosystem needs.

Species selected will reflect species composition of the desired stands.

Additional Criteria to Provide Erosion Control

Plants should be evenly distributed over the planting site. Control erosion with mulches, plant residues, contour planting, or other appropriate measures.

Use non-competitive cover crops between planted rows on critical erosive slopes.

Additional Criteria for Short Rotation Woody Crops/Energy Production

Rotation	Spacing	Species
8 years	**10’ X 10’ to allow for mechanical or chemical weed control in first two years**	**Cottonwood** **Black willow** **Silver maple** **Hybrid poplar**

Additional Criteria for Storing Carbon (Sequestration)

To increase carbon storage, select species which are adapted to the site to assure strong health and vigor. Plant the full stocking rate for the site.

Additional Criteria for Air Quality

See Windbreak/Shelterbelt Establishment (380).

CONSIDERATIONS

Plans for beautification plantings should consider foliage color, color and season of flowering, fruit and limb drop, maintenance, and mature plant height.

Plans for wildlife plantings should consider blocks or clumps (non-linear) plantings.

Consider protecting the plantings from wildlife damage.

Tree arrangement and spacing should allow for access lanes, as appropriate.

Where pesticide spray drift from adjacent cropland could adversely affect plants, consider establishing a 10 foot wide tall grass barrier adjacent to and immediately upwind of the planting.

Plants which may be alternate hosts to undesirable pests should be avoided.

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

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.

GENERAL SPECIFICATIONS

The following table can be used as a guide in choosing suitable planting stock or seed:

Objective	Planting Stock
Beautification	1, 2, 3, 4, 5
All others	1, 2, 3, 5
1 = Bare-root; 2 = Container grown; 3 = Cutting; 4 = Balled & burlap; 5 = Direct seeding	

1. Bare-root: Plant large diameter seedlings with well-branched, fibrous root systems. Discard any diseased or damaged seedlings. For underplanting hardwoods, use stock at least 3/8 inch in stem diameter.
2. Container grown: Use healthy, well-developed plants. Discard any diseased or damaged material.
3. Cuttings: (Cottonwood and Willow on suitable sites) Use cuttings prepared during the dormant season from wood of the previous season's growth. The cuttings should be taken from healthy, moderately vigorous stock plants growing in full sunlight. At least two buds should be included in the cutting. The minimum size of cuttings should be 1/4 inch in diameter and 8 inches in length.
4. Balled and burlap: Use plant stock that is 18 inches or more in height for shrubs and 48 inches or more in height for trees. Do not use plants with cracked or broken rootballs. Avoid plants with root systems that are visible on the rootball surface and that circle the trunk.
5. Direct seeding: Use viable, mature seed. Adaptable hardwood species for direct seeding include native ash, maple, oak, hickory, black cherry, hackberry, basswood and black walnut.

Mature, viable seed can be collected from quality seed bearing trees, either from the ground or directly off the tree. Collected seed should be from within 100 miles, north to south, of the planting site.

If seed will be stored, surface air-dry the seed first, place in 4 mil plastic bags and store in a cold environment, air temperature between 33 and 40 degrees. Maintain seed moisture content between 30% to 50%.

Sites will be tilled to create a firm, weed free seedbed.

Seed can be planted anytime from October through April when soil conditions allow; do not plant on frozen soil. Fall seeding eliminates the need for stratification. White oak acorns have little, if any, dormancy and should be planted as soon as possible after collection in the fall.

Seeding can be done either by hand dispersal or broadcasting. Large seeds such as oaks, walnut and hickory should be seeded at least one inch deep. Lighter seeds such as ash and maple, should be seeded ¼ inch deep. After seeding cultipack, roll, or drag the entire site to insure seed to soil contact.

Recommended seeding rates are currently based on uncleaned and unweighed seed. When this type of seed is used, the following general seeding recommendation will be followed to obtain 25,000 to 40,000 seeds per acre.

Species	**Bushels/Acre**
Ash and Hard Maple:	1
Oak and Hickory:	3 to 4

In addition to these species, native seed of hackberry, basswood, silver maple, black cherry, black walnut, and cottonwood should be added to diversify stand composition.

When cleaned seed is available, seeding mixtures will use a minimum of four different species and apply a minimum of 3000 seeds per acre. Use the following charts as a guide for seeding rates.

Species	**Clean Seeds/lb**
Green ash*	17,000
White ash	13,000
Hackberry	4,000
Silver maple	1,750
Pin oak	420
N. Red oak	125
Shagbark hickory	120
White oak	90
Bur oak	60
Black walnut	50

*Due to current threat by Emerald Ash Borer, ash may be short-lived, if attacked by the EAB.

Care of planting stock. Protect stock from desiccation during temporary storage and delivery to the planting site. Keep all types of planting stock, except the ones needed immediately for a supply during planting, stored in a cool environment (preferably < 50 degrees F) out of direct sunlight and wind. Do not plant in frozen soil.

Cuttings: If planting will be delayed, place cuttings in moist sand or paper, sphagnum moss, or plastic bags and store in a cool (34-40 degrees F) place.

Seedlings: Seedlings should be promptly examined in the shipping container and watered or re-wrapped in moist packing material. Survival can be increased by dipping roots in a commercial water-absorbing gel before planting or by soaking seedlings in water one to two hours before planting. If planting will be delayed for more than five days, keep seedlings in shipping container and place in cold storage at 35 to 45 degrees F.

Container grown: Container grown stock should be kept in its container and its soil kept moist. Thoroughly water plants two days before planting. This will facilitate removal from containers during planting.

Direct seeding: Keep seeds cool. Maintain seed moisture content of 30-50 percent. Do not allow seed to mold. If seeds are field collected, place seeds in porous bags to prevent heat buildup. Keep seeds cool and stratify if necessary. For further information on direct seeding, refer to Iowa State University Forestry Extension Note F-363, Direct Seeding on-line at: http://www.forestry.iastate.edu/publications/pubs-pdf/F-363.pdf

Balled and burlap: Keep the root ball moist by watering slowly from the top. Wet the foliage occasionally. Balled planting stock can be held temporarily by placing soil or mulch around the entire ball of the tree and keeping it moist.

Planting Dates. Use the following guidelines:

Bare root stock:

Hardwoods (deciduous): March 15 - June 1 and October 1 until frost in soil

Conifers (evergreen): March 15 - June 1 only

Cuttings: March 15 to June 1.

Plant as soon as possible after materials arrive, soak in water for 12 to 24 hours before planting. Plant cuttings within two days of collection or arrival. Do not plant into frozen soil. Avoid planting on hot, windy days. A cool, cloudy day is preferred.

Balled and burlap and container grown stock can be planted any time of the year that the ground is not frozen if soil moisture is sufficient.

Seed may be planted in fall or spring anytime that soil and site conditions allow (do not seed into frozen soil). Spring seeding may reduce rodent and insect damage. Fall seeding will eliminate the need for stratification. Acorns of most species in the white oak group have little or no dormancy and should be planted as soon as possible after collection in the fall.

Planting methods. Plant seedlings upright at the same depth or slightly deeper (one-inch) than the stock was growing in the nursery or container. Properly planted seedlings should resist gentle lifting pressure.

Check each planted row for proper planting depth and root position and for adequate soil packing around the roots.

Plant cuttings leaving a single bud above ground.

Balled and burlap/containerized: Dig a hole large enough to hold root ball or container volume. Remove plants from containers before placing in the ground. If plants are in tarpaper pots, the tarpaper should be slit along each side or removed before placing in the ground. Place stock at same depth it grew at the nursery and firmly pack soil around roots to eliminate air pockets.

Direct seeding: Care must be taken to completely cover the seed and achieve good soil-seed contact. Plant seeds at the depth recommended in the General Specifications section of this standard, regardless of the method of planting. One or more of the following seeding methods should be used.

Broadcast: Broadcast the seed evenly over the planting area and cover seeds with mineral soil.

Strip: Broadcast the seed evenly over the prepared strips and cover with mineral soil.

Spot: Plant two to five seeds per spot. Seal planting hole.

Machine: Make sure seeds are covered with mineral soil.

Natural regeneration: The use of a natural seed source may be used under any of the following conditions:

- Areas that experience flooding that make plantings unlikely to succeed.
- Depression areas too wet to machine or hand plant.
- Sites likely to be invaded by soft-mast species that would likely out-compete planted hard mast species.

- Sites that are within 200 feet of existing mature woodlands and adjacent to desirable seed sources on two sides.

Planting Rates General.

Hardwood trees: 544 - 725 plants/acre

Shrubs: 727 – 1742 plants/acre

Conifers: 605 - 726 plants/acre

Biofuel: 436 - 1210 plants/acre

Plants per acre for selected spacing:

Spacing (feet)	**Plants per acre**
5 x 5	1742
6 x 6	1210
6 x 8	907
6 x 10	726
7 x 10	622
7 x 7	889
8 x 8	680
8 x 9	605
9 x 9	538
8 X 10	544
10 x 10	436
10 x 12	363
11 x 11	360
12 x 12	302
14 x 14	222
16 x 16	170
18 x 18	134
20 x 20	109
30 x 30	48
Planting rates less than this must be approved by NRCS or DNR Forester	

Direct Seeding: For timber production, isolated sites and increased mast production use a minimum of 3000 seeds per planted acre. Higher seeding rates may be required to adequately ‘capture’ the site and limit competition from weeds.

Seedlings or Cuttings: Plant a minimum of 544 plants per acre for the following intended products and species:

Saw logs (hardwood)

Saw logs (conifer)

Poles (conifer)

Posts (hardwood)

Agroforestry.

Base plant spacing upon the type of agroforestry practice being developed.

Wildlife Habitat and Watershed Protection.

Use any of the minimum planting rates under "Planting Rates *General*." Shrub planting rates should reflect a minimum of 726 plants per acre (6 x 10 spacing).

For wildlife habitat development or wetland restoration a minimum rate of 700 seeds per acre can be used, provided there is an adequate mature tree seed source of desired species within 200 feet on two sides. If a mature seed source is not close, use 3000 seeds per planted acre.

Wind Erosion, Energy Conservation, Snow Control

Per acre planting rates will vary according to the extent of the planting and individual site plans. Base per acre rates on the following spacing:

Row Type/Heights	**Minimum *Between Row* Spacing**
Between shrubs less than 10 feet in height	10 ft.
Between shrubs and trees from 10-25 feet in height	12 ft.
Between trees greater than 25 feet in height	16 ft.
Between any wide crowned trees or conifers	20 ft.

Plant Type 20-year Heights	**Plant-to-Plant Spacing *Within Rows***
Shrubs < 10' tall	3' - 6'
Shrubs and trees 10'-25' tall	5' – 10'
Trees > 25' tall	8' – 16'

Plant-to-plant spacings up to 20' may be planted for appropriate species, *only if additional rows (more than the minimum number) are added.*

Closer spacing results in providing protection in the shortest period of time. Where appropriate, the narrowest spacing can be used, with a thinning required to achieve the ultimate spacing.

Beautification: Per acre planting rates will vary according to the extent of the planting and individual site plans.

Adapted Species.

For species selection—refer to:

http://www.ia.nrcs.usda.gov/plants.html and click on "Iowa Woodland Suitability Recommendations" or refer to "Woodland Suitability Guide at: http://www.iowadnr.com/forestry/soils.htm

Base selection of listed species on soil type, site limitations, landowner objectives, landscape characteristics, and geographic location.

Weed Control. Suppress weeds and grass in a zone two to four feet around each plant or row until plants are established.

If herbicides are used, apply them only when needed and handle with care. Follow all label directions and precautions. If herbicides are not handled or applied properly, they may be injurious to humans, animals, fish, wildlife, desirable plants, and pollinating insects and may contaminate water supplies.

If mechanical means are used, care should be taken to avoid physical damage to plantings. Keep tillage depths shallow to avoid root damage.

If mulches or fabric mats or weed barriers are used, refer to Mulching (484).

OPERATION AND MAINTENANCE

Competing vegetation will be controlled until the woody plants are established.

Check for insect and disease damage with regular inspections. Seek professional assistance for diagnosis and control measures.

Maintain firebreaks around all plantings as needed.

Replanting will be required when survival is inadequate to meet the purpose of the planting.

Trees and shrubs should be protected from fire, insects, disease, and animals until established.

The use of irrigation, mulching, geo-textile mats, tree shelters, and tree shades may be necessary to ensure adequate survival.

REFERENCES

Seeds of Woody Plants in the United States: Agricultural Handbook No. 450, USDA Forest Service, 1974.

Tree Planting: Establishment and Care, Iowa State University Extension, PM 1677, Reviewed and Reprinted March, 2004.

Direct Seeding: Iowa State University Extension, F-363, November, 1999.

Fall Planting of Bare Root Seedlings: Iowa State University Extension, F-355, Revised December, 1998.

Grass and Weed Control for Tree and Shrub Seedlings: Iowa DNR Publication, February, 2002.