NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

TREE AND SHRUB ESTABLISHMENT

(Ac.)

CODE 612

DEFINITION
Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

PURPOSE
To establish woody plants which will:
- Provide forest products
- Provide wildlife habitat
- Provide long-term erosion control and water quality improvement
- Treat waste
- Reduce of air pollution
- Sequester carbon
- Conserve energy
- Enhance aesthetics

CONDITIONS WHERE PRACTICE APPLIES
On any area where woody plants can be grown.

CRITERIA
General Criteria Applicable To All Purposes

1. Species will be adapted to site conditions and suitable for the planned purpose(s). See Section IV - FOTG, Appendix B - Tree/Shrub Recommendations for adapted species and site conditions.
2. Native species shall be used whenever possible consistent with the intended purpose. Species identified as being invasive shall not be used.
3. Planting or seeding rates will be adequate to accomplish the planned purpose.
4. Planting dates, and care in handling and planting of the seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival.
5. Only viable, high-quality and adapted planting stock or seed will be used.
6. Site preparation shall be sufficient for establishment and growth of selected species. See Ohio NRCS practice standard 490, Forest Site Preparation.
7. Adequate seed or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.
8. Timing and use of planting equipment will be appropriate for the site and soil conditions.
9. The acceptability and timing of coppice regeneration shall be based on species, age, and diameter.

10. The planting will be protected from unacceptable adverse impacts from pests, wildlife, livestock damage, or fire.

11. Each site will be evaluated to determine if mulching, supplemental water or other cultural treatments will be needed to assure adequate survival and growth.

12. Woody plants shall be established without compromising the integrity of property lines, fences, utilities, roads, legal drains, other easement areas or right of ways
13. Where subsurface drains (tile lines) cross through a tree/shrub planting, and where these drains will remain functional, sealed conduit shall be installed through the planting and extend a minimum of 50 feet on either side of the planting, or trees/shrubs shall not be planted within 50 feet on either side of the tile line.
14. Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice.

Additional Criteria for Improving or Restoring Natural Diversity
Species selected will be indigenous to the site and will reflect species composition of the desired stands.

Additional Criteria for Providing Wildlife Habitat
Species selected shall provide appropriate food and cover needed by the species targeted for management. Spacing and distribution shall maximize food production and/or cover provided.

Additional Criteria for Long-Term Reduction of Soil Erosion
Equipment will be operated on the contour or across the slope. A non-competitive cover crop will be planted between the rows. Competing vegetation will be controlled by herbicides rather than through the use of tillage.

CONSIDERATIONS

General

Typically, planting bare root seedlings has proven to be the most economical and successful method to establish shrubs and trees and should be the first method considered. Unique planting needs or site conditions may dictate that other methods are more appropriate.

When underplanting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment. Overstory removal will occur in a timely manner to allow supplemental plant establishment.

Use locally adapted seed, seedlings or cuttings when possible. Seed sources for direct seeding or woody stock should originate from no more than 200 miles north or south of the planting site. Priority will be given to plant materials that have been selected and tested in tree/shrub improvement programs. All plant materials should comply with a minimum standard, such as the American Nursery and Landscape Association, Forest Service, or state-approved nursery.

In general, mixed species plantings should be encouraged unless not consistent with landowner planting objectives. Stand diversity should be encouraged by including hardwoods, conifer and shrubs. Monocultures are to be avoided, if possible.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Site Conditions

Soil testing may be done to determine pH, phosphorus (P) and potassium (K) levels before establishment of trees or shrubs. Plant species adapted to the site conditions or consider adjusting the pH or nutrient levels. Some species may have very specific requirements. Soil testing and any amendments recommended as a result are only recommended for high value crops (Christmas trees, walnut plantings, sugar bush plantings, etc.) and not for general reforestation. The amendments will not last the life of a general reforestation planting.

Consider adding mycorrizal inoculate either as an amendment at the planting site or incorporated into water absorbing gel dip for bare root seedlings. Residual chemical carryover should be evaluated prior to planting.

To improve plant growth, consider 2 additional years of chemical or mechanical weed control after plants are established. Weed control should be performed using narrow (2-3 feet) bands on each side of a plant row unless the entire site is treated.

Water Quality

Generally, species with deep or extensive root systems are better for water quality improvement. Species used to treat waste should have fast growth characteristics, extensive root systems, capable of high nutrient uptake, and may produce wood/fiber products in short rotations. For riparian areas, consider species adapted to site flooding conditions, their ability to provide shading of water bodies and organic material/woody debris likely to be generated by the species.

Wildlife Habitat

Where multiple species are available to accomplish the planned objective, consideration should be given to selecting species which best meet wildlife needs. Consider species recommended in Ohio NRCS standards 644, Wildlife Wetland Habitat Development, or 645, Wildlife Upland Habitat Management; recommendations of Division of Wildlife biologists; or other references listed in the Field Office Technical Guide. Consider woody vegetation present on adjacent land when planning species and planting arrangements for wildlife habitat.

Carbon Storage

For optimal carbon storage, select plant species that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site. Relatively long-lived species will tie up carbon for longer periods of time.

Forest Products

Consider species for which there is or is likely to be sufficient market demand. Species such as black walnut, black cherry, sugar maple, and some oaks are considered fine hardwoods. These should be mixed with other trees (hardwoods or conifers) to promote diversity, facilitate thinning operations and encourage straight boles. Consider planting several rows of conifers around the edges and periodically within the stand to serve as a wind barrier.

Aesthetics

Plans for landscape and beautification plantings should consider foliage (summer and fall) color, season and color of flowering, and mature plant height. Trees and shrubs should not be planted so that they infringe on adjoining property or unreasonably use of adjacent property. A mixture of plant sizes and forms should be considered. Consider using curvilinear designs and small group plantings to increase visual diversity.

Direct Seeding

Direct seeding sites within 100 feet of woody, brushy or grass cover are subject to high seed predation by rodents, reducing the chances for success. Consider using other stock types, doubling the seeding rate, reducing rodent populations or a combination of these measures.

Spring seeding can reduce rodent and insect damage. Fall seeding eliminates the need for seed storage.

In addition to landowner objectives and site conditions, the landowner may consider the availability and cost of seeds when selecting species; some species may be available for free by collecting locally.

A mix of heavy and light seeded species may be used. The light-seeded species such as red maple, ash, basswood, sweetgum, hackberry, dogwood, sumac, redbud or chokecherry may increase the cover and provide a quick cover that is less competitive than grasses or forbs as well as providing valuable wildlife habitat; these species may be more likely to regenerate naturally. The heavier seeded species may provide wildlife or timber benefits and are less likely to establish themselves without planting. The inclusion of heavier seeded species such as oaks, hickories and walnut is necessary if they are needed to produce the desired cover.

Natural Regeneration

Natural regeneration may be a desirable method on sites where other planting techniques are not feasible and where an unknown stand composition is acceptable. Even on sites that meet the conditions outlined below, natural regeneration may not provide an acceptable stand in a timely manner and plans for other methods or land uses may be necessary. Consider whether or not the likely seed sources will provide the plant community desired. Floodplain and wet sites may likely have extensive colonization by species such as silver maple, green ash, willow and cottonwood.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved job sheets, narrative statements in the conservation plan, or other acceptable documentation. The minimum documentation for this practice is outlined on the last page of this standard.

Plans and specifications will include the following: adapted tree species for the purposes outlined, site preparation, spacing, plant material storage requirements, planting methods, planting date, cultural practices, maintenance requirements, and variations in methods that may be used. Separate specifications can be prepared for each of these planting methods.

In general, four methods of tree/shrub establishment may be used. These include 1) planting bare root seedlings or cuttings; 2) planting container or ball and burlap stock; 3) direct seeding; or 4) natural regeneration. The method to be used will be influenced by site conditions, the species desired, management requirements and aesthetics. Use of container stock or balled and burlap stock may be a good method where unique site conditions indicate a higher survival of desirable species than other methods. Also ball and burlap stock may provide a more aesthetically pleasing plant immediately as opposed to smaller stock. However, over time, other methods may eventually provide a suitable cover as well, at a lower initial cost. Natural regeneration may be the cheapest method and result in plant species naturally adapted to the site but does not allow for as much selection of species or spacing that meets a desired objective.

1. Bare root seedlings and cuttings

Stock selection Discard weak, moldy or damaged stock. Plant materials that have been dried, frozen, subjected to mold or extremely high temperatures will be assumed to be dead and will not be planted. Conifer seedlings shall be at least 3/32 inch in caliper 1 inch above the root collar. Conifers will be at least 6 inches in height above the root collar with a 1:1 or 1.5:1 top to root ratio being desired. Hardwood seedlings shall not be less than 7/32 inch caliper above the root collar. They shall be at least 8 inches above the root collar and have roots at least 8 inches long. Seedlings should be 2 to 3 years old (2-0 or 2-1 stock). Roots may be pruned only if necessary due to planting equipment limitations; roots shall not be pruned to less than 8 inches and no more than 25% of the root system shall be removed

Cuttings from suitable species (willow, cottonwood, hybrid poplar, and dogwood) shall be made during the dormant season from wood of the previous season's growth. Cuttings shall be at least ½ inch in diameter at the midpoint and at least 15 inches in length. Cuttings shall contain at least two healthy buds.

Care of stock Bare root seedlings shall be protected from desiccation during temporary storage by keeping them in a cool environment and out of direct sunlight and wind. Upon delivery, packing materials should be examined immediately and moistened, if necessary. Roots shall be kept moist during planting operations by placing them in moss, water absorbing gel, mud slurry or other appropriate material. They shall not be soaked in water for more than 2 hours.

Roots may be pruned only if necessary due to planting equipment limitations; roots shall not be pruned with a sharp blade to less than 8 inches and no more than 25% of the root system shall be removed.

If planting is delayed more than 5 days, bare root stock will be kept in moist shipping container in cold storage of 35 to 40^{o} F. If this is not feasible, seedlings will be heeled in. This is done by digging a slightly sloping trench, placing the seedlings in the trench and covering the roots with moist soil. Do not allow the roots to dry out.

If cuttings are not to be used immediately, they will be stored in moist material at 35-40^{o}F. Warm and soak the cuttings 7-10 days before planting. This is done by immersing ¾ of their length in water and placing them in the shade at 50-70^{o} F. Cuttings are ready to plant when buds start elongating, showing bright green around the bud scales, and just before roots begin to grow.

Planting dates Bare-rooted stock shall be planted according to the following schedule: South of I-70: in late winter or spring as soon as the ground thaws until April 15; North of I-70: in late winter or spring as soon as the ground thaws until April 30. Dormant cuttings shall be planted from February 1 to March 31 as long as the ground is not frozen. Cuttings with buds that have broken dormancy shall be planted between April 15 and June 30 when soil temperatures are above 50^{o} F and the soil is moist.

Site preparation The site shall be prepared to reduce plant loss due to weed competition, unfavorable soil conditions or animal damage. Use the appropriate methods found in the Ohio NRCS standard Forest Site Preparation (490) for the cover present prior to planting.

Planting rates The planting rates shall be consistent with the intended purpose of the planting. In general, higher planting rates will reduce the need for weed control, accelerate the establishment of the stand and improve timber values. Wider spacings will typically increase the flowering or fruit production. See Section IV - FOTG, Appendix B - Tree/Shrub Recommendations for recommended spacings for various species and uses. For windbreaks or shelterbelts, refer to Ohio NRCS standard 380, Windbreak/Shelterbelt Establishment for appropriate spacings.

Planting methods Bare-rooted trees or shrubs may be planted with a mattock, dibble or planting bar or mechanical tree planter. Plant the tree at the same depth it was growing in the nursery. The seedling root collar should line up with the soil surface. Plant the tree upright. Make sure the roots are hanging downward in a natural position and not doubled or sharply bent. Press the soil so that it is firmly packed around the roots so that the tree is held in place and there is good soil-root contact. Plant only one tree per spot. Do not allow plant roots to dry out while planting.

Cuttings shall be kept moist while planting. Plant upright with the buds pointing up. Leave 1 or 2 good buds above ground. If soil is loose, cuttings may be pushed into the soil by hand, otherwise make a hole with a dibble bar. Firm the soil around the cutting. Ensure that the bottom of the cuttings will be deep enough to reach moist soil.

2. Container and balled and burlapped stock

Stock selection Use only healthy, well developed plants. Discard any weak, damaged or diseased stock. For balled and burlapped sock, do not use plants with cracked or broken rootballs, root systems that are visible on the rootball surface or roots that circle the trunk. For balled and burlapped stock, shrubs and conifers shall be at least 18" in height; trees shall be at least 48" in height. Minimum container/rootball and caliper sizes will be:

Balled and Burlapped Stock

Conifers	
Tree Height	Minimum Diameter Ball
18-24"	10"
2-3'	12"
3-5'	14"
5-6'	20"

Hardwoods		
Tree Height	Minimum Diameter Ball	Caliper[1]
5-6'	12"	1/2"
6-8'	14"	3/4"
8-10'	16"	1"

Container stock (all species)

Container Size	Tree Height	Caliper[1]
1 gallon	2 – 4'	3/8 – 5/8"
3 gallon	2 – 6'	3/8 – 5/8"

[1] Caliper (diameter at ground level) shall be measured 1 inch above the root collar

Care of stock Container grown stock should be kept in its container in a shady location and its Soil kept moist. Thoroughly water plants 2 days before planting to facilitate removal from containers. Rootballs of balled and burlapped stock shall be kept moist by watering slowly from the top. Store temporarily (less than 2 weeks) by placing soil or mulch around the entire ball and keeping it moist.

Planting dates Container or balled and burlapped stock may be planted any time between September 15 and June 1 when the soil is not frozen and soil moisture is adequate.

Site preparation The site shall be prepared to reduce plant loss due to weed competition, unfavorable soil conditions or animal damage. Use the appropriate methods found in the Ohio NRCS standard Forest Site Preparation (490) for the cover present prior to planting.

Planting rates Container or balled and burlapped stock may be used to supplement existing stands, where certain species are needed to supplement natural regeneration, to provide a particular form or large initial size for aesthetic purposes or where site conditions make other methods unfeasible. Therefore the planting rates will vary.

Where container stock is being used to supplement natural regeneration (see below for likelihood of success criteria), plant large container stock at the rate of 28 trees per acre (40' X 40' spacing). Where container stock is to be the primary means of plant establishment, plant small container stock at a rate of approximately 300 trees per acre (12' X 12' spacing). Other spacings for container or balled and burlap stock may be appropriate for other specific uses such as windbreaks, environmental plantings, or supplemental plantings.

Clump plantings of balled and burlap or container stock are appropriate for some uses. The minimum number of trees in these cases shall be 110 per acre (20' X 20' spacing); the minimum clump size shall be ¼ acre unless site conditions or intended purpose dictate otherwise

Planting methods Container stock shall be planted in a hole slightly larger than the container diameter. Remove plants from containers before placing in the ground and firmly pack soil around roots to eliminate air pockets. Before planting loosen any spiraling roots and prune if needed.

For balled and burlapped trees, never pick up a tree at the stem or trunk; handle stock at the root ball. Dig a hole 11/2 times as wide as the root ball and about the same depth as the root ball. Remove any rope, wire, or plastic twine from the tree. Pull back burlap around trunk and fold once in the hole. Carefully place the tree in the hole and firmly pack soil around roots to eliminate air pockets. After planting water as needed.

3. Direct seeding

Seed selection Seed should be evaluated for viability by floating and/or visual inspection. More details on evaluating seed viability may be found in *Seeds of Woody Plants in the United States* or the *Illinois Direct Seeding Handbook*. Floating should be done as soon as possible after the seed have been collected. Inspect seed to ensure that only undamaged, viable, mature seeds are used. A random sample of 10 seeds per bushel should be selected for inspection. Crack or cut open seeds to ensure that all seed are filled, moist, normal colored and not destroyed by insects. If non-viable seed is found, increase the seeding rate by the percentage of non-viable seed.

Care of seed See the *Illinois Direct Seeding Handbook* for seed collection, sorting, handling and storage techniques by species. If possible, seed should be planted as soon as it is cleaned and sorted. If planting is to be delayed more than a few days, seed should be placed in porous bags and placed in storage at no more than 50^{o} F and preferably 35-40^{o} F. Do not allow heat buildup in the seed and never leave tree seed in the sun.

Heavy seeded species (oaks, walnuts, hickories) will be stored moist but not wet. Rehydrate seed by soaking in cold water for 4-24 hours as soon as possible after collection or delivery. Keep seed moist but do not allow to rot or mold. All other species are to be stored dry.

If seed is to be stored more than a few weeks, place it in sealed containers and store at 35-40^{o} F. Heavy seeded species may be placed in sealed plastic bags. Inspect bags periodically to see that proper moisture conditions are being maintained.

Some species may need to be properly stratified for good germination. Details on species needing stratification and the proper methods are found in the *Illinois Direct Seeding Handbook.* After removal from storage, inspect seeds for quality as described above.

Planting dates Seed may be planted whenever the ground is not frozen and soil moisture is adequate. Planting from July 1 to September 15 should be avoided due to higher soil temperatures and reduced soil moisture which may lead to reduced survival.

Site preparation Use the appropriate methods found in the Ohio NRCS standard forest site preparation (490) for the cover present prior to seeding.

Planting rates The following rates shall be used regardless of the intended purpose of the planting. Plant a minimum of 3,000 seed per acre of heavy-seeded species if row planting. Plant at least 4,500 per acre if broadcast seeding. If there is no source of light-seeded species within 500 feet of any portion of the planting site, that portion will receive an additional 1,000 seed per acre of either heavy or light-seeded species. See Section IV - FOTG, Appendix B - Tree/Shrub Recommendations, for the seed per pound by species. To overcome predation, double the seeding rate for the first 100 feet of the planting site adjacent to woodlands.

Planting methods Seed may be planted mechanically or by hand, in rows or broadcast. Heavy-seeded species should be planted at a depth of 2 times the diameter of the seed. Plant all seed at 2 inches or more if seed predation and/or low soil moisture are anticipated. If broadcast seeding, light-seeded species will be sown on the surface of the soil. Heavy-seeded species will be broadcast, covered with 1-2 inches of soil and cultipacked or rolled.

4. Natural regeneration

Natural regeneration is the establishment of trees or shrubs from a seed bank present in the soil or seeds carried in from nearby sources. Natural regeneration may be used as the sole means to establish woody vegetation on a site or it may be used to supplement a stand established by planting seedlings, planting container stock or direct seeding. It is best used on a site where it is not feasible or practical to establish trees by other means due to:

- The site is typically flooded at times when plantings or seedings would be done and make establishment by planting or seeding unlikely to succeed.
- The site is too wet to be machine or hand planted at typical times for planting.
- The site is inaccessible to planting equipment.
- The site is likely to be invaded by other species (primarily soft-seeded species) that would likely out-compete the planted species.

In order for a site to be suitable for natural regeneration, a suitable seed source must be present. For floodplain sites, the site must be at least frequently flooded with an upstream floodplain dominated by woody vegetation. For other sites, there must be existing mature, seed producing trees within at least 200 feet of the entire site. Site preparation may be necessary to remove excess sod or similar vegetation which would make germination unlikely. If natural regeneration is unlikely, tress and/or shrubs must be planted or seeded.

Where natural regeneration is used, at least 300 stems per acre of woody vegetation (including planted/seeded species, where applicable) must be present after 3 growing seasons. If, after 3 growing seasons, at least 300 stems per acre are not present, planting or seeding of trees and/or shrubs must be done if it appears that natural regeneration will not be sufficient to produce the required stand within an acceptable time frame.

OPERATION AND MAINTENANCE

Control weed competition during establishment (3 years). Competing weeds, brush, and vines can adversely affect survival, form and rate of tree growth. Additional years of weed control may

be needed in some instances e.g. to control johnsongrass, quackgrass, or other hard to control weed species. Noxious weeds will be controlled. Use the following or combination of methods as needed to control weed competition:

- shallow cultivation (1.5 inches or less)
- mowing
- spraying approved herbicides
- cutting woody plants and applying approved pesticides

Check survival of planted species (other than seeded sites) after one year. Replanting may be necessary is survival is below 70%. Check survival of direct seeded and natural regeneration sites after 3 years to insure that at least 300 desirable stems/acre of woody plants are established. If less than 300 stems/acre are established, additional planting will be completed if it is determined that additional natural regeneration will not be sufficient to colonize the site within an acceptable time frame (usually 5 years).

Shear and shape Christmas trees and correlatively prune hardwood species, as needed depending on species and growth form desired. Refer to Ohio NRCS standard 660, Tree Shrub Pruning.

Protect the planting from fire. Plan access roads and firebreaks prior to planting. See Ohio NRCS standard 560, Access Road and 394, Firebreak.

Fence if necessary to protect the planting from excessive livestock browsing and trampling damage, refer to FOTG Standards, Use Exclusion (472) and Fence (382).

Protect from disease, rodents, deer, and insects using approved pesticides, hunting, fencing, or other appropriate methods. Additional information can be viewed from the “Illinois Direct Seeding Handbook”, Wildlife Damage Management.

Supplemental water will be provided as needed. Generally this is not recommended for general reforestation; however it may be needed for plantings of high value crops.

Periodic applications of nutrients may be needed to maintain plant vigor.

REFERENCES

1. Section IV - FOTG, Appendix B - Tree/Shrub Recommendations
2. Native trees for urban and rural America. Gary L. Hightshoe. Iowa State University Research Foundation. 1978.
3. Silvics of North America. Volume 1. Conifers and Volume 2. Hardwoods. USDA Forest Service Agriculture Handbook 654. 1990.
4. The woody plants of Ohio. E. Lucy Braun. Ohio State University Press. 1961.
5. The native plants of Ohio. Ohio State University Extension Bulletin 865. 1998.
6. Planting trees and shrubs for wildlife. Ohio Division of Wildlife.
7. Tree planting guide. Ohio Division of Forestry. 1993
8. American Standard for Nursery Stock. ANSI Z60.1-1973. American Association of Nurserymen
9. Illinois Direct Seeding Handbook. Illinois NRCS. 2000. (available on Illinois NRCS web site)
10. Seeds of Woody Plants in the United States. USDA Forest Service Agriculture Handbook 450. 1974. (also available at www.wpsm.net)

Practice Documentation For:	*Tree/Shrub Establishment - 612*
The following documentation must be in the case folder or engineering subfolder.	
Practice Planning	
1. Is the practice part of a conservation plan? 2. Have the purpose(s) for the practice been identified? 3. Is the location of the practice identified on a map or plan drawing?	
Practice Design	
Have the following design criteria been addressed? 1. Adapted tree species for the purposes outlined 2. Spacing, planting methods, cultural practices. 3. Variations in methods and species between interplanting, underplanting, and planting in open areas. 4. Acres planned.	
Practice Installation / Application	
Does the practice meet the minimum criteria for the planned purpose(s)?	
Have the following criteria been documented in the assistance notes or practice jobsheet? 1. Species planted. 2. Spacing for each species planted. 3. Quality of the stand. 4. Acres planted.	
Practice Deficiencies	
If applicable, have the practice deficiencies been communicated with the decisionmaker?	
Practice Maintenance	
Have the following maintenance actions been communicated to the decisionmaker? 1. If needed, competing vegetation will be controlled until the woody plants are established. Noxious weeds will be controlled. 2. Replanting will be required when survival is inadequate. 3. The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.	
Other Comments:	