



Natural Resources
Conservation Service
CONSERVATION PRACTICE
STANDARD TREE/SHRUB
ESTABLISHMENT CODE

612

(ac)

DEFINITION

Establishing woody plants by planting seedlings or cuttings, by direct seeding, and/or through natural regeneration.

PURPOSE

Establish woody plants to—

- Maintain or improve desirable plant diversity, productivity, and health.
- Create or improve habitat for desired wildlife species compatible with ecological characteristics of the site.
- Control erosion.
- Improve water quality. Reduce excess nutrients and other pollutants in runoff and groundwater.
- Sequester and store carbon.
- Restore or maintain native plant communities.
- Develop renewable energy systems.
- Conserve energy.
- Provide for beneficial organisms and pollinators.

CONDITIONS WHERE PRACTICE APPLIES

Tree/shrub establishment can be applied on any site capable of growing woody plants.

CRITERIA

General Criteria Applicable to All Purposes

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at <https://www.nrcs.usda.gov/> and type FOTG in the search field.

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Select one or more species that are suited to soil and site conditions, and appropriate for the planned purpose(s).

Determine desired stocking levels for trees and/or shrubs based on ecological characteristics of the site and species, and landowner objectives. Plant, seed, and/or naturally regenerate at densities/rates that reflect anticipated seedling mortality to achieve desired stocking levels in the established stand.

Use NRCS Conservation Practice Standard (CPS) Tree/Shrub Site Preparation (Code 490) to prepare sites for planting, seeding, or natural regeneration, if conditions are not suitable for establishing the desired plants.

When using natural regeneration to establish trees and/or shrubs, ensure that a source of seed and/or vegetative propagules is or will be present, or that advanced reproduction exists, sufficient to achieve objectives. Where natural regeneration relies on seed sources, apply any needed stand treatments and/or

site preparation at appropriate times to facilitate germination and establishment of seeds from desired species. Modify forest stand conditions as needed, using CPS Forest Stand Improvement (Code 666), to create favorable stand structure for initiating natural regeneration. Use NRCS CPSs Prescribed Burning (Code 338), Brush Management (Code 314), and/or Herbaceous Weed Control (Code 315), as needed, to obtain the desired species composition, density, and arrangement of trees/shrubs in naturally regenerated areas. Implement coppice regeneration (originating from root shoots or stump sprouts) based on suitability of tree species, age, diameter, and site conditions. Determine the correct timing for coppice regeneration based on species characteristics.

Use tree/shrub planting to accomplish or supplement forest stand regeneration in locations where natural regeneration of desired species is not possible, or will not meet objectives.

Select only viable, high-quality, and adapted plant materials. Select planting stock that conforms to established seed transfer protocols within the State, and complies with minimum standards accepted by the American National Standards Institute (ANSI). Do not plant any species listed on the Federal or State invasive species or noxious weed lists.

Choose appropriate planting dates and handling methods to increase rates of survival. Select planting techniques and timing appropriate for soil and site conditions.

Alter species selection and/or timing of planting/seeding to minimize potential effects of residual chemical carryover, as needed.

Evaluate the site to determine if mulching, supplemental water or other cultural treatments (e.g., tree protection devices, shade cards, root dips, geo-textile mats, etc.) are needed to assure adequate survival and establishment. Minimize the need for supplemental water and/or nutrients by choosing site-adapted plant materials, planting methods, and planting seasons. Where supplemental moisture is needed to achieve tree/shrub establishment, use NRCS CPS Irrigation System, Microirrigation (Code 441).

Protect tree and shrub plantings, seeded areas, and naturally regenerated areas from unacceptable adverse impacts of pests, wildlife, livestock, and/or fire. Protect from pests, as necessary, by applying integrated pest management techniques for pest prevention, avoidance, monitoring, and suppression.

Allow at least a 16-foot maintenance strip from the outside row of trees or shrubs to adjacent property lines or contrasting land use areas. Trees or shrubs will not be planted closer than

stated unless all involved landowners agree in writing.

Where functional subsurface drains (tile lines) pass through a tree/shrub planting, sealed conduit will be installed through the planting and extend a minimum of 100 feet from rows of large trees (capable of reaching heights greater than 60 feet) and 75 feet from all other trees and shrubs. Trees and shrubs will not be planted within 50 feet of either side of existing/functional subsurface drains.

Removal of products (e.g., trees, biomass, medicinal herbs, nuts, fruits, etc.) is allowed, provided that conservation purpose(s) are not compromised by the loss of vegetation or by harvesting disturbance.

Additional Criteria for Wildlife Habitat

Use multiple native species (minimum of 3 or more) that best meet wildlife needs. See Illinois Biology Technical Note No. 22 for recommended list of woody plant species.

Additional Criteria for Providing Erosion Control and Improving Water Quality

Plants or seed will be evenly distributed over the planting site. Planting rows and equipment operation will be conducted across the slope or along the contour.

Apply mulches, plant residues, non-competitive cover crops or other appropriate erosion control measures on critical erosive slopes (see NRCS CPS: Mulching (Code 484); Forest Trails and Landings (Code 655); Tree/Shrub Site Preparation (Code 490)).

Additional Criteria for Reducing Nutrients and Pollutants

When plantings are used to remove excess nutrients from runoff or groundwater, select species that have fast-growth characteristics, extensive root systems, and a high-nutrient uptake capacity. Trees and shrubs used to reduce pollutants must be tolerant of the types of pollutants contained in effluent or soils at the site.

Additional Criteria for Sequestering and Storing Carbon

For shorter term, rapid carbon sequestration, select species that have high-growth rates, recognizing that they are typically short-lived. For long-term storage of carbon, select plants with a long life span, the ability to reach a large size, high-wood density, and potential for use in long-lived products. Establish and maintain a fully stocked stand.

Additional Criteria for Restoring or Maintaining Native Plant Communities

Species selected for planting, or those favored in natural regeneration, will be native to the site and will create a successional state that progresses toward the identified target plant community.

Underplanting in Existing Forestland

Improve stand composition and/or stocking by planting a more desirable species under or within an existing stand of established trees.

Overstory canopy conditions at, or reduced to, a 40-70% stocking level are necessary to allow for adequate light to reach the planted stock. Adjustments within stocking level range will be dependent upon shade tolerance of planted species, site conditions, and management objectives.

All underplanted seedlings and container stock will benefit from additional cutting or killing of

overstory trees 2 or more years after establishment to maintain or increase the amount of light reaching the ground.

Control of competing herbaceous and woody plants prior to and during establishment will be achieved in accordance to NRCS CPS Tree/Shrub Site Preparation (Code 490).

Underplanted seedlings are particularly susceptible to browse damage by deer and rabbits. When heavy seedling damage is anticipated, protect newly planted trees with fences, tree shelters, or repellants.

Additional Criteria for Developing Renewable Energy Systems

Select plants that can provide adequate types and amounts of plant biomass to supply identified bioenergy needs.

Manage the intensity and frequency of energy biomass removals to prevent long-term negative impacts to the site.

Harvest biomass for energy in a manner that will not compromise other intended purpose(s) and functions of the site.

Additional Criteria to Conserve Energy

Increase energy efficiency by planting trees to provide shade for buildings.

Select plants with a potential height growth that will be taller than the structure or facility being protected. Use proper plant densities to optimize the shade produced.

Design tree and shrub plantings to avoid damage to structures, and to allow adequate space for maintenance access to walls and windows. Plant at a distance that is greater than mature crown spread, and select species that develop deep root systems.

To protect structures from heat loss due to wind, use NRCS CPS Windbreak Establishment (Code 380).

Additional Criteria for Habitat for Beneficial Organisms and Pollinators

Plant trees and shrubs that provide habitat and food sources for beneficial organisms, such as pollinators, predatory and parasitic insects, spiders, insectivorous birds and bats, raptors, and terrestrial rodent predators. Select plant species that meet dietary, nesting, and cover requirements for the intended beneficial organisms during the critical period for control of target pests and, if possible, for the entire year.

Protect beneficial organisms from harmful pesticides.

CONSIDERATIONS

Consider using plant materials that have been selected and tested in the Plant Materials Program or in similar tree/shrub improvement programs.

Consider using diverse tree and shrub species combinations which best meet the needs of desired wildlife and pollinator species.

When selecting plant materials, consider whether the species, variety, or cultivar possesses aggressive traits, and whether it poses a potential threat to the existing or desired plant community.

Use of locally adapted seed, seedlings, or cuttings is recommended. Ideally, seed source of plant materials should be within 100 miles north or 200 miles south of the planting site.

Consider potential impacts of extreme weather events (e.g., drought, flooding, wind, late spring frosts) when selecting plant species and sites for planting.

When using trees and shrubs for carbon sequestration and storage, consider using modeling tools to predict carbon sequestration rates and amounts of stored carbon.

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

When underplanting, trees and shrubs should be planted sufficiently in advance of overstory removal to ensure full establishment where feasible.

Consider establishing species with growth rates and at densities that make them competitive with weeds and undesirable plants.

Consider using species that provide subsistence and cultural values, (e.g., as used by Tribes).

Consider designing plantings to enhance visual quality in farmsteads, recreation areas, and along public rights-of-way, by applying foliage color, season and color of flowering, mature plant height, edge- feathering, and other landscaping techniques.

Residual chemical carryover should be evaluated prior to planting. Alter species selection and/or timing or planting/seeding, as needed.

Consider using 4-5 foot tube tree shelters to mark rows in row plantings. Install as many well-dispersed tree shelters as feasible, especially if rabbit or deer damage is likely. Place the shelters over the most vigorous seedlings and secure with a decay-resistant stake.

For level planting sites of more than a few acres, consider operating planting equipment in a circling pattern, spiraling inward from the outside to the center. An inward spiraling pattern eliminates the need to stop and turn at the ends of rows, saving time and energy. A more natural appearance is also obtained since row direction is not readily apparent.

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

When direct seeding, consider increasing the seeding rate as much as possible above the minimum specification with low-cost or locally available woody seeds, which serve as a woody cover crop or nurse crop. Woody plants are usually less competitive than grasses or forbs and are the best companion crops for trees. Potential nurse crop species include the light-seeded tree species (see **Species Selection**).

Other potential trees and shrubs include hazelnut, redbud, sumac, dogwood, pawpaw, chokecherry, and plum (see [Direct Seeding of Shrubs](#) in REFERENCES). Test soils and/or consult soil survey report before planting to determine whether soil fertility, pH, or species mix need to be adjusted. Soil tests should indicate a minimum of 15 pounds of phosphorus and 150 pounds of potassium per acre. Some species, such as pin oak (pH < 6.8) and black walnut (high fertility), have very specific requirements.

Consider adding mycorrhizal inoculate either as an amendment at the planting site or incorporated into water-absorbing gel dip (synthetic polymer) for bare root seedlings.

To improve plant growth, consider 2 additional years of chemical weed control after plants are established. Weed control should be performed using narrow bands (2'-4' wide) on each side of a plant row unless the entire site is treated.

Applications of nutrients may be needed to maintain plant vigor and improve planting survival.

Considerations for Organic Systems During Vegetation Establishment

Natural mulches, such as wood products or hay, can be used to support tree/shrub establishment by controlling competing vegetation, as a viable alternative to using herbicides. Certified weed-free mulches are preferred. Use NRCS CPS Mulching (Code 484).

Pests may be managed through augmentation or introduction of predators or parasites and development of habitat for natural enemies of pests; non-synthetic controls such as lures, traps, and repellents may be used.

Invasive plant species may be controlled through mulching with fully biodegradable materials; mowing; livestock grazing with protection for plantings; hand weeding and mechanical cultivation; pre-irrigation; flame, heat, or electrical means. Use NRCS CPS Prescribed Burning (Code 338), as recommended by professional forester or biologist.

Considerations for Reducing Energy Use

When trees are planted to reduce summer energy use in buildings, consider prioritizing their placement on the west side of the building, where the greatest daily solar heat gain occurs. The second priority is the east side. Trees or shrubs planted within 30 to 50 feet of a building generally provide effective shade to windows and walls, depending on tree height potential.

Deciduous tree or shrub species planted adjacent to the south side of buildings in cool climates can provide shade in the summer yet allow sun to reach the building in winter.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe requirements for applying the practice to achieve its intended purpose, and obtain any required permits.

Use Illinois Job Sheet(s) JS-IL612 (TS-DS-NR) or other acceptable documentation. A current and fully prepared Illinois Forest Management Plan (IFMP) will provide complete specifications and serve as an appropriate plan of operations.

Plans and specifications will include, as a minimum, the following:

- Objective(s) for tree/shrub establishment.
- Detail maps showing the location of plantings and/or natural regeneration areas.
- Soils map and description of soils and Ecological Sites (if available).
- Site preparation specifications, utilize NRCS CPS Tree/Shrub Site Preparation (Code 490).
- Establishment method by species and stock type.
- Number of trees/shrubs per acre to be planted, by species and stock type.
- Row spacing (between and within).
- Timing of planting and/or natural regeneration relative to considerations for seasonal

factors, plant physiology, disease, insects, and wildlife impacts.

- Vegetation control and maintenance.
- Mitigation measures, if needed, to reduce wildfire hazard or the potential for disease and insect pests.

Planting Stock Type

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

Site	Planting Stock
Open Fields	1,2,3,5
Understocked Forestland	1,2,5
Landscaping	1,2,3,4,5
Environmental	1,2,3,5
1 = Bare root; 2 = Container grown; 3 = Cutting; 4 = Balled & burlapped; 5 = Direct seeding	

All stock types: Discard weak, moldy or damaged material. Plant materials that have been dried, frozen, subjected to mold or high temperature will be assumed to be dead and will not be planted.

Calipers (diameter) are measured at 1 inch above root collar (nursery soil line). Tree/shrub height and root length are measured from the root collar.

Bare root: Plant seedlings with well-branched, fibrous root systems. Minimum height, caliper and root length (RL) will be:

Conifers			Hardwoods		
Height	Caliper	RL	Height	RBD	RL
6"	3/32"	8"	12"	7/32"	8"

Determine depth of planting equipment and root prune only if necessary, to a length of no less than 8 inches, using a sharp tool. Never remove more than 25% of the root system.

Container grown: Plant seedlings with dense, fibrous non-curling root system. Minimum height, caliper and root volume (RV) will be:

Plug Stock and Small Container

Conifers			Hardwoods		
Height	Caliper	RV	Height	Caliper	RV
6"	3/32"	7 in ³	12"	7/32"	7 in ³

Container Grown Stock (Air root-pruned potted stock) - all species

Height	Caliper	RV
2-4'	3/8"	>= 2 gal

Cuttings: Suitable species include cottonwood, hybrid poplar, willow, dogwood and elderberry. Use cuttings prepared during the dormant season from wood of the previous season's growth. At least two healthy buds will be included in the cutting. The minimum size of cuttings will be 3/8 inch in stem diameter and minimum of 8 inches long.

Balled and burlapped: Use stock that is at least 18 inches tall for shrubs. Do not use plants with cracked or broken root-balls, root systems that are visible on the root-ball surface, or roots that circle the trunk.

Minimum height, caliper, and root-ball diameter (RBD) will be:

Conifers			Hardwoods		
Height	RBD	Caliper	Height	RBD	Caliper
18-24"	10"	Not Applicable	4-6'	12"	1/2"
2-3'	12"		6-8'	14"	3/4"
3-5'	14"		8-10'	16"	1"
5-6'	20"				

(Be advised that although balled and burlapped stock is usually the largest type of planting stock available, it will probably not outperform other types of planting stock over time. Often other stock types will equal or surpass balled and burlapped stock within 5 to 10 years, at much lower initial cost.)

Direct seeding: Only undamaged, viable, mature seed will be used. Inspect by species at least 10 randomly selected seed per bushel. Crack or cut open seed and ensure all seed is filled, moist, normal colored and not destroyed by insects. For more information on how to inspect seed, see Seeds of Woody Plants of the United States or Seed Biology and Technology of Quercus (for oaks) or the Illinois Direct Seeding Handbook. Acorns may have up to one insect hole and ¼ of the nut damaged by insects and still be viable. If any non-viable seed is found, the seeding rate will be increased by the percentage of non-viable seed.

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 (< 50 degrees F) out of direct sunlight and wind.

Bare root: Promptly examine all stock in the shipping container and moisten packing material, if necessary. Seedling roots may be soaked in water for no more than 2 hours or coated with a water-absorbing gel dip (synthetic polymer) immediately before planting to increase survival. If planting will be delayed for more than 5 days, keep seedlings in shipping container and place in cold storage at 34-40 degrees F. If cold storage is not feasible or available, seedlings will be heeled in. Dig a trench a little deeper than the root systems and spread roots against the back of the trench. Cover roots completely with soil, tamped to eliminate air spaces. Water as needed to keep roots moist but not wet.

Container grown: Keep in containers in a shady location and maintain soil moisture. Do not drop or handle by stem. Thoroughly water 2 days before planting to facilitate removal from containers.

Cuttings: If planting will be delayed, place in moist packing material and then in plastic bags and refrigerate at 34-40 degrees F. Warm and soak cuttings for 5-10 days before planting. Make small slits in the bag, leave cuttings in the bag and immerse ¾ of their length in water. Place cuttings in shade at 50-70 degrees F. Cuttings are ready to plant when the buds start

elongating, showing some bright green around the bud scales, and just before roots begin to grow. If weather prevents planting when cuttings are ready, cuttings can be held for weeks by placing them in cold storage at 34-40 degrees F.

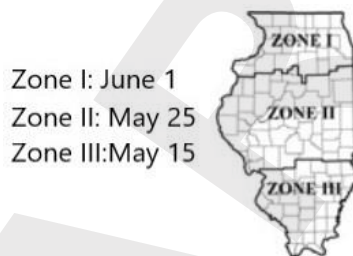
Balled and burlapped: Keep the rootball moist by watering slowly from the top. Wet the foliage occasionally. Store temporarily (less than 2 weeks) by placing soil or mulch around the entire ball and keeping it moist.

Direct seeding: See Illinois Direct Seeding Handbook for seed collection, sorting, and handling techniques by species. If possible, seed should be planted as soon as it has been cleaned and sorted. If planting is delayed more than a few days, seed will be placed in porous bags, such as onion bags, and in cold storage, no more than 50 degrees F and preferably 34-40 degrees F. All light-seeded species (see **Species Selection**) as well as persimmon and Kentucky coffeetree will be kept dry. Heavy seeded species will be kept moist but not wet. Do not allow to mold. Acorns will be rehydrated by soaking in cold water for not less than 4 and not more than 24 hours as soon as possible after collection or delivery and not allowed to dry out. Do not allow seed to heat up. Avoid storing in large quantities unless well ventilated and refrigerated. Never leave tree seed in the sun. For further information by species see Seeds of Woody Plants of the United States or Seed Biology and Technology of Quercus (for oaks) or the Illinois Direct Seeding Handbook.

If light-seeded species will be stored for more than a few weeks, place in sealed containers at 34-40 degrees F. If heavy seeded species will be stored for more than a few weeks, transfer to sealed plastic bags: 1.75 mil for white, chinkapin and swamp chestnut oak; 4 mil for all other species. Store at 34-40 degrees F. Inspect bags periodically and if no condensation is visible on the inside of bags, rehydrate by soaking. Inspect seed, as described in the previous section, when removing from storage before planting. Acorns in the white oak group should be planted as soon as possible in fall, do not try to store more than 6 months. Other species can be stored under carefully controlled temperature and humidity for up to 3 years and planted whenever soil is unfrozen and moisture is adequate. If sprouting of seed begins, seed can still be successfully planted but risk of dehydration is increased.

Planting Dates

Bare root seedlings: Do not plant into frozen or dry soil. Begin planting as soon as the ground can be worked and complete by the dates below (see Illinois Field Office Technical Guide, Section I, Maps, for Plant Suitability Zones):



Fall planting of dormant bare root seedlings may be done after October 1 until the ground freezes as long as soil moisture is adequate. Fall planting of bare root stock will not be done

on soils subject to frost- heave action.

Avoid planting on hot, windy days. A cool, cloudy day is preferred.

Balled and burlapped and container grown stock: Plant at any time of the year that the ground is not frozen, adequate soil moisture is present and normal precipitation is expected. Water if needed.

Cuttings: Plant between mid-April and June when soil temperature reaches 50 degrees F, or when corn is being planted locally. Soil must be moist.

Direct seeding: Tree/shrub seed may be planted from October through June anytime the ground is not frozen and soil moisture is adequate. For shrubs, the time of the year seeds are produced is generally the best time to establish that species from seed. Spring seeding can reduce rodent and insect damage. Fall seeding (prior to January 1) can eliminate the need for stratification.

Site Preparation

Follow guidelines in NRCS CPS Tree/Shrub Site Preparation (Code 490).

Planting Methods

All stock types: Assure that tree/shrub planting is performed by trained and closely supervised personnel. Hand planting is well suited to small areas, plantings on steep terrain, or sites that are rough, rocky, or have scattered slash and logging debris. Machine planting is well suited to gentle terrain and well- prepared sites.

Bare root and plug container stock: Plant seedlings upright (within 20 degrees of vertical for hardwoods, 10 degrees for conifers) at same depth or slightly deeper (1 inch) than the stock was growing in the nursery. Properly planted seedlings should resist gentle lifting pressure. Do not allow roots to be twisted or bent into a J or L shape. Inspect by digging up and replanting a sample of planted trees. Check for proper depth, root position and adequate packing of soil around roots.

Container \geq 2 gallon: Plant by hand or using an auger that is larger in diameter than the container. Handle plants by moving the container, not by grasping the stem. Remove plants from containers before placing in the ground. Straighten or cut all encircling roots to avoid future girdling problems. If plants are in paper pots, slit along each side or remove before placing in the ground. Place plants at the same depth as in the nursery and firmly pack soil around roots to eliminate air pockets. On wetland and floodplain sites the best results have been obtained when ridges or raised beds at least 12 inches high have been created and seedlings planted into these slightly raised sites.

Cuttings: Keep cuttings wet while planting. Plant in a vertical position with buds pointing up. Leave 1 or 2 good buds above ground, about 1 inch of the cutting exposed. If soil is loose, cuttings may be pushed into soil by hand, otherwise make a hole with a dibble. Firm but do not pack the soil. Assure that bottom of cuttings will be deep enough to reach moist soil.

Balled and burlapped: Dig holes $1\frac{1}{2}$ times as big as the rootball. Handle plants by moving the rootball, not by grasping the stem. Remove any rope, wire, or plastic twine from the tree. Pull back burlap around trunk and fold once in the hole. Straighten or cut all encircling roots to avoid future girdling problems.

Place plants at the same depth as in the nursery and firmly pack soil around roots to eliminate

air pockets. Water if needed.

Direct seeding: Seed may be planted mechanically or by hand, in rows or broadcast. Depth of planting for heavy seeded species will be approximately 2 times the seed diameter, or 1 to 4 inches deep, depending upon species. Plant all species at 2 inches or more if seed predation and/or low soil moisture are anticipated. Light-seeded species will be sown on the surface of the soil and firmed by rolling or cultipacking. Heavy seed that is broadcast will be disked in or covered with mineral soil and firmed by rolling or cultipacking.

Natural regeneration: In some instances it is not feasible or practical to attempt to establish a stand of trees by either planting or direct seeding in either spring or fall. Natural regeneration may be used under any of the following conditions:

- Local reports or a site inspection indicate that the site is flooded, subject to swift currents, or too wet for planting equipment in both spring and fall of the typical year.
- The site is inaccessible to planting equipment (islands or other remote sites).
- The site is on the unprotected side of levees along major rivers (fourth order stream or greater)
- There are existing mature trees suitable to the planting area, preferably including at least 2 hard mast tree species, within 200 feet of the entire planting site.

Planting Rates and Spacing

General

Bare root or cuttings: The following are typical planting rates used for woody species. Adjust rates within listed ranges for desired objectives, site conditions, maintenance requirements, planting combinations and species needs

Woody Species	Plant Rate / Acre
Hardwood Trees ¹	436 - 907
Shrubs	1089 - 1742
Conifer Trees	538 - 1210
Biofuels/Biomass	605 - 1210
¹ Can include up to 50% conifers	

Spacing	Plants / Acre	70% Survival
x 5	1742	1219
5 x 8	1089	762
6 x 6	1210	847
6 x 8	907	634
6 x 10	726	508
6 x 12	605	423
7 x 7	889	622
7 x 10	622	435
8 x 8	681	476
8 x 10	544	380
9 x 9	538	376
9 x 10	484	338

10 x 10	436	305
20 x 20	109	76
30 x 30	48	34
40 x 40	28	20

Direct seeding: Use the same rates for all intended products and purposes. Plant a minimum of 3,000 seeds per acre of heavy seeded species (see **Species Selection**) if row planting; 4,800 if broadcast seeding. If there is not a source of light seeded woody plants within 500 feet of the planting site, add another 1000 seeds per acre of either light or heavy seeded species. See Illinois Direct Seeding Handbook, Appendix A-10 for seed per pound by species. To overcome predation by wildlife, double the seeding rate for the first 100 feet beyond a forest or grassland edge.

The following chart shows row spacing and seed spacing combinations that will result in approximately

3000 seeds per acre:

Row Spacing (feet)	Seed Spacing (feet)
8	1.8
9	1.6
10	1.5
11	1.3
12	1.2
13	1.1
14	1.0

Row Spacing (feet)	Seed Spacing (feet)
15	1.0

Container: Smaller container grown stock (≥ 7 in3) can be planted at the lowest rates listed above for bare root and cuttings.

Large (≥ 2 gallon) container grown stock is best suited to sites that have a history of being wet or flooded in spring since they can be effectively planted in fall when bare root seedlings, subject to natural regeneration of soft mass species are less available and subject to frost heaving. Large container stock is capable of rapid height growth, allowing it to keep up with fast-growing, light seeded bottomland tree species. Rapid early height growth is important for establishing windbreaks. If natural regeneration is expected to fill in between container trees, plant at 28 trees per acre (approximately 40' X 40'). Adequate fill in natural regeneration is likely to occur on frequently flooded sites with an upstream floodplain dominated by woody vegetation or where a mature forest stand is within 200 feet of the planting site. If the above conditions do not exist, plant at least 48 trees per acre (approximately 30' X 30').

Balled and Burlapped: See *Energy Conservation, Snow Control and Beautification* below.

Agroforestry

See NRCS CPSs, Alley Cropping (Code 311), Windbreak/Shelterbelt Establishment (Code 380), Riparian Forest Buffer (Code 391), Silvopasture (Code 381), Multi-Story Cropping (Code 379).

Wildlife Habitat

For tree species, use any of the minimum planting rates under **Planting Rates and Spacing, General**. For shrub plantings, use one of the following guidelines:

- NRCS SPS Upland Wildlife Habitat Management (Code 645)
- Plant a minimum of 1089 plants per acre

Solid shrub plantings are best suited to small well positioned locations within tree plantations and/or along perimeters of tree plantations, property boundaries, or adjacent to agricultural crops and power lines.

For more information regarding direct seeding of shrubs, see Direct Seeding of Shrubs in REFERENCES.

For specialized wildlife planting areas refer to the appropriate conservation practice standard(s) for guidance.

Underplanting in Existing Forestland

Establishment of container trees and/or bare root seedlings in a forestland condition often will not require the same planting rate specifications as those for open fields or reforestation plantings. Individual trees or groups of trees may be planted under canopy of existing trees or planted in naturally or artificially created openings within a forest stand.

Planting rates will vary dependent upon existing stand conditions. Suitable species, stock type, location and planting density will be specified in Illinois Job Sheet 612TS, Illinois Forest Management Plan or IDNR Tree Planting Plan. Plant up to 400 bare root seedlings or up to 28 container trees (\geq 2 gallon) per acre. Spacing between two bare root trees will be no closer than 6 feet in any direction. Container trees will be spaced no closer than 20 feet in any direction.

Adapted Species and Selection

Base species selection on soil type, site limitations, landowner objectives, landscape characteristics and geographic location. Refer to conservation practice standards.

For guidance on species selection, refer to Illinois FOTG Section II, CTSG Forestland Interpretations and Windbreak Interpretations; Section IV NRCS CPSs Upland Wildlife Habitat Management (Code 645), Riparian Forest Buffer (Code 391), Windbreak/Shelterbelt Establishment (Code 380) and/or the standard for the conservation practice being planned.

All stock types: Plantation success is highly correlated with increased species diversity. Plant as many different suitable species as possible. For shrub plantations, see NRCS CPS Hedgerow Planting (Code 422) for recommended species.

Direct seeding: The following species have been successfully established using direct-seeding:

Heavy Seeded Species	Light Seeded Species
Black Walnut	Maple
Oak	Basswood
Hickory	Sycamore

Pecan	Sweetgum
Persimmon	Hackberry/Sugarberry
Kentucky Coffeetree	Black Cherry
	Tulip Poplar
	Bald Cypress
	Blackgum

Weed Control

Provide a 2-4 feet diameter competition-free zone in all directions around all woody plantings. If non-living mulches (including weed mats) are used, follow NRCS CPS Mulching (Code 484).

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

If herbicides are used, read and follow all label directions and manufacturers recommendations.

Use of living mulches and weed mats may cause an increase in rodent or deer damage to the woody planting.

If living mulches are used, use Table 1 of NRCS CPS Tree/Shrub Site Preparation (Code 490) to control weed competition.

OPERATION AND MAINTENANCE

Review and provide the operator all applicable operation and maintenance measures to maintain the conservation practice throughout the intended lifespan.

Treat the area periodically, if needed to maintain the health of the plant community. Do not conduct maintenance practices and activities during the primary reproductive period of wildlife. Exceptions can be considered to maintain the health of the vegetative community if such exceptions do not conflict with agency requirements.

Control access by vehicles and/or equipment during or after tree/shrub establishment to protect new plants and minimize erosion, compaction and other site impacts. Refer to NRCS CPS Access Control (Code 472).

Inspect the trees and shrubs periodically, and protect them from adverse impacts of insects, diseases, competing vegetation, fire, livestock, wildlife, non-functioning tree shelter and/or weed barriers, etc.

Maintain a weed-free area at least 2 feet in all directions from planted or seeded trees and/or shrubs for at least the first 2 full growing seasons after planting.

Control competing grass species in a 2-foot radius until woody plants are \geq the mature height of competing grasses.

Control plant species on the Federal or State invasive species and noxious weed lists.

If mulches are to be used, refer to NRCS CPS Mulching (Code 484). If herbicides are to be applied, read and follow all label directions and manufacturers recommendations.

Replant when survival after one growing season is less than 70% of planted materials other than seed.

Plant natural regeneration sites if recruitment and survival following 3 growing seasons is less than 500 evenly distributed seedlings per acre.

Replant direct seeded sites if survival following 2 growing seasons is less than 500 evenly distributed seedlings per acre.

Desirable natural regeneration of equitable size and species may be substituted for planted material to achieve the stocking requirements of the planned purpose.

Replant to achieve at least the minimum requirements of the intended purpose and stock type used.

Maintain 300 trees/acre for basic cover requirements or 70% of the original planting rate when specific plant densities and stock types are used for an intended purpose. Surviving plants should be evenly distributed over the planting area.

Apply appropriate minerals according to a soil test to a minimum of 15 pounds per acre of phosphorus and 150 pounds per acre of potassium. Adjust pH only when human action has resulted in an unnatural pH. Periodic applications of nutrients may be needed to maintain plant vigor. If nutrients are applied, refer to NRCS CPS Nutrient Management (Code 590).

Following full establishment of trees/shrubs, refer to NRCS CPSs Forest Stand Improvement (Code 666) and Tree/Shrub Pruning (Code 660) for subsequent management.

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