

TREE/SHRUB PLANTING PROCEDURES (380TPP)

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1/ Tree and shrub planting plans will contain/specify all the procedures for items I-X that are applicable to the site. These procedures are considered components of the tree/shrub planting practice.

2/ Field Office Technical Guide (FOTG) tree and shrub planting practices and codes are as follows:

- Critical Area Planting (practice code 342)
- Riparian Forest Buffer (practice code 391)
- Tree/Shrub Establishment (practice code 612)
- Windbreak/Shelterbelt Establishment and Renovation (practice codes 380 and 650)
- Wetland Wildlife Habitat Management (practice code 644)
- Upland Wildlife Habitat Management (practice code 645)
- Restoration of Declining Habitats (tree planting portion only, practice code 643)

Important!!!

The success of any tree planting is dependent upon the site preparation, stock quality, planting and handling techniques, and maintenance used by the planner, vender, planter, and landowner. Procedures in this document illustrate a wide variety of methods that have proven successful for conservation tree and shrub plantings in Nebraska.

I. PREPARATION OF PLANTING SITES: Planting sites shall be properly prepared at least the fall prior to spring tree/shrub plantings and at least 3-months prior to fall plantings. Proper site preparation is essential for survival and adequate growth rate of newly planted trees and shrubs. If erosion is a concern, adequate erosion control measures including cover crops will be utilized.

A. Grass, Alfalfa, or other herbaceous vegetation: Aggressive dense sod forming grasses like Smooth bromegrass and Reed canarygrass and alfalfa will severely reduce the growth rate of

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trees and shrubs. Where these grasses or alfalfa are present, they shall be eliminated from the entire tree-planting site, unless fabric mulch is being utilized or the sod is killed back from the tree row at least twice a year until the trees shade out the grass. Tall native warm season grasses like Big bluestem, Indiangrass, and Switchgrass will also adversely impact the growth rate of seedling trees and shrubs. The most appropriate method of site preparation from the following options will be used prior to planting trees:

1. Aggressive sod forming grasses and alfalfa (The following methods may be used):

- a. Spray the entire site the season prior to tree planting with a non-selective herbicide according to label requirements and/or till (tillage/spraying must be adequate to kill vegetation).
- (1) Seed a cover crop of sudan, sorghum, or millet if needed to control erosion. Small grain cover crops such as rye and wheat can also be used as a cover crop, but must be killed with a non-selective herbicide while in a vegetative state (prior to making a seed head) to avoid allelopathic effects from mature straw.
 - (1) Plant the trees into the cover crop residue the following spring (refer to Range Planting 550 for guidance on cover crops).
 - (2) Summer fallow one year or longer, if necessary, to kill the sod. Till in the spring before planting the trees. A fall-sown crop of oats may be used where needed to control soil erosion.
 - (3) Plant trees directly into the sites that are sprayed sod where practical. When a tree-planting machine is used on heavy soils, tree row tillage the previous fall is usually necessary to break up the sod. Breaking up the sod allows moderate compaction to get root-soil contact and eliminates air pockets that dry out tree roots.
 - b. Kill sod by tilling or spraying at least a six-foot wide strip with non-selective herbicide according to label requirements the season prior to tree planting. This option is only applicable on sites where fabric mulch is being utilized or the sod is killed back from the tree row at least twice a year until trees shade out the grass. Sod must be killed at least 2-feet wider than the fabric mulch for Option 1 of anchoring fabric mulch and the same width as the fabric mulch for Option 2 (refer to Section IX Fabric Mulch Installation). Tillage and/or spraying must be adequate to kill vegetation.

2. Non-aggressive vegetation (i.e. mid and low growing native grass sod and/or those species listed in Section VI "Vegetative Cover Between Tree/Shrub Rows"). The following methods may be used:

- a. Scalp planting or furrow planting into narrow strips may be used on these sites **when planting conifers, and/or planting broadleaf trees and shrubs where animal control devices are utilized.**
 - (1) When scalp planting, conifers or broadleaf trees/shrubs with animal control devices are planted in a shallow furrow 2 to 4 inches deep that is at least 18-inches wide with the sod thrown to both sides. The furrow shall be prepared immediately prior to or as part of the planting operation. Plantings on these sites shall be limited to conifers since they are less subject to rodent damage and more likely to succeed. Broadleaf trees and shrubs may be planted with this method when animal control devices that are adequate to avoid damage from the rodents are installed immediately after planting. Suitable broadleaf trees and shrubs without animal

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control devices can be used if at least a six-foot strip is killed with tillage or a non-selective herbicide or when fabric mulch is being installed according to requirements in Section IX "Fabric Mulch Installation".

- b. Strip tillage or non-selective herbicides may be used on sites planted to all tree and shrub species (refer to photo of strip tillage of native sod below).
 - (1) A minimum of six-foot-wide strips will be killed the season prior to planting trees.
 - (2) Trees may be planted with a narrow furrow directly into killed sod when chemical methods are used.
 - (3) When fabric mulch is being applied, site preparation width shall be 2 feet wider than the fabric mulch for option 1 and the same width as the fabric mulch for option 2. Residue from sod killed by a non-selective herbicide shall be mowed and removed prior to tree planting when it interferes with the placement of fabric mulch.
- c. Mow a strip and remove residue prior to tree planting that is at least the same width as the fabric mulch for Option 2 of anchoring fabric mulch (mowing only applies to option 2).

Photograph of Strip Tillage on Native Sod



3. Sites with aggressive sod forming grasses (i.e. bromegrass and Reeds canarygrass) and alfalfa where it is not possible to operate equipment to kill all vegetation on the entire planting site the following methods of site preparation may be used.
 - a. Fabric must be installed when planting on sites where it is not possible to operate equipment that contain aggressive sod forming grasses or alfalfa.
 - b. Kill sod by tilling, or spraying a strip with non-selective herbicide according to label requirements the season prior to tree planting. Sod must be killed that is at least 2 feet wider than the fabric mulch for Option 1 of anchoring fabric mulch and the same width as the fabric mulch for Option 2. Tillage and/or spraying must be adequate to kill vegetation.
 - c. Residue from sod killed by a non-selective herbicide shall be mowed and removed prior to tree planting when it interferes with the placement of fabric mulch.
- B. Row Crop and Small Grain Sites:** (Caution: Avoid cropland sites that have had recent applications of herbicides that could be harmful to the selected trees or shrubs.)
1. If the site is in row crop, trees may be planted directly into crop stubble unless residue is too heavy or ridges need to be leveled for the tree planter to successfully plant into. When residue is too heavy or ridges need to be leveled, till in the fall prior to planting the trees when possible. Deep chiseling prior to disking may be needed to break potential hard or plow pans. When tillage is necessary, a fall-sown crop of oats may be used where needed to control erosion.

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2. If the site is in soybean stubble, the trees may be planted in the spring without further preparation, unless ridges need to be leveled.
3. If the site is in small grain stubble, the trees may be planted in the spring without further preparation. Grass plantings may need to be delayed due to allelopathic effects.
4. On sandy soils, crop residue or a planted cover crop between the rows may be necessary to prevent wind erosion.
5. On steep slopes, tillage operations shall be on the contour or with terraces where practical. Crop residue or a planted cover crop between the rows may be necessary to prevent excessive erosion and/or siltation.

II. PLANTING STOCK

This guide is to be used as a reference when advising cooperators as to the size and quality of nursery stock desirable for use in tree plantings. Larger stock or containerized stock is also acceptable for use. All undersized, poorly rooted, diseased, or otherwise poor quality trees shall be disposed.

A. Plant Size

1. Broadleaf species
 - a. Seedlings not less than 7/32" or more than 3/8" in caliper 1" above the root collar are recommended.
 - b. Planting stock that is 18-inches to 24-inches tall offered by most commercial nurseries would meet this standard.
2. Coniferous species
 - a. Planting stock must have a good balance between top and root.
 - b. Seedlings shall be 2 to 3 years old (2-0 or 2-1 stock) and 5 inches to 12 inches tall. Seedlings shall be either transplants or bed root pruned. One year old, eastern redcedar seedlings (1-0 stock) may be used when 2-0 stock is not available, if they are not less than 1/8" in caliper and 1" above the root collar.
3. Greenhouse container grown seedlings that meet the size requirements above are adequate for field planting.

B. SEED SOURCES

1. All planting stock shall be purchased from nurseries that are known to be using locally adapted seed or cuttings of known origin.
2. Species that are not native to the site or similar sites, shall be from seedlings produced from seed collected from localities having climate, latitude, and altitude similar to the site, or from known seed sources that have been selected and tested in tree improvement programs for adaptability.
3. Planting stock must be certified disease and insect free (special caution shall be taken for out-of state seed stock).

C. HANDLING AND STORAGE

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1. Seedlings shall be kept in a dormant stage until planted. They shall be stored in a cool, moist environment (preferred temperature of 34-40 degrees F.).
2. If regulated cool storage is not available, the plants may be "heeled in" by temporarily covering the roots with damp soil in a cool shaded area.
3. During all stages of handling and storage, the roots will be kept moist and cool. Plants that have been to heat in the bale and/or to develop mold or the roots allowed to dry shall not be planted.
4. Poor quality or damaged stock shall be destroyed.

III. PLANTING DATES (bare root and containerized/potted plants)

- A. Plant only when the soils are free of frost.
- B. Bare root plants shall be planted only when they are in a dormant stage.
- C. Planting seasons:

1. Spring -Plant no later than the following for individual vegetative zones:

* see footnote below	Conifer	Broadleafs
Vegetative Zone I	June 1	June 1
Vegetative Zone II	May 22	June 1
Vegetative Zones III & IV	May 15	May 22

*Planting dates may be extended up to one week if weather and site conditions are adequate.

2. Fall – Planting statewide:
 - a. September 15 until the ground freezes.
 - b. Use only potted/containerized plants in the fall.
 - c. Soil moisture conditions must be adequate or if supplemental watering that thoroughly soaks the soil profile is completed.

IV. PLANTING OPERATION

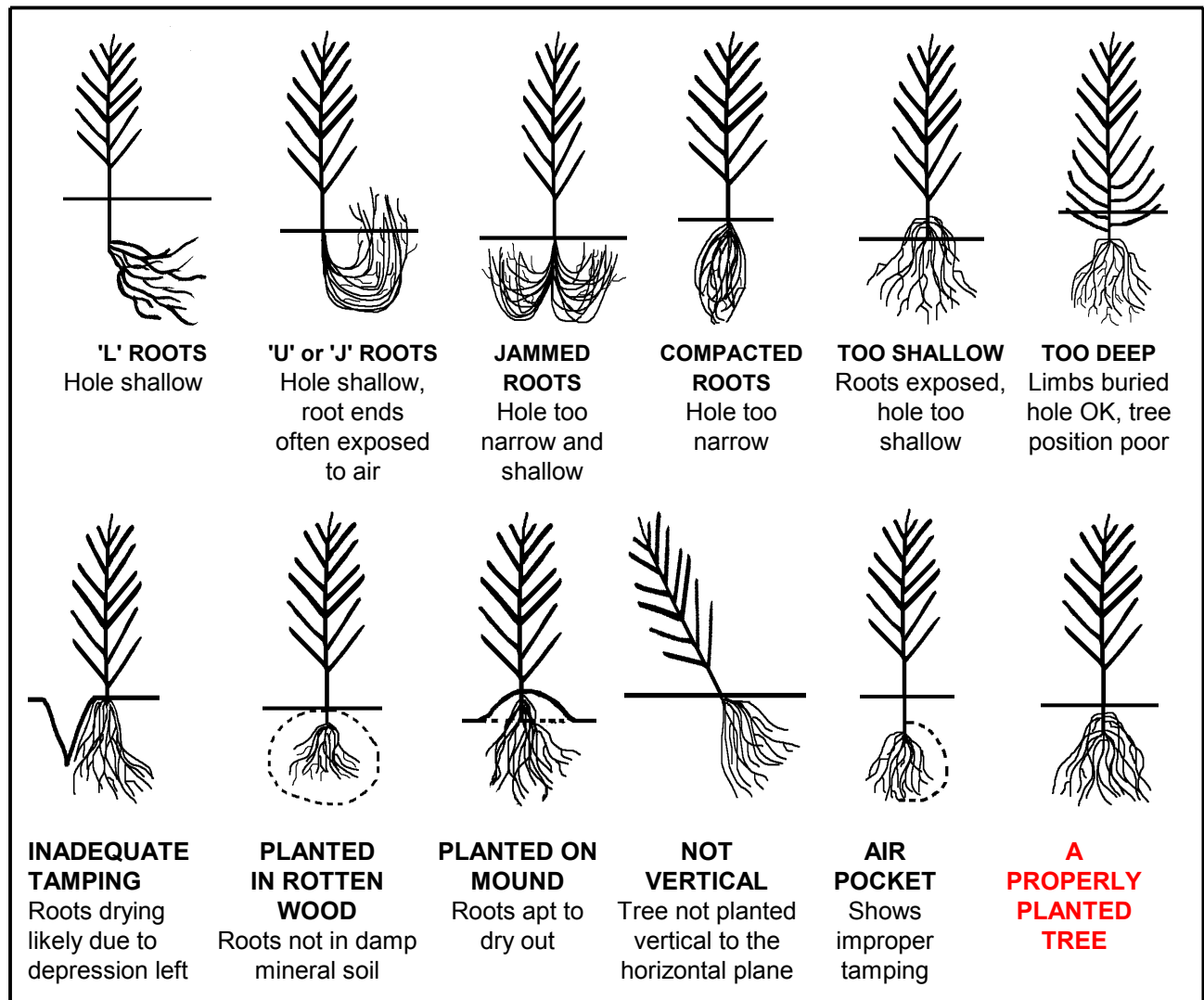
Planting conditions, seedling care, and proper planting methods are very important. The following guidelines will be followed:

- A. During planting operation, roots of trees or shrubs must be protected from **drying out**. Have water on site to soak and keep roots wet. Plantings should not be done when weather conditions exceed 80 degrees F and/or wind speed exceeds 20 mph. When it is not possible to delay planting when weather conditions exceed 80 degrees or wind speed is greater than 20 mph, a root-dipping polymer will be used in addition to having water on-site to soak roots.
- B. Trees and shrubs shall not be planted when the **temperature** is at or below freezing.
- C. Trees and shrubs shall be planted in a vertical **position** with the root collars at or approximately one-inch below the soil surface (refer to figure 1 for proper planting method).

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D. The trench or hole for planting must be **deep and wide** enough to permit the roots to be spread out as naturally as possible.

E. Sufficient soil **compaction** is needed to assure good root-soil contact and to eliminate air pockets



that allow the soil and roots to dry.

Figure 1 (Drawings 1-11 illustrate various ways that trees shall NOT be planted, the ideal planting is shown in drawing 12.)

V. CONTROL OF COMPETITIVE VEGETATION AFTER PLANTING (annual and perennial vegetation)

Competitive vegetation shall be controlled for a minimum of 3 years and thereafter as needed to successfully establish the tree planting. Competitive vegetation includes competitive annual and perennial broadleaf and grass weeds, aggressive sod forming grasses, and alfalfa. Aggressive sod forming grasses such as Smooth brome grass, Reeds canarygrass, and alfalfa need to be eliminated between the tree rows where practical. The operation and maintenance plan shall provide for keeping competitive vegetation including all aggressive sod forming grasses and alfalfa at least three feet outside the drip line of the trees or shrubs by mechanical, chemical, or physical control. Refer to the Section I “**Preparation of Planting Sites**” for requirements on controlling perennial vegetation prior to planting. Erosion control must be addressed on erosive sites. Select the appropriate site conditions and alternative(s) from the following:

A. Non-Erosive sites shall have competitive vegetation controlled by one or more of the following methods:

1. Between the tree rows

- a. Clear cultivation with a spring tooth harrow, sweep chisel plow (duckfoot), disk (tandem disk only), shovel cultivator, or other tillage implement. Tillage depth would be 2 to 4 inches to avoid damage to tree roots.
- b. Plant an annual cover crop like grain sorghum or forage sorghum. Approximately 4-feet shall be left between the cover crop and the tree row.
- c. In some cases, chemicals may need to be used on the entire tree planting area to control competitive vegetation (refer to the current Cooperative Extension “Guide for weed management in Nebraska and/or product label). If this method is used, caution must be taken to avoid erosion and concentration of the chemicals from runoff or damage to trees from drift or overspray.
- d. Mow between the rows approximately once each month during the growing season.

2. In the tree row

- a. Hand hoeing
- b. Tractor-mounted row hoes
- c. Over the row cultivation with a flexible tine or finger-type weeder (when weeds are in less than the three-leaf stage)
- d. Use an appropriate herbicide to control competitive vegetation in a 1 ½ to 2-foot band adjacent to each side of the tree row or 3 to 4-foot diameter circle around each tree (refer to the current Cooperative Extension “Guide for weed management in Nebraska and/or product label).
- e. A rototiller or other small tillage device may be used.
- a. Polypropylene fabric mulch in rolls or fabric squares installed according to requirements in Section IX Fabric Mulch Installation.
- f. Utilize organic mulch consisting of clean corncobs, woodchips, or bark. Do not use hay or straw mulch; these materials harbor rodents that can girdle the trees. Refer to the

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Mulching standard (484) for other requirements when installing these types of organic mulch.

B. Erosive sites that are not scalp planted shall have competitive vegetation controlled by one or more of the following methods:

1. Between tree rows;

- a. Plant an annual cover crop like grain sorghum, or forage sorghum. Approximately 4 feet should be left between the cover crop and the tree row.
- b. Use appropriate herbicides to minimize weed growth.
- c. Mow between the rows approximately once each month during the growing season.

2. Within tree rows

- b. Hand hoeing
- c. Tractor-mounted row hoes
- d. Over the row cultivation with a flexible tine or finger- type weeder (when weeds are in less than the three-leaf stage).
- e. Use an appropriate herbicide to control competitive vegetation in a 1½- to 2-foot band adjacent to each side of the tree row or 3 to 4-foot diameter circle around each tree (refer to the current Cooperative Extension "Guide for weed management in Nebraska and/or product label).
- f. Rototill at least a 12-inch wide strip, 2 to 4 inches deep along each side and in the row approximately once each month during the growing season.
- g. Polypropylene fabric mulch in rolls or fabric squares installed according to Section IX Fabric Mulch Installation.
- h. Organic mulch consisting of clean corncobs, woodchips, or bark. Do not use hay or straw mulch; these materials harbor rodents that can girdle the trees. Refer to the Mulching standard (484) for other requirements when installing these types of organic mulch.

C. Erosive sites that are scalp planted into non-competitive permanent vegetative cover shall have competitive vegetation controlled by the following alternative methods:

1. Between the tree rows:

- a. Mow between the rows approximately twice during the growing season.

2. In the tree rows:

- a. Hand hoe or weed around each tree
- b. Rototill a 12- to 24-inch wide strip 2 to 3 inches deep along each side and in the row approximately once each month during the growing season.
- c. Use an appropriate herbicide to control competitive vegetation in a 1½- to 2-foot band adjacent to each side of the tree row or 3 to 4-foot circle around each tree (refer to the current Cooperative Extension "Guide for weed management in Nebraska" and/or product label).

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- d. Polypropylene fabric mulch in rolls or fabric squares installed according to Section IX Fabric Mulch Installation.
- e. Organic mulch consisting of clean corncobs, woodchips, or bark. Do not use hay or straw mulch; these materials harbor rodents that can girdle the trees. Refer to the Mulching standard (484) for other requirements when installing these types of organic mulch.

VI. VEGETATIVE COVER BETWEEN TREE/SHRUB ROWS (low maintenance grass seedings)

A. Site selection:

1. Plant where a low or mid size cover is desired for aesthetic reasons.
2. Plant where erosion can not be controlled with other methods and/or when the area between tree rows will not have tree canopy cover in the desired time frame.

B. Site preparation and planting:

1. Grasses/legumes such as Smooth brome grass, Reed canarygrass, and alfalfa must be eliminated prior to planting less competitive vegetative cover. Planting may be done directly into chemically killed sod or a clean tilled seedbed.
2. Plant directly into crop stubble or plant a cover crop, i.e., grain sorghum, sudan grass, millet, etc. between the tree rows the growing season prior to seeding grass. Refer to the Pasture and Hayland (512) and/or Range Seeding (550) standards and specifications for the proper method of using a cover crop for seedbed preparation.

C. Species selection and seeding requirements:

1. Refer to Tables 2 and 3 for example mixtures and a list of potential grass species to be utilized for permanent vegetation cover plantings.
2. Species selected must be adapted for the site. Refer to FOTG Section II-Pastureland and Hayland Interpretations "Certified Grass Varieties for Nebraska" for guidance on the appropriate grass varieties to use.
3. Seed at least 30 pure live seeds (PLS)/ sq. ft of grass or grass/legume.
4. Plant mixtures of predominately native grasses directly into a cover crop residue or other properly prepared seedbed during the time period November 1 to May 31 (optimum - March 1 - May 15). Refer to Range Seeding 550 standard and specification for more guidance.
5. Plant mixtures of predominately cool season grasses into a properly prepared seedbed from August 1 to September 15 and November 15 to May 1. Refer to Pasture Planting 512 for more guidance.

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TABLE 2. Example Permanent Vegetation Cover (low maintenance) Mixtures (species must be adapted to the site)

Vegetative Zones	Cool Season or Warm season	Species/ Mixture	Percent of Mixture	PLS lbs/ac
I, II, III, IV	Warm Season	Sideoats grama	100	6.8
I, II, III, IV	Warm Season	Sideoats grama	60	4.1
		Blue grama	40	0.6
I, II, III, IV	Warm Season	Sideoats grama	35	2.4
		Blue grama	32	0.5
		Little bluestem	32	1.6
I, II, III, IV	Warm Season	Sideoats grama	60	4.1
		Blue grama	30	0.5
		Buffalo grass	10	2.3
I, II, III, IV	Warm Season	Buffalograss	37	8.5
		Blue grama	63	1.0
I, II, III, IV	Warm Season	Buffalograss	100	23.3
I	Warm and Cool Season	Green needlegrass	27	2.0
		Sideoats grama	29	2.0
		Blue grama	25	0.4
		Little bluestem	19	1.0
IV	Cool Season	Orchardgrass	90	1.8
		Red Clover	10	0.5

TABLE 3. Potential Species For Permanent Vegetation (low maintenance) Cover Mixtures (species must be adapted to the site)

Vegetative Zones	Potential Species
I, II, III	Sideoats grama, Buffalograss, Hairy grama, Prairie junegrass, Little bluestem, Green needlegrass, Blue grama, all other short native warm season grasses, and adapted native legumes
IV	Orchardgrass, Red clover, White clover, Sideoats grama, Buffalograss, Hairy grama, Prairie junegrass, Little bluestem, Blue grama, all other short native warm season grasses, and adapted native legumes

D. Operation and Maintenance:

1. A short and midsize permanent vegetation cover grass mixture will need to be mowed at least once a year at the appropriate time of the growing season when non-desirable species begin to invade.
2. Sites planted to short grasses that are naturally tall grass prairies shall be mowed at least twice a year to keep non-desirable species from invading.
3. Mowing should occur by the first of June and must cease six weeks prior to a killing frost on native warm season grasses. Mowing on cool season grasses/legumes should occur after July 1 and no later than September 15. Mowing for weed control during establishment shall

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be completed whenever necessary. Note: Mowing should be delayed until after July 15 to avoid detrimental effects on nests of upland game birds and grassland songbirds.

E. Other alternatives to low maintenance grass seedings:

1. Tall/mid height native grasses (i.e. Big bluestem, Western wheatgrass, Switchgrass, etc.) not listed in Table 3 and adapted to the site according to Range Planting (550) or Pasture and Hayland Planting (512) can be utilized **only** if fabric mulch is installed. When taller native grasses are utilized, they shall be kept at least 4 feet away from the drip line of trees and mowed once annually.
2. Annual cover crops such as milo, millet, and sudan may be planted annually as long as it is managed to avoid excessive damage from rodents, deer, etc. For guidance on planting requirements, refer to "340 Cover Crop".

VII. CARE AND MAINTENANCE

A. Replanting

1. Dead or damaged trees will be replaced by replanting as needed within 3 years after the planting. Ensure the planned density or purpose of the tree planting practice can be achieved. Refer to Nebraska Forestry Technical Note No. 63 for detailed replanting requirements.
2. Replanting will be made with the same species or a species with a similar habit of growth.

B. Protection

1. Livestock will be prevented from damaging the tree planting. Fencing shall be used to exclude livestock if necessary.
2. Prevent fire hazards by keeping the area between rows and isolation strip (area on outside edges) cultivated or mowed. Crop residue, weeds, trash, or other materials shall also be removed.
3. Protect young trees from wild mammal damage by using individual tree protection devices (tubes or other devices), animal repellants, and/or fencing. See Woodland Technical Note 51 for detailed information on animal repellents.
4. Keep trees/shrubs reasonably free of trash such as residue, weeds, or other materials that can harbor rodents. Do not use hay or straw mulch; these materials harbor rodents that can girdle the trees. If organic mulch is desired, clean corncobs, woodchips, or bark are recommended. Refer to the Mulching standard (484) for other requirements when installing these types of organic mulch. Fabric mulch installed according to Section IX Fabric Mulch Installation may also be utilized to control rodents an.
5. Control mice, gophers, and other undesirable rodents by the use of poison baits. Mouse baits should be placed in tin cans nailed to a board. Gopher baits are best placed with a machine of the "gopher-getter" type.
6. Install animal protection devices when rabbits, or deer or other animals are a concern.
7. To prevent, detect, and treat for insects and diseases, trees should be examined monthly. Seek professional assistance for diagnosis and control measures.

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C. Management

1. Management of tree plantings is oriented towards maintaining a dense and vigorous stand of trees/shrubs. The following practices may help accomplish this goal:
 - a. Competitive vegetation including annual weeds and perennial vegetation will be controlled before and after planting (refer to Section I "Preparation of Planting Sites" and Section V "Control of Competitive Vegetation After Planting").
 - b. Prune to remove dead, dying, and broken branches.
 - c. Thin trees prior to maturity to prevent overcrowding and stagnation.
 - d. Old windbreaks that are ineffective should be renovated by removing diseased and dead trees, and filling in voids by replanting new trees/shrubs to maintain their planned density and effectiveness. Refer to Windbreak Renovation (650) for guidance.
 - e. Root pruning may be needed to prevent crop yield reduction adjacent to windbreaks. Refer to Windbreak Renovation (650).

D. Supplemental Watering

It is impractical to give a standard recommendation on watering rates or water requirements because of varied soil types and variations in weather conditions. The following general guidelines should be followed:

1. Soak the soil profile thoroughly to a depth of 3 to 5 feet for established trees and 2 to 3 feet for newly planted seedlings. Do not water again until the profile has dried for established trees and the upper one-foot has dried for newly planted seedlings. Thorough watering at less frequent intervals is more desirable for root development than frequent, light watering.
2. Watering one or two times per week will probably be needed for newly planted trees. Two to five gallons of water per plant per watering should be applied to small trees and five to ten gallons for large established trees.
3. After the first year, it is desirable to decrease watering frequency and increase the amount of water applied per watering.
4. The first watering in the spring after the last frost and the last watering in the fall before the first frost are most important to maintain plant vigor.

VIII. DRIP WATERING SYSTEM

A. General Considerations

1. The inclusion of a drip watering system as a component part of a tree planting should be considered a temporary part of the planting. It will help insure survival of new plantings and provide supplemental water during periods of drought and promote faster growth for more protection and wildlife cover.
2. Drip watering is based on the concept that prevention of moisture stress (as opposed to correcting moisture stress) will be realized by maintaining favorable soil moisture conditions on only a portion of the root system. Water is applied at slow rates (1 to 2 gallons per hour) for a sufficient period of time to maintain part of the soil at or near field capacity.
3. The installation of a drip watering system is for establishment purposes and is normally limited to new plantings 3 years or less in age.
4. An adequate water supply shall be required before the system is installed.
5. Preference should be given to those woody species that are both deep rooted and long lived.
6. Preference should be given to those plantings that can produce multiple benefits.

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B. Design and Installation

Drip system shall be designed in accordance with 441 Irrigation Systems Microirrigation System (441). The following guidance shall also be followed:

1. A drip watering system is designed to provide equal delivery of water from all emitters after considering pressure, friction or line loss, elevation changes, and any other factor that influence flow of water.
2. Minimum pressure must be provided at the critical point of the system. The critical point is the point in the system where the difference in elevation between the ground and the hydraulic gradient is the least. For systems requiring over 15 psi, pressure-compensating emitters will be used unless an even discharge rate can be obtained with non-compensating emitters.
3. The emitter shall be placed within 12 inches of the plant.
4. All pipelines shall be designed to permit draining to prevent freezing damage and permit flushing to remove foreign matter, such as algae, etc. which could clog the emitters.
5. A pressure regulator shall be installed when needed.
6. A filtration system shall be provided at the system inlet that meets manufacture's requirements for the emitter being installed. The filtration system will not be less than a 100 mesh or its equivalent.
7. A pressure gauge is required in the line at the outlet end of the filter. A pressure gauge installed in front of the filter may be desirable, but it is not required.
8. An injector may be provided ahead of the filter so that chlorine can be injected into the system to prevent algae or organisms from plugging the emitters. Fertilizer can also be injected into the irrigation system through the device.
9. An automatic timer is desirable, but not required.
10. The header line should go to the high point or critical point, where practical, and the laterals attached to run downgrade.
11. The lateral lines shall be snaked during installation (not less than 1 foot per 100 feet nor more than 5 feet per 100 feet) to allow for contraction and expansion. Lateral lines should be extended approximately 5 feet past the last emitter in the row with end cap or flush valve to flush sediment.
12. Friction Loss charts found in the National Engineering Handbook, Section 15, Irrigation, Chapter 7, Trickle Irrigation, may be used for design of main and lateral lines. Effects of multiple outlets (emitters) on friction loss shall be considered. Velocity in any lateral, manifold, or main shall not exceed 5 ft/sec.
13. The basic layout and installation is as follows: From the main supply line or hydrant, an injector, filter, and pressure regulator (when needed) are installed. Following the filter, a pressure gauge is installed. From there the line is extended to the planting and continued across the rows as a header (sometimes called a sub-main or manifold). This line may be as small as $\frac{3}{4}$ " if it will carry the designed flow. Attached to the header line, $\frac{1}{2}$ " or larger black plastic laterals are snaked in the row with emitters placed within 12 inches of the plants. Lateral lines are extended at least 5 feet beyond the last plant and a flushing type end plug installed.

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IX. FABRIC MULCH INSTALLATION

A. Material requirements for fabric mulch and staples.

1. One layer of Polypropylene fabric with polyester blend that has the appearance of tightly woven burlap on the soil surface (Refer to photo of Option 1 for anchoring fabric mulch).
2. When Option 1 is used to anchor mulch and when scalp planting, the minimum width for continuous roll fabric mulch or individually placed fabric squares is 6 feet.
3. When Option 2 is used to anchor mulch the minimum width for continuous roll fabric mulch or individually placed fabric mat squares is 3 feet.
4. Fabric thickness is a minimum of 14 mil.
5. Fabric must be black and/or capable of preventing underlying plant growth.
6. Fabric must be treated with carbon black that provides not more than 70% breakdown by UV light after 2500 hours, which prevents breakdown for about 5 years.
7. Slots must be cut wide enough (for at least a five year old tree) at the time of planting to avoid girdling of trees. When shading will occur prior to breakdown of fabric mulch, slots must be cut wide enough for mature trees.
8. Staples shall be at least 8 inches in length.

B. Installation requirements for fabric mulch on continuous rolls by machine installation.

1. Site preparation width shall be 2 feet wider than the fabric mulch for option 1 and the same width as the fabric mulch for option 2. Follow site preparation guidelines in (according guidelines found in Section I "Preparation of Planting Sites").
2. On sites where non-aggressive vegetation are present (i.e. mid and low growing native grass sod and/or those species listed in Section VI "Vegetative Cover Between Tree/Shrub Rows"), fabric mulch can be installed over existing vegetation; vegetation shall be mowed and removed first.
3. Fabric mulch installation shall occur **no later than 30 days** after trees are planted to insure adequate weed control and/or water conservation. For best results, the fabric should be installed right after the trees/shrubs are planted.
4. Fabric mulch will be centered over planted trees. During installation, an 'X'-shaped cut is made in the fabric; and the tree is pulled into an upright position through the fabric mulch. The seedling shall be pulled out from under the fabric as soon as possible to avoid heat-damage to the seedlings. The cut should be kept as short as possible to position a tree with a maximum cut length of twelve inches. If shading of fabric occurs prior to breakdown, the cut shall be large enough to avoid girdling of trees/shrubs.
5. When planting trees/shrubs after mulch anchoring, make an 'X'-shaped cut in the center of the barrier for access to the soil. Keep the cut as small as possible to plant the tree/shrub and no longer than 12 inches. If shading of fabric occurs prior to breakdown, the cut shall be large enough to avoid girdling of trees/shrubs.
6. For renovation sites, two three-foot widths of continuous roll fabric mulch may be used. Cut and lay the material around the base of the trees/shrubs. Fabric mulch will be overlapped six inches in the center and anchored using manufacturer's staples. Staples shall be placed within six to twelve inches of the base of each tree/shrub.
7. If row spacing is such that fabric mulch overlaps, use manufacturer's staples (option 2); otherwise, either option is acceptable.

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C. Anchoring Fabric Mulch (two options based on width of fabric)

1. Option 1 – Continuous roll fabric mulch or fabric squares that are at least 6 feet wide will be anchored by placing soil over the entire edge of the fabric. Placed soil is required to cover at least one foot of each edge of the material (squares will need all four edges covered). A shovel of soil or staple will be placed near the center of the fabric approximately 6 inches from each tree/shrub (see figure 2). Refer to photograph below for example.
2. Option 2 – Continuous roll fabric mulch or fabric squares that are at least 3 feet wide will be anchored by using staples. Staples will be placed along each edge and down the middle of the material. Maximum placement of the staples will be at three-foot intervals or closer when specified by the manufacturer. A middle staple will alternate with the edge staples. The middle staple is not required on renovation sites where two three-foot rolls are used. When using fabric squares, each corner and the center will be anchored with staples.

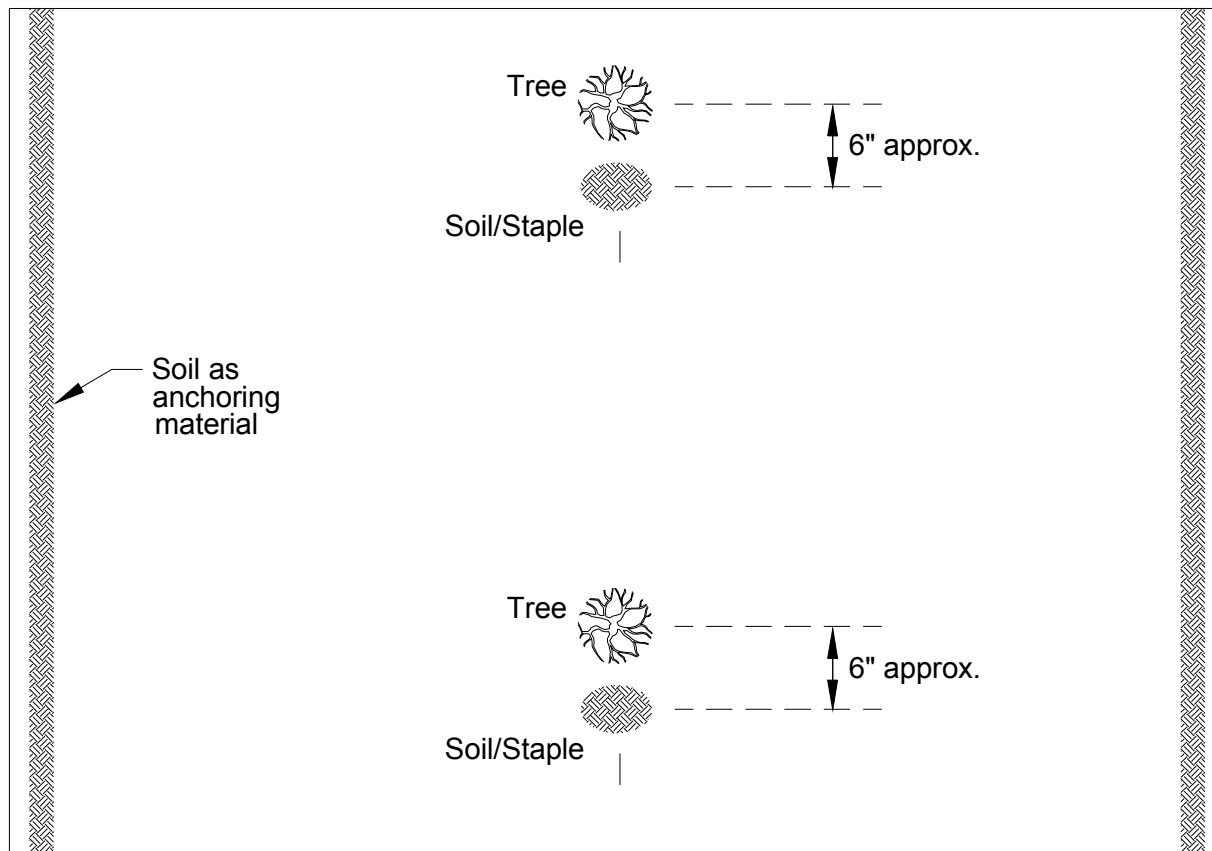
D. Special Planning Considerations When Installing Fabric Mulch

1. If installed, place drip systems on top of the fabric mulch for easier maintenance.
2. Good site preparation (according guidelines found in Section I “Preparation of Planting Sites”) the year prior to installing mulch is essential to store moisture in the soil, especially on sodbound sites (e.g. smooth brome) and during droughty conditions.
3. Mulch will repel water for 3-4 weeks due to chemical surfactant applied to the fabric during manufacturing. Installing mulch so runoff water will gravitate towards trees/shrubs in order to maximize moisture collection will reduce supplemental watering that may be needed.
4. For maximum moisture collection, it is best to have that portion of the fabric mulch near seedlings lower than the outer edges. When machine planting, this can be accomplished by deepening the planter furrow and pushing the fabric center into this depression by walking on it while pulling seedling tops through the X-shaped cut.
5. If the soil is very dry at planting time, watering may be done before fabric installation.
6. When using Option 1 to anchor fabric mulch on slopes greater than 5 percent, consideration should be given to placing staples in addition to soil anchor next to the base of each tree as an additional anchor.
7. Tree and shrub planting plans will specify site preparation requirements, tree/shrub rows where mulch is to be installed, total length and width of mulch required, and specific anchoring requirements
8. On slopes greater than 10% and very long slopes allow for a 10-foot gap in the continuous roll fabric mulch and ensure water is diverted away from mulch, every time a new roll is started to reduce the risk of water washing the fabric away and causing erosion.

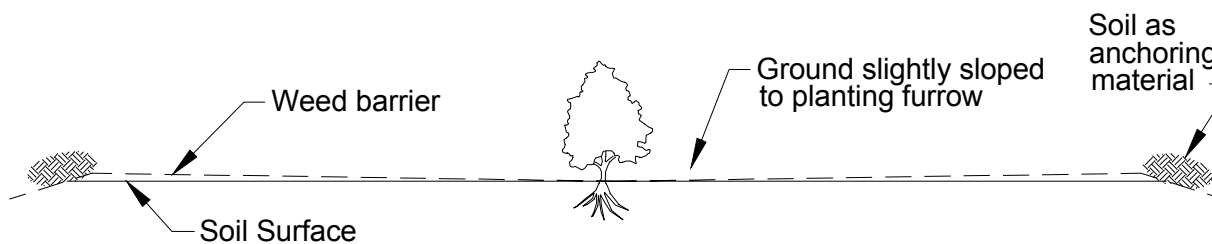
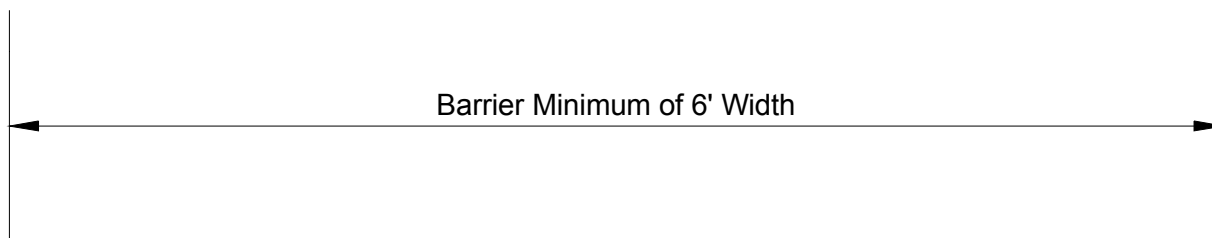
Photograph of Option 1 for Anchoring Fabric Mulch



Figure 2 - Polypropylene Fabric Mulch (Option 1)



Top View



Side View

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X. DIRECT TREE/SHRUB SEEDING (Does not apply to Windbreak/Shelterbelt Establishment and Renovation - practices 380 and 650 or Critical Area Planting 342)

A. Adapted Species

1. The following species are best suited for direct seeding methods:
 - Black walnut
 - Oaks (preference on native species)
 - Hickories (preference on native species)
 - Ponderosa pine (north central and northwest Nebraska)
 - Green ash
 - Maple Species
 - Pecan (eastern Nebraska only)
 - Horsechestnut/Ohio buckeye
 - Hazelnut
 - American plum
 - Chokecherry

B. Direct Seeding Sites

1. Tree and shrub species utilized for direct seeding methods must be suited to the site according to Field Office Tech Guide Section II Windbreak Interpretations (Tables 1-10 in the Conservation Shrub/Tree Suitability Group information).
2. Avoid direct seeding on southerly or westerly slopes, which are exposed to intense summer sunlight and winds that make them droughty.
3. Site preparation shall be done according to guidelines in Section I "Preparation of Planting Sites". Direct seeding sites should have no or very sparse vegetation. If aggressive sodforming grasses (i.e. Smooth brome grass), or alfalfa are present, all vegetation will need to be killed according to site preparation guidelines. Seeding directly into aggressive sodforming grasses without killing it is not acceptable!!!
4. For broadcast seeding of light seed (ash, maple, pine) having bare soil and all aggressive sod killed is essential.

C. Rate of Seeding

1. Broadcasting - minimum of 10,000 heavy seeds per acre and a minimum of 30,000 light seeds per acre. Species such as oak, walnut, hickory, etc. have heavy seeds (nuts and acorns) and species such as ash, maple, pine, etc. have light seeds.
2. Machine and/or hand planting – Plant a minimum of 5,000 heavy seeds per acre (seed will be placed from 6 inches to 2 feet in the row and from 8 to 25 feet between rows, based on species, landowner objectives and maintenance equipment).

D. Seed Collection and Quality

1. Seed should be obtained from natural/well adapted stands within 120 miles of the planting location or from a reliable seed source that will ensure adaptability.
2. Germination is best for most species when the seed is collected and planted the same fall. Seed should not be allowed to completely dry. Black walnuts can be held over the winter (stratified) and planted in the spring. Silver maple and white oak species should be planted immediately after seeds mature and fall.

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E. Preparation of Planting Sites

Planting sites shall be properly prepared before planting. Refer to Section I "Preparation of Planting Sites" for more details on killing existing vegetation. The following methods may be used to prepare the site for direct seeding:

1. Light seeds (ash, maple and pine): Eliminate vegetation and cultivate the ground to provide bare exposed soil. If sod is present, kill the sod on the entire site the prior to seeding according to guidelines in Section I "Preparation of Planting Sites".
2. Heavy seeds (oak, hickory, pecan and walnut): Eliminate vegetation to allow seeds to be planted into the soil. If sod is present, kill the sod on the entire site the prior to seeding according to guidelines in Section I "Preparation of Planting Sites".

F. Methods of Seeding

1. Broadcasting - Seed is broadcast evenly over the planting area and covered with a disk or other similar implement. Bare soil is essential for light seeds (ash, maple, and pine). If light seed is used with heavy seed, spread the heavy seed first, disk 2 to 4 inches deep, sow the light seed, then disk 1 inch deep. Heavy seeds like walnuts and acorns need to be planted 2 to 4 inches in the soil. Broadcast seedings should be cultipacked to ensure a firm-planting seedbed.
2. Machine Planting (heavy seed only) – Plant in furrows twice as deep as the nut/acorn diameter. Plant mixtures of hardwood seeds in a furrow 2 to 4 inches deep. Plant mixtures of shrub seeds in a furrow 1-inch deep. Plant trees in rows that are no more than 25-feet apart to ensure adequate density and shrub rows no more than 10-feet apart.
3. Hand Planting – (heavy seed only) Place nuts/acorns twice as deep as the nut/acorn diameter (approximately 2-inches deep) and firm the soil over the hole.

G. Planting Dates

1. Seed shall be planted in the fall.
2. Seed as soon as nuts are available in the fall and seed until the ground is frozen. Fall seeding will be more successful if squirrels and other rodents are controlled. Seeds should not be allowed to dry out.
3. Black walnuts can be held over the winter (stratified) and planted in the spring prior to May 1st.
4. Most fall planted seeds will begin to germinate and emerge about May 1 in most years.

H. Replanting

1. Reseed areas that fail to survive or grow for the first 2 years following seeding.
2. Refer to Nebraska Forestry Technical Note No. 63 for detailed replanting requirements.

I. Protection of Planted Seed and Seedlings

1. Rodents must be controlled to eliminate predation on planted seed and seedlings. Deer may need to be deterred.
2. Livestock will be excluded from the planting area. Fencing may be necessary.
3. The planting will be protected from fire.

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J. Maintenance

1. Grass sod and other competitive vegetation that escaped control methods during site preparation will be controlled for a minimum of 3 years after the date of seeding. Refer to Section V "Control of Competitive Vegetation After Planting" for guidelines for controlling competitive vegetation after planting. Refer to current Nebraska Herbicide Guide for guidelines on herbicides that can be utilized.
2. Non-selective herbicides can be used to control weeds/grasses prior to seedling emergence (usually about May 1).
3. Shredding above the height of germinated tree/shrub seedlings may be utilized to allow sunlight to reach the seedlings.
4. Refer to Section VII "Care and Maintenance" for detailed operation and maintenance guidelines.

K. Management

1. Refer to Tree and Shrub Pruning Standard (660) and Forestland Improvement (666) for long-term guidance on forestry management.
2. Contact your local forester for assistance in developing a long-range forestry management plan.

References for Direct Seeding Methods:

"Growing Walnuts for Profit and Pleasure," The American Walnut Manufacturers Association, 1958.

"The Fundamentals of Black Walnut Production," Extension Service, University of Nebraska, EC 67-1735.

"Forestry Handbook," Society of American Foresters by R. D. Forbes, 1955.