TECHNICAL NOTES

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TREE AND SHRUB PLANTING, CARE AND MANAGEMENT

Dan Ogle, Plant Materials Specialist, Idaho - Utah
Loren St John, Manager, Plant Materials Center, Aberdeen, Idaho
Craig Stange, Forester, North Dakota

This plant materials technical note provides guidance for establishing trees and shrubs as part of the following Natural Resources Conservation Service (NRCS) Field Office Technical Guide (FOTG) Practice Standards:

Windbreak/Shelterbelt Establishment (practice code 380)
Tree/Shrub Establishment (practice code 612)
Windbreak/Shelterbelt Renovation (practice code 650)
Riparian Forest Buffer (practice code 391)
Upland Wildlife Habitat Management (practice code 645)
Hedgerow Planting (practice code 422)
Alley Cropping (practice code 311)
Recreation Area Improvement (practice code 562)
Streambank and Shoreline Protection (practice code 580)

The success of any tree and shrub planting is dependent upon site preparation, stock quality, planting and handling techniques, and maintenance employed by the planner, vendor, planter, and landowner. This document illustrates a wide variety of methods that have proven successful for conservation tree and shrub plantings in the Northern Great Plains and Intermountain West.

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WINDBREAK SUITABILITY GROUPS

Windbreaks are often planted on land that did not grow trees originally. Knowledge of how trees grow on such land can only be gained by observing and recording their performance where trees have been planted and survived.

Each tree and shrub species has certain climatic and physiographic limits and suitability to a site. A species may or may not be suited to a site because of soil characteristics. All soil series mapped in the state have been placed in 10 groups of similar soils, which are further divided, into major land resource areas (MLRA).

Windbreak Suitability Groups (located in the FOTG Section II - Windbreak Interpretations) will help to determine expected 20-year heights of trees and shrubs based on MLRA and the soil series of the planting site. Table 2 provides additional information on tree and shrub characteristics of many species and Table 3 illustrates salinity tolerance of a number of tree and shrub species.

PLANNING THE PLANTING

GENERAL GUIDELINES

DETERMINE OBJECTIVES - LISTEN TO YOUR CLIENT/CUSTOMER

- Control Wind Erosion
- Increase Crop/Forage Yields
- Reduce Home Energy Costs
- Livestock Protection
- Wildlife Habitat
- Noise Reduction
- Screen
- Improve Water Quality
- Improve Air Quality
- Snow Management (Living Snowfence)
- Fuel
- Fiber
- Food
- Riparian
- Beautification

Inventory Needs - Purpose - Location

Develop a sketch of the existing landscape with measured distances to structures, roads, fences, etc., and length/width of land area.

Identify water sources for irrigation if needed.

Determine soils and current vegetation on site for species suitability and site preparation.

Determine climatic conditions including average annual rainfall, prevailing and troublesome winds, C factor, and potential snow problems.

Develop **Site Specifications (ID-CPA-027 Windbreak/Shelterbelt Planting Spec. or ID-CPA-028 Tree-Shrub-Riparian Planting Spec.)** including species selection, plant spacing within and between row, planting site preparation, use of weed barrier material, planned irrigation, weed and pest control, establishment protection, and moisture requirements.

Plant Spacing

Spacing within row (single or multiple row)

Shrubs/small conifers	3 - 6 feet
Low broadleaf/medium conifers	6 - 12 feet
Tall broadleaf/tall conifers	10 - 16 feet
Spruce	12 - 16 feet

Spacing within row (twin-row high density)

Shrubs/small conifers	3 - 5 feet
Junipers	5 - 8 feet
Low broadleaf/medium conifers	6 - 10 feet
Tall broadleaf/tall conifers	8 - 14 feet

Spacing in windward rows should be at the narrower spacing listed.

Trees such as juniper and blue spruce and dense shrubs such as Siberian Peashrub are the preferred species for twin-row plantings.

Large spreading trees such as cottonwood, poplar, elm, and tree-type willows are not to be used in twin-row high-density plantings.

Spacing between rows (except twin-row high density)

Between-row spacing for multiple row windbreaks is generally 8 - 24 feet depending on growth form and equipment that will be used to maintain the windbreak. A tree with an overtopping habit of growth should not be planted within 20 feet of other rows. Siberian elm, cottonwood (poplar) , honey locust, silver maple, black locust, and tree willows are examples of trees with this habit of growth.

Between-row weed control must be considered. Allow at least 4 feet wider than implement to be

used for weed control plus width of weed barrier fabric that may be installed when determining spacing between rows. Twin-row high-density windbreaks should be planted in rows at a minimum of six feet and no more than 12 feet apart.

Plant spacing for riparian practices will be dependent upon the objectives and purpose of the practice (see Idaho Plant Materials Technical Note 23, How to Plant Willows and Cottonwoods for Riparian Rehabilitation).

MOISTURE REQUIREMENTS

It is impractical to give a standard recommendation on watering rates because of varied soil types, variations in weather conditions, and individual species requirements. The following provides general guidelines:

Establishment Year	2 - 4 gallons per week
Second Growing Season	5 - 6 gallons per week
Third Growing Season	7 - 8 gallons per week
Mature Plant	9 + gallons per week

If accelerated growth rates are a goal of the planned windbreak, 5-10 gallons per day may need to be applied to each fast growing tree after the fourth growing season.

Guidelines - refer to Idaho Forestry Technical Note No. 14 for specific information on irrigation systems and design.

Use of weed barrier fabric may reduce irrigation requirements by as much as 50 percent or more.

Discontinue irrigation toward end of growing season – allows plants to harden for winter. Approximately one month prior to the normal date of the first killing frost in the fall, irrigation should be discontinued to trees and shrubs to allow them to slow growth. This will help them prepare for the winter. Once a killing frost has occurred, one last irrigation application will be beneficial to help provide moisture for root growth that does occur during the winter. A late fall irrigation application is especially beneficial to conifers which continue transpiration through the winter.

PLANT STOCK REQUIREMENTS

Planting stock should not come from sources greater than 250 miles away in latitude, 500 miles away in longitude, or 2,000 feet difference in elevation, unless long-term replicated field trials or extensive historical data indicate that the stock is hardy for a given location. "Planting stock sources" refers to the location where the plant naturally occurred or was propagated, not the location of the nursery where it was purchased.

Native planting stock must be grown from locally adapted seed or cuttings of known origin and meet height and caliper standards listed below. For species that are not native, the seedlings must be produced from seed collected from localities having similar climate, latitude and elevation to the planting site or from seed sources that have been selected, tested and/or released through tree improvement programs.

Bare Root Deciduous Seedlings shall not be less than 3/8-inch caliper at 1 inch above the root collar. Bare root deciduous seedlings shall have a shoot (top growth) of at least 12 inches. Bare root seedlings should not be topped, unless non-topped stock is not available. Rooted planting stock should have a root-to-shoot ratio of **2:1**.

Bare Root Coniferous Stock shall be either 3-0 or 2-1 aged stock at a minimum (3-0 equal's 3 years in a seedling bed. 2-1 equals 2 years in a seedling bed and 1 year in a transplant bed). Coniferous seedlings or transplants shall have at least a 6-inch shoot. Coniferous seedlings or transplants shall have a minimum stem diameter of 3/16 inch at 1 inch above the root collar. Rooted planting stock should have a well-developed fibrous root system and should not exceed a 2:1 root-to-shoot ratio.

Note- bare root conifer stock should not be recommended unless the planting crew has experience in handling bare root conifers. Bare root conifers are extremely susceptible to seedling mortality from improper handling.

Container-grown Stock shall have a root mass of at least 7 cubic inches (10- 40 cubic inches preferred). Seedling height should be at least 6 inches. Container-grown stock must be produced in containers that minimize girdling roots or J-roots.

Vegetative Deciduous Cuttings shall be no less than ½ inch diameter at the base, have the apical bud and all lateral side branches removed, and produced in lengths long enough to reach a soil depth that remains moist to

saturated throughout the growing season, or the site must be irrigated (see Figure 6). Depth to the moist- saturated zone must be determined before cuttings are ordered or harvested. In no case will vegetative deciduous cuttings be less than 10 inches in length. Tops of dormant-season- collected cuttings may be dipped in latex paint, paraffin or sealing wax to reduce desiccation and mark the top.

Vegetative cuttings should be collected while dormant. Dormancy means no bud swell, no green showing on buds, and no separation of bud scales. Actively growing materials can be used, but survival will be lower.

Vegetative cuttings of willow, dogwood, and cottonwood (*Populus* species) can be stored up to 6 months. Proper storage consists of 34-38 degrees F. temperatures with 90 -95 percent relative humidity. Storage in plastic bags will achieve the desired humidity, but care must be taken to prevent mold growth. Do not allow stock to dry out for even short periods of time, as survival will be significantly reduced.

STORAGE OF STOCK

Rooted planting stock and cuttings will be stored in a cool, moist environment (34-38°F) or heeled into the soil. During all stages of handling and storage, keep roots moist and cool and free of mold. Keep roots covered at all times. Evaluate stock that has been allowed to dry, heat up (e.g., within a bale, delivery carton or container), or that has developed mold or other problems. Destroy stock if there is any doubt as to the viability. Live cuttings that are not immediately planted after harvest shall be promptly placed in controlled storage conditions (34-38°F) and protected until planting time.

Landowners may keep stock for up to one week before planting by storing in a shaded, cool, moist location. An unheated basement or potato cellar works very well. Plant bundles should be turned every day when temporarily stored to avoid mold and/or drying problems within the bundle. Ensure roots are moist and not exposed to the air. **Do not store bare root planting stock in a bucket of water.** Trees will commonly break dormancy (begin to leaf out) with this type of storage, resulting in poor survival.

For longer storage periods, stock may be heeled in. This can be described as high-density planting in a furrow. Locate the heel-in bed in good soil in a protected location. See Figure 1 for details.

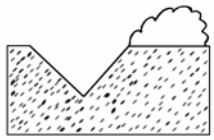


Figure 1A: Dig a trench deep enough for proper root placement.

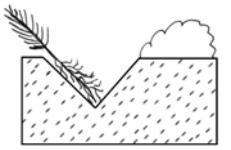


Figure 1B: Break bundles and spread plants along the trench wall with 2-3 inches between each plant.

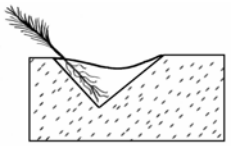


Figure 1C: Immediately cover roots with soil and lightly pack. Thoroughly soak the trench with water after planting to remove air spaces and improve root to soil contact.

Cover roots quickly to minimize exposure to sun and air. Short periods of exposure can significantly reduce survival and establishment. Leaving plants in a heel-in bed for longer than one growing season increases the difficulty of transplanting and decreases survivability.

CARE & HANDLING REQUIREMENTS

Roots of bare root stock shall be kept moist at <u>all times</u> during planting operations by placing in a water-soil (mud) slurry, super-absorbent (e.g., polyacrylamide) slurry, or covering with wet peat moss, wet cloth, wet gunny sack or other equivalent material. Do not cover with dry peat moss or other dried material.

The rooting medium of container or potted stock shall be kept moist at all times by periodic watering.

Pre-treat stored unrooted cuttings prior to planting by soaking in water for at least 24 hours. Note: Soaking will not harm cuttings and <u>may</u> increase root formation. Pre-treat bare rootstock by soaking roots in water-soil (mud) slurry or polyacrylamide to thoroughly coat roots for several minutes before placing on the tree-planting machine.

Keep roots moist and covered throughout the planting operation. To further reduce planting shock, stock should be carried during the planting process in buckets of slurry. Do not

allow rooted conifer stock to be immersed for longer than one hour.

Stock shall not be planted when soil is frozen or dry. Do not handle trees or shrubs when temperatures are freezing or below.

Reduce exposure of bare root seedlings to air and sunshine while loading the planter and during the planting operation. Studies have shown that exposure of pine roots to air and sun on a 73-degree day for only 2 minutes resulted in 80 percent mortality.

Do not plant on hot, dry, windy days. Refer to Figure 2, Climatic Stress Chart, to identify suitable conditions for planting.

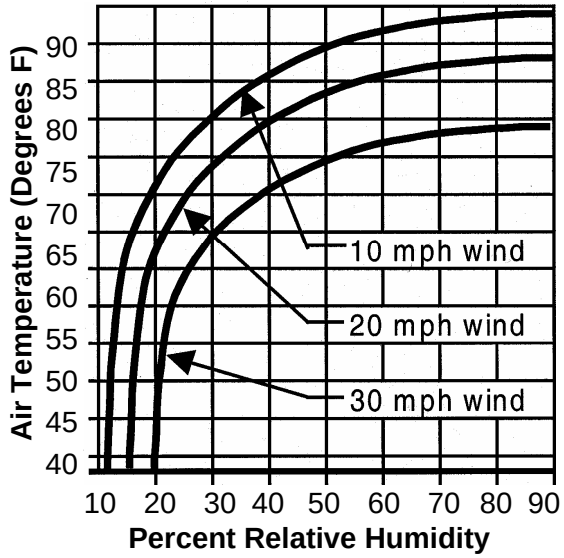


Figure 2: Climate Stress Chart

Cease planting when field temperature and humidity conditions are above the curved line appropriate for sustained wind speeds at the site. As conditions approach those indicated by the appropriate wind speed line, use extra care to prevent desiccation of roots and tops. Site conditions falling below the appropriate wind speed line are generally considered good for tree and shrub planting. Cease planting when sustained wind speeds exceed 30 mph (miles per hour). To get a feel for changing climatic conditions, go to the appropriate weather site at:

http://weather.noaa.gov/weather/ID_cc_us.html

Remove any wire or plastic ties that encircle the trunk or limbs of planted stock. If ties remain on the plant, they will eventually girdle and kill the stem above that point as the stem diameter increase.

Sweating Seedlings

Bur oak and hackberry may require special preparation before planting, especially in cold, wet soils. These species have a tendency not to break dormancy without a "sweating" treatment. Trees that do not break dormancy during the first growing season will die.

Sweating trees is a simple process that usually requires nothing more than the packing material shipped with the trees and duct tape. One to two weeks before the trees are to be planted, remove them from the cooler. Line the cardboard shipping boxes with a large plastic bag. Place broken bundles of trees loosely in the plastic-lined box. Wet them thoroughly. Fold and tape the plastic together to make an air tight seal. Store the wrapped trees at room temperature, away from direct sunlight, for one to two weeks, checking to ensure they do not dry out.

Condensation should form on the inside of the plastic within hours, indicating a tight seal and that the sweating process is working.

When properly sweated, the buds of these species will have swollen and in some cases opened. Use extra precautions when planting sweated stock, especially if leaves are starting to emerge, because they are very sensitive to drying out during handling and the effects of hot dry winds immediately after planting.

PLANTING SITE PREPARATION

Planting sites shall be properly prepared based on soil and vegetative conditions listed below. Avoid planting on sites that have had recent application of pesticides that may be harmful to woody species.

Check waiting period restrictions and carryover characteristics of pesticides applied to the planting site in the previous one to two years prior to initiating tree planting.

If pesticides are used, apply only as needed within Federal, State and local regulations. Follow label directions and heed all precautions listed on the container.

On sites treated with pesticides, especially tilled sites, be alert to health risks that may result from handling the chemically treated soil or breathing the chemically impregnated dust. If pesticides

are used, apply only as directed by the label and follow all precautions listed on the label.

Site preparation may include the whole field, strips, or patches. Individual site preparation (scalp area) for each tree/shrub should provide a minimum 3-foot diameter circle, or a minimum 3-foot x 3-foot square planting spot (1.5 feet on each side of the planted stock).

The planting area must be free of living sod and perennial weeds before planting.

Site Preparation Using Tillage

Site Preparation with Tillage – on sites with sod-covered or perennial herbaceous cover, site preparation should **begin the year before** planting. Herbicide application in spring when grass is actively growing is ideal. Plowing in the fall (and ripping if a soil compaction or hardpan is present) followed by disking in spring just prior to tree planting will create a clean weed free firm planting bed ideal for shrub and tree root development.

Perform sufficient tillage to kill the sod and maintain the entire site in a weed free condition prior to tree and shrub planting.

Non-selective herbicides may be used to kill sod grasses and other herbaceous species prior to tillage. Follow guidelines under Chemical Site Preparation and instructions found on the herbicide label.

Avoid tilling soils that are too wet, to minimize compaction.

Be alert to potential wind and water erosion risks during the fallow period. On irrigated sites, an annual cover crop of oats or spring grain may need to be planted to control erosion while minimizing water usage. Oats and spring grain will die over winter, but must be seeded early enough (mid to late August) to attain 4-6 inch height prior to freeze up to provide soil protection.

For very erosive sites that are not covered by rhizomatous grasses, (smooth brome, reed canarygrass, intermediate wheatgrass, Kentucky bluegrass or quackgrass) and no plans for between-row cover crops, till only 4-10 foot wide strips where the trees/shrubs will be planted while leaving and maintaining the existing vegetation between the rows. This will reduce wind and water erosion, sandblasting, provides easier site access, and provides wildlife benefits. The wider tilled area is appropriate for locations where weed control fabric is to be installed after the tree or shrub planting.

Orient tree and shrub plantings on the contour, when possible, to minimize water erosion risks during the fallow period and subsequent planting and maintenance operations.

Deep tillage or ripping may be necessary on sites with compaction or natural pans that will restrict tree and shrub root development. This type of tillage should occur the summer or fall prior to planting. Avoid deep tillage (greater than 2 inches deep) immediately prior to planting to reduce drying out the planting bed.

Site Preparation with tillage on Cropland Sites

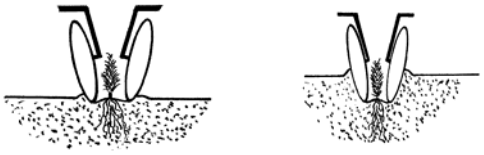
Shallow tillage immediately prior to planting to remove sprouted annual weeds, crop seed, and grasses is appropriate. Shallow tillage between harvest and freeze up the year before planting may be desirable. Be alert to potential wind and water erosion risks during the fallow period on irrigated sites. If needed, seed an annual cover crop of oats or small grain to control erosion while minimizing water usage. Oats or small grain will die over winter but must be seeded early enough (mid to late August) to attain a 4-6 inch height prior to freeze up to provide soil protection.

Avoid excessive and deep tillage prior to planting. Tillage is not needed or effective if there are no weeds present. Deep tillage or ripping may be necessary on sites with compaction or natural pans that will restrict tree and shrub root development. This type of tillage should occur the year prior to planting.

A firm planting bed for tree planting should be similar to a firm seedbed for grass or alfalfa seeding where adult human footprints are barely visible and planting equipment leaves a minimal trench (see Figure 3). Prior to planting, firm the planting bed if needed, to reduce soil drying and to aid in proper depth placement of the plant and natural moisture movement within the soil.

All precautions concerning erosion and sand blasting on sod-covered sites also apply on cropland sites.

Consider tilling only 4- 10 feet strips where the tree/shrubs will be planted (8- 10 feet strips, if weed barrier fabric is to be installed planting), thereby allowing the standing stubble between



This
Firm soil, plants at proper depth.

Not This
Soil too loose, plants pressed too deep.

Figure 3: Effects of Seedbed Firmness

the rows to act as temporary wind protection for new seedlings.

Site Preparation by Scalp Planting

Scalp planting is a method that places plant material in an area cleared of competing vegetation. The area cleared must be at least 1.5 feet on each side of the planted stock. This operation is usually performed by hand, backhoe, or front-end loader immediately prior to planting.

Do not scalp plant into aggressive sods such as smooth brome, reed canarygrass, intermediate wheatgrass, Kentucky bluegrass or quackgrass without additional weed control and site preparation treatments. Follow guidelines under Site Preparation using Chemicals and follow instructions found on the herbicide label before planting into sites with existing aggressive sod grasses.

Scalping tends to encourage a rapid flush of annual weeds on the freshly exposed soil that will require a post-plant weed control effort.

When scalping on native rangelands, orient plantings in locations that are most conducive to tree/shrub growth. The best sites for growing trees and shrubs are often found in toeslope positions, north or east facing slopes, or in swales and draws.

When possible, orient rows on a true contour to harvest runoff moisture and reduce erosion.

Site Preparation using Chemicals

Chemical Site Preparation on Soddy Sites with Perennial Herbaceous Cover)

Site preparation with herbicides on soddy sites should be initiated the growing season before planting.

Follow label instructions so that application technique and timing of herbicide application will lead to a complete control of the vegetation. Repeated applications throughout the fallow period may be necessary.

For sites with rhizomatous grasses, (smooth brome, reed canarygrass, intermediate wheatgrass, Kentucky bluegrass, or quackgrass) and some bunch grasses such as crested wheatgrass, completely spray the entire area where the trees/shrubs will be planted, including a 10-foot wide band around the outside of the planting.

On very erosive sites without rhizomatous grasses and no plans for cover crops, completely spray out 4- 10 feet wide strips where the trees/shrubs will be planted while leaving existing vegetation between rows. This will reduce potential erosion, sandblasting, provide easier access, and will provide wildlife benefits.

Undisturbed dead sod will often provide a growing season of weed control or suppression after the trees or shrubs have been planted.

Herbicides vary as to their risk of leaching or runoff. Avoid using herbicides with high leaching or runoff potential on sites where there is increased risk of polluting surface or ground water sources.

Site Prep using Chemicals on Cropland Fields

Apply appropriate burndown chemicals according to label directions prior to planting trees and shrubs.

Site Preparation for Natural Regeneration

Until more data on the viability of this planting method becomes available, review and approval of each site, planting plan and maintenance schedule will be obtained from NRCS State Range Specialist or Plant Materials Specialist.

This procedure should only be attempted on sites within the 2- 50 year flood plain of stream systems where adequate native seed trees or shrubs are within 200 yards of every part of the planting site and soils are suitable for tree planting.

Stream systems where this could be attempted with a reasonable chance of success include:

- All perennial streams.
- Scattered segments of rivers that meet flooding, soil, and seed tree requirements.

Perennial grasses need to be controlled with herbicides and/or tillage prior to attempting this method of tree and shrub establishment. Riparian forest natural regeneration sites will tend to be very weedy due to large weed seed banks and high nutrient levels until tree canopies become dense enough to shade out the understory herbaceous vegetation.

Once herbaceous vegetation has been controlled, the site should be tilled to expose bare mineral soil just prior to seed dispersal from the tree species desired. Seed dispersal may occur from mid spring to late fall depending on the species. During planning phases, determine dispersal times of the desired species to ensure timely site preparation. Besides direct on site observation, the following source, "Woody Plant Seed Manual"; can be used to determine likely seed dispersal times:

http://www.nsl.fs.fed.us/wpsm/Genera.htm

Consider leaving strips of vegetation perpendicular to flood flows to reduce scour erosion.

Site Preparation to Install Fabric

Weed control or barrier fabric should be woven material treated with carbon black guaranteed to have a life expectancy of at least 5 years.

Fabric Site Preparation, All Sites

All instructions concerning fabric installation for weed control after planting apply when fabric is used for site preparation. Refer to Synthetic Mulch (Fabric) Weed Control under the maintenance section of this reference.

Installation of weed control fabric as a form of site preparation can be very effective. When properly applied, it can effectively prevent weed growth and store seasonal moisture. See Idaho Plant Materials Technical Note No. 25, Function and Operation of a Machine to Lay Weed Barrier Material.

Minimum fabric widths should be 6 feet. (About 4 feet of weed control fabric will be on the soil surface following installation by machine.)

Soil, rocks, or staples must hold down fabric edges. It is essential that wind not be allowed to get under the fabric because the force of wind will tear the fabric away from the ground. Staples or rocks can be spaced in the center of the fabric close to where the trees/shrubs will be planted the following spring. When soil is not used to anchor the fabric edges, staples, pins, or rocks must be placed every 3- 5 feet along the edge. Do not use soil to hold down the fabric centers, as weeds will quickly establish on the soil spots, reducing the effectiveness of the fabric.

After installation, fabric should be taut, reasonably level, and well anchored. It is extremely important to ensure that the fabric does not girdle the trees or shrubs as they grow.

Fabric Site Preparation, Tilled Sites

The area to be tilled should be 2- 4 feet wider than the width of the fabric, for those sites where fabric will be installed by machine. If the fabric will be hand placed, tillage need only be as wide as the fabric.

If plants are to be planted by hand, tillage should be deep enough to accommodate roots of the species to be planted.

Fabric Site Preparation, No Till Sites

Use of fabric laying machines on soddy sites is not recommended.

Large amounts of grass and other herbaceous cover should be mowed and removed from the site before fabric installation to reduce the risks of rodent damage to the newly planted trees and shrubs.

Equipment modifications may be necessary if installing fabric by machine on soddy sites. Fabric laying machines usually need to be reinforced in order to get good fabric placement and soil coverage on the fabric edges in soddy sites. Fabric may also be hand placed by anchoring the edges every 3-5 feet with staples, pins, or rocks. Every 10- 15 feet a staple, pin, or rock should be placed in the middle of the fabric to prevent "billowing" by the wind. Additional anchoring of fabric installed by machine is not generally necessary.

Tools used for planting must be able to easily penetrate non-tilled soils to the proper depth under the fabric. If easy penetration is not likely,

use the Fabric Site Preparation, Tilled Sites method.

Grass Cover

Cool season grasses such as 'Foothills' Canada bluegrass, 'Covar' sheep fescue, 'Durar' hard fescue, 'Sodar' streambank wheatgrass, 'Rosana' western wheatgrass, 'Vavilov' Siberian wheatgrass or 'Ephraim' or 'Roadcrest' crested wheatgrass may be seeded between tree/shrub rows to reduce erosion and runoff, prevent sandblasting, and improve wildlife cover. Refer to Idaho Plant Materials Technical Note No. 24 "Grass, Grass-Like, Forb, Legume, and Woody Species for the Intermountain West" and Idaho Plant Materials Technical Note No. 34 "Guidelines to Reduce Rodent Damage While Establishing Windbreaks" for additional information.

When planting grasses between rows, it is essential a weed free zone of at least 4 feet be maintained around each tree or shrub (2- feet radius around the trunk) for the first 3 years after planting. In southern Idaho, it is best if the weed free zone is maintained for the entire life of the planting.

These grass species are not generally shade tolerant and will be suppressed as growing tree and shrub canopies shade the ground. In no case should a sod-forming cool season grass such as smooth brome, reed canarygrass, intermediate wheatgrass, or Kentucky bluegrass be substituted for these species.

The grasses listed above may be seeded before or after the tree and shrub planting. When seeding these grasses during the tree-planting year, be alert to the potential conflict between the grass seeding dates (see 327 Conservation Cover, 512 Pasture Planting, or 550 Range Planting standards) and the recommended ending tree planting date (see following table). Seeding grass during the prior year fallow period or seeding between rows after tree and shrub planting or fabric installation can minimize the potential conflict between grass seeding and tree planting dates.

Short statured, cool season bunchgrasses are particularly effective between fabric strips. Without tillage between fabric strips, there is no risk of the weed barrier fabric being hooked by a tillage implement and damaged.

The pure live seed (PLS) seeding rates found in Idaho Plant Materials Technical Note No. 24 are to be used for designing between row grass seedings. Double the seeding rate if seed is broadcast planted. Use a percentage of the recommended rate when planning a seed mixture.

PLANTING

Planting - All Sites Except Natural Regeneration

Plant only in the spring of the year after frost is out of the ground. All stock will be planted by:

MLRA	Spring * (Before)
8, 9, 11, 28A	May 1
10, 12, 13, 25, 44	May 15
43A, 43B, 43C, 47	June 1

* Dates are based on the average, last moderate spring freeze (28 º or lower) for each MLRA.

Extension of these planting dates by 15 days may be made by the district conservationist, if local soil moisture and temperature conditions justify it and are documented. Before granting an extension, consider the cooperator's ability and willingness to address the increased need for supplemental watering, wind protection, and/or shade that may be necessary in the weeks immediately following a later planting.

If irrigation is required, the irrigation system must be installed and functional prior to planting.

Summer and fall planting of trees and shrubs during the active growing period should not be attempted since consistent survival has not been demonstrated. Dormant fall planting might be considered, but understand the survival rate is likely to be lower than spring planting periods.

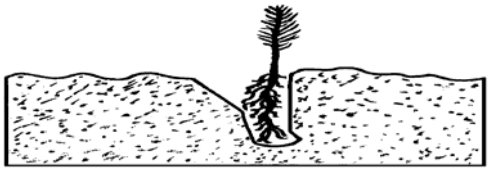
Immediately after planting of stock, whether by hand or machine, pack soil firmly around each plant to eliminate air pockets. Proper adjustment and operation of the tree-planting machine will reduce the need to pack the planting trench with tractor tires. It is a good idea to walk the newly planted rows to straighten the plants and lightly pack the soil around the plants with your feet. Avoid the "stomp of death" by overly compacting the soil.

Planting - Bare Root Stock (Seedlings, Transplants, Rooted Cuttings)

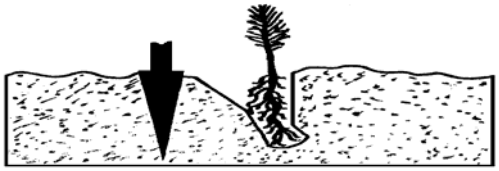
Rooted stock will be planted in a vertical, upright position with the root collars approximately ½-inch below the soil surface. See Figures 3, 4, and 6.

The planting trench or hole must be deep and wide enough to permit roots to spread out and down without J-rooting or L-rooting. Trim straggly roots of bare-root stock as needed to prevent J-roots, L-roots, broken roots, or wadded roots that may result from "stuffing" too many roots into the planting hole. Do not prune roots to less than 10-12 inches in length. See Figure 5.

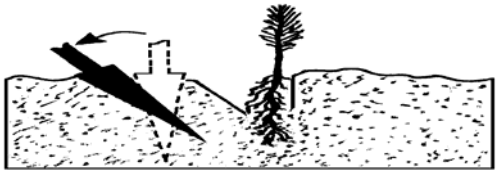
1. Insert dibble at angle shown and push forward to vertical.



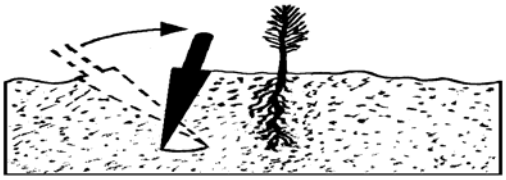
2. Remove dibble and place seedling at correct depth.



3. Insert dibble vertically, 3- 4" back from tree.

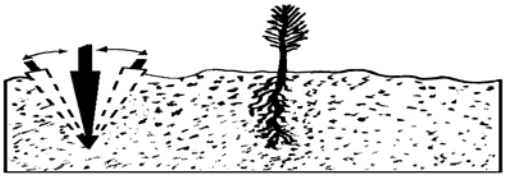


4. Pull dibble back to close bottom of tree planting hole.



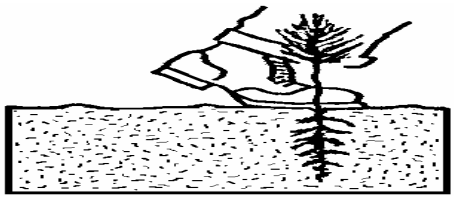
5. Push dibble forward to close top of tree planting hole.

6. Insert dibble vertically 3- 4" back of previous hole.



7. Wiggle dibble back and forth to close previous hole.

8. Press hole closed with heel of shoe.



9. Press soil firmly around tree with toe of shoe while moving to next position.

Figure 4: Hand Planting

Planting - Unrooted Cuttings (Willow, Poplar, Cottonwood and Dogwood Species)

The base of longer cuttings, or the entire cutting if smaller, should be soaked for at least 24 hours before planting. If cuttings have been stored for more than one week, recut the base to maximize water uptake. Cut back until the cut is into green tissue. Refer to Idaho Plant Materials Technical Note No. 23 “How to Plant Willows and Cottonwoods for Riparian Rehabilitation”.

Planting may be by hydraulic waterjet stinger, hand dibbles, shovels, tree planters, or probes. Refer to Idaho Plant Materials Technical Note No. 39 "Waterjet Stinger: A Tool to Plant Dormant Unrooted Cuttings".

Insert cuttings to the depth required to reach adequate soil moisture with one to two buds sticking above the soil surface. (Note: Depth to growing season water table must be determined before obtaining cuttings to ensure cuttings are sufficiently long enough to reach the water table.) Make sure that the base end is planted down. See Figure 6.

When planting shorter cuttings with a traditional tree-planting machine, ensure the soil is firmly packed against the cutting. Shorter cuttings will require supplemental watering to ensure survival and establishment.

Ensure the planting hole is large enough to prevent damage to the bark and buds.

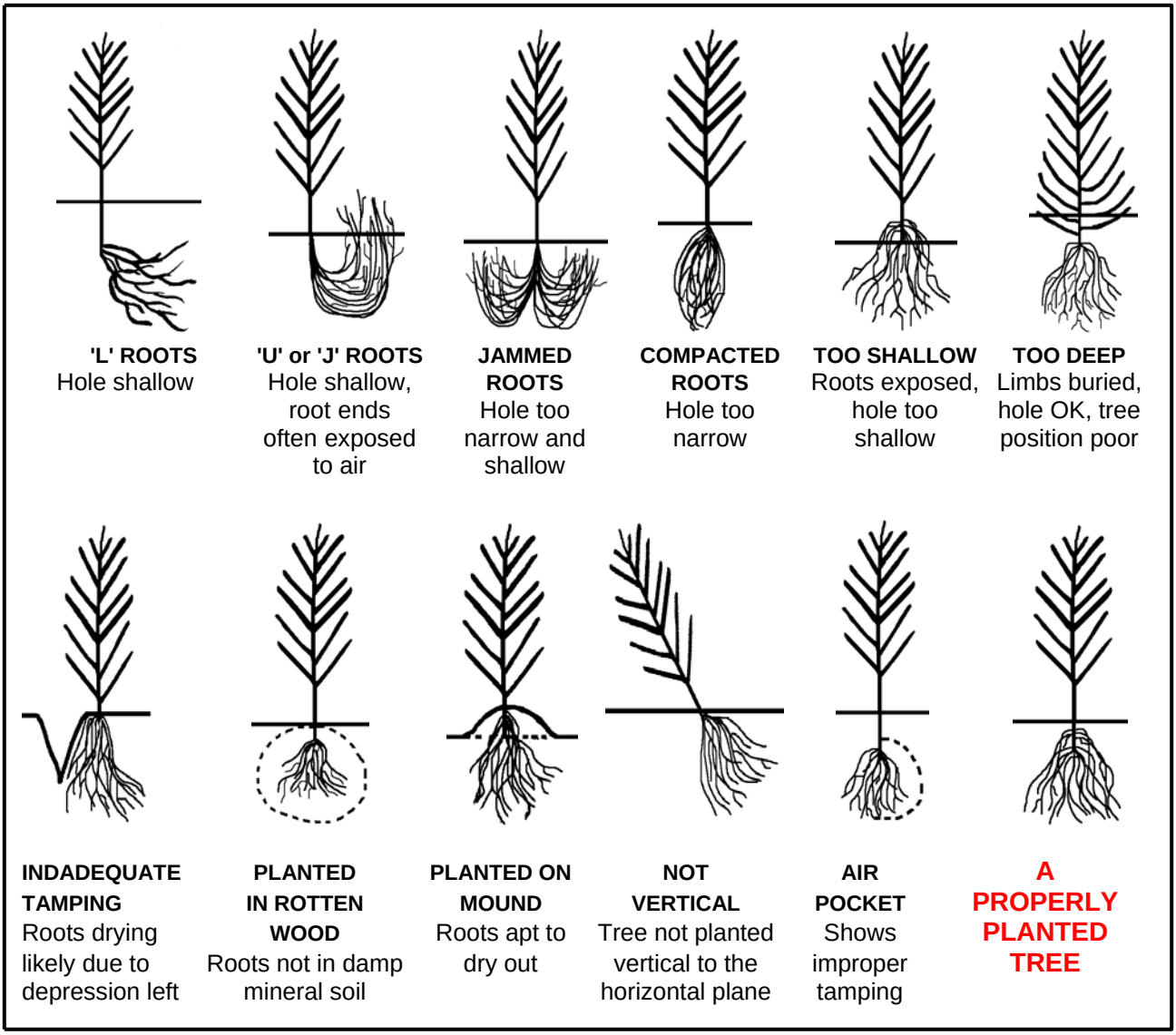


Figure 5: Examples of improperly planted trees.

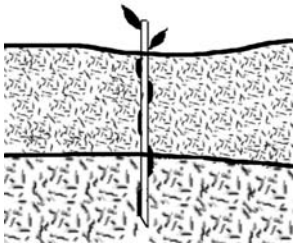


Figure 6: Unrooted Cutting

Once the cutting is in the hole, ensure that voids are eliminated either by packing around the cutting or by using the waterjet stinger to prepare the planting hole.

When planting by hand, avoid excessive force that may kink or break the cutting.

Planting - Container-grown Stock

Remove container stock from the tubes, pots or blocks, wire baskets, etc. in which they were grown, if not already done by the nursery. Balled and burlap stock can remain in the burlap ball but all ties must be removed from around the trunk and the burlap rolled back off the top of the ball, once placed at the proper depth in the planting hole.

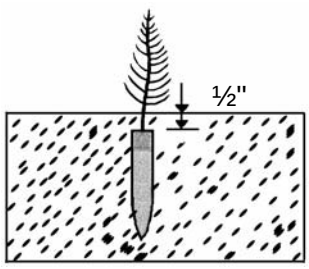


Figure 7: Container-grown planting depth

Container-grown stock should be planted so the top of the root ball or plug is covered with about ½ inch of soil. See Figure 7.

During planting ensure the root ball stays moist. Do not soak in water.

If containers did not prevent formation of a root-bound condition (heavy root growth spiraled around the inside of the pot), the roots need to be gently manipulated to straighten. In some cases, the spiraled root growth may need to be pruned.

Bare root seedlings, transplants, or container grown stock shall be dormant when planted.

Avoid planting stock after bud break, except for bur oak and hackberry that have been sweated. Container grown stock in gallon pots or larger may be planted after bud break, based on specific situations and individual requests of a variance.

MAINTENANCE AFTER PLANTING

Weed Control, All Methods

Competitive vegetation will be controlled for a 1.5 feet minimum radius (3 feet diameter) around each plant for at least 3 years after planting.

To minimize erosion risks and to improve conservation and wildlife benefits, consider leaving non-sod-forming grasses and legumes outside the 3-feet minimum weed free area. Utilize “patch” weed control methods to maintain a 3 feet diameter weed free zone around each plant or a 1.5 feet wide weed free band along each side of each row. As the planting matures, the herbaceous vegetation strips will get narrower.

Aggressive sod-forming grasses such as smooth brome, reed canarygrass, intermediate wheatgrass, Kentucky bluegrass and quackgrass, or deep rooted legumes such as alfalfa should be controlled in the tree or shrub area for the life of the planting.

Consider providing a 10 feet wide weed-free zone around the entire planting to serve as a fire break, aid in weed control, and reduce perennial sod grass encroachment. In areas prone to erosion or to meet the landowner's objectives, these areas could be planted to a non-competitive grass and kept short with regular mowing.

Where overland water flow may create a scour erosion hazard, orient the weed-free zones at an angle to the water flow. Perpendicular is most effective.

Utilize mowing, herbicides, or tillage to prevent invasion of aggressive sod-forming grasses and weeds, throughout the planting, and until tree canopies begin to close. A sparse cover of weeds or grasses outside the 3 feet wide weed free zone may actually benefit the planting by trapping snow, cooling the soil surface, and controlling erosion.

Weed control may be by tillage, chemicals, or fabric. When using chemicals, follow label

instructions. Control of unwanted vegetation should continue until weeds do not threaten the growth and function of the trees and shrubs.

Damage to roots, trunks, and branches from chemicals, tillage, or animals can significantly reduce the vigor of the planting and make it more susceptible to disease and insect damage thereby shortening the life of the planting.

Mechanical Weed Control

Use caution when tilling around trees and shrubs. Poor tillage techniques (too deep, too close to the trunk) can damage trunks, limbs, and roots. Erosion that may result from indiscriminate tillage may remove several inches of soil exposing roots to severe damage by future tillage operations. Tillage should be no deeper than 2- inches to reduce damage to tree and shrub roots.

Use tillage only when needed to maintain or improve the health and vigor of the planting. Tillage, when weeds are not growing, wastes moisture and fuel and increases the risk of mechanical injury to trees.

Chemical Weed Control

Follow label directions when applying the appropriate chemical to control weeds. Adhere to all rules and regulations that apply to chemical applications on tree and shrub plantings.

Some approved herbicides are non-selective and must not come in contact with any part of the tree or shrub. Other approved chemicals prevent weeds from germinating or kill newly germinated weed sprouts but will not kill emerged weeds.

Use chemicals only when needed to maintain or improve the health and vigor of the windbreak. Always follow label directions when using chemicals for weed control.

Organic Mulches

Organic mulches may include straw, wood chips, sawdust, chopped corn-cobs, grass clippings, or other organic by products. Organic mulches may provide ideal food and habitat for rodents. Mulches are most effective when maintained to the dripline of the tree. For newly planted stock, mulches should be placed in a 3-4 feet diameter circle around each plant to a depth of about 4 inches. When mulching shrub rows, mulch can be applied in a contiguous 4-feet wide band (2 feet each side of the plants).

In situations of higher precipitation, frequent irrigation, or on fine textured, wet soils, it may be appropriate to maintain a 4- 6 inch mulch-free circle around each trunk to minimize potential trunk injury. Excessive moisture situations may cause mulch that is in contact with the trunk to encourage bacterial growth. The bacteria may cause bark injury and allow disease which might shorten the life of the tree or shrub.

Avoid mulches that may contain small grain seed, as they will attract rodents. In some situations, small grain seed in mulch will germinate and become a thick mat of competing weeds.

Light - fine mulches such as straw or sawdust are prone to blowing away and should be firmly tamped down with water or crimping equipment. On exposed sites with strong winds, fine or light mulches will not be adequate. For extremely windy sites, use mulches with large- sized chips or a high proportion of long (10- 16 inch) twigs to tie mulch together and resist blowing.

Maintaining standing small grain stubble or growing a crop immediately adjacent to the weed free zone helps prevent mulch blowout.

Consider planting herbaceous wind barriers between newly established woody plant rows to reduce risk of mulch blowout, reduce transpiration, and to harvest snow moisture.

Synthetic Mulch (Fabric) Weed Control

Synthetic Mulch (Fabric) *Quality - All Methods*

Fabric shall be of such quality that the manufacturer warrants life expectancy of the fabric for at least five years.

Fabric must be capable of preventing underlying plant growth.

Fabric may be pin- punched plastic, solid polyethylene, woven polypropylene, or some other rot-resistant material. It must prevent plant shoots from pushing through from below.

The minimum width for continuous rolls of fabric applied by machine will be 6 feet; nominal 4 feet weed control width after installation. Individual fabric squares may be as small as 4 feet square since the full 4-feet, when stapled or pinned, effectively prevents weed growth around the tree or shrub.

In certain planting designs a profusion of root suckers is desired. Consider not using fabric on suckering shrubs where a dense thicket is desired.

Searing fabric edges on home-cut individual squares of woven fabric will help to prevent fabric edges from fraying and potentially being hooked by maintenance equipment.

Some types of fabric, in particular some of the pin-punched types and polyethylene, are prone to puncturing by animal hooves (antelope, deer, elk, moose, etc.) which will allow weeds to emerge, reducing the effectiveness of the fabric.

Fabric Installation - All Methods

Tilled sites should be firm and level so that the fabric will lie flat against the ground across the entire area covered by fabric. (Sites should be firmed to barely show an adult foot print, prior to planting.) See Figure 8.

Improper Weed Control Fabric Installation	Proper Weed Control Fabric Installation
Tree planted in furrow. Fabric bridged over limbs. Creates an "oven". Heat can kill plants.	Fabric flush to ground surface. All limbs above fabric. Soil around tree is cool and moist.

Figure 8: Improper & Proper Fabric Installation

Fabric should not bridge over ridges or valleys left by planting operations. Fabric not flush to the ground around the tree can provide a runway for rodents and trap summer heat sufficient to damage or kill the young plant.

If fabric is installed under a no-till situation, excessive vegetation should be removed from the area where fabric will be placed, to reduce rodent habitat and to allow fabric to lie flat against the soil surface.

Openings for trees or shrubs shall be cut with a sharp instrument to avoid tearing fabric or "running" of individual fabric fibers.

Openings shall be X, C, L or J- shaped. Length of slit should not exceed 12 inches. Do not use I- shaped (straight) slits as abrasion of tree bark can occur and as trees grow, girdling can occur.

When fabric is placed over plants before openings are made, use care to avoid cutting the plant when making the opening. Trees and shrubs must be pulled through the fabric within minutes after installation to avoid damaging temperatures created by the fabric "oven."

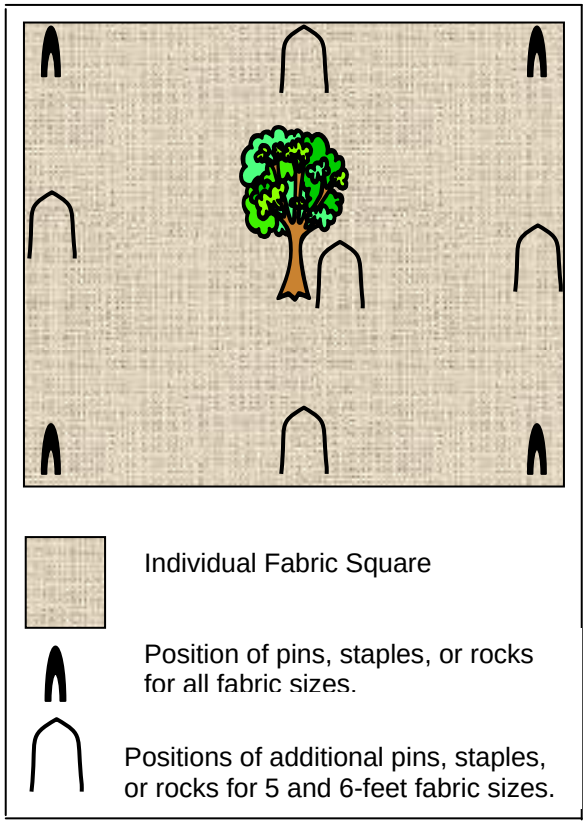
Ensure fabric edges are firmly anchored.

Fabric is not recommended within flood plains. One flooding event could cover the fabric with silt, eliminating its effectiveness, or flood flows could tear out the fabric.

Do not cover weed control fabrics or plastics with organic mulches or gravel. These materials will delay the breakdown of the fabric or plastic and can provide a medium in which weeds will flourish.

Installation of Individual Fabric Pieces

Figure 9: Positions of Pins, Staples, or Rocks for Individual Fabric Squares



Individual fabric pieces shall be at least 4-foot square or 4- feet in diameter.

Use landscape fabric staples, pins, or rocks to anchor fabric. Do not use soil to anchor individual fabric pieces. Individual rocks should weigh at least 5 pounds to resist being moved by wind or water

Four- foot fabric squares shall have each corner anchored. Five- and six- foot squares shall have each corner and the midpoint of each side anchored, as well as an anchor point near the tree or shrub. See Figure 9.

Pins or staples shall be of sufficient length to resist movement, based on soil textures. Follow manufacturer recommendations for staple length.

Installation of Continuous Fabric Strips

Site preparation, if tilled, shall be at least 8- 10 feet wide to allow enough loose soil to properly anchor fabric.

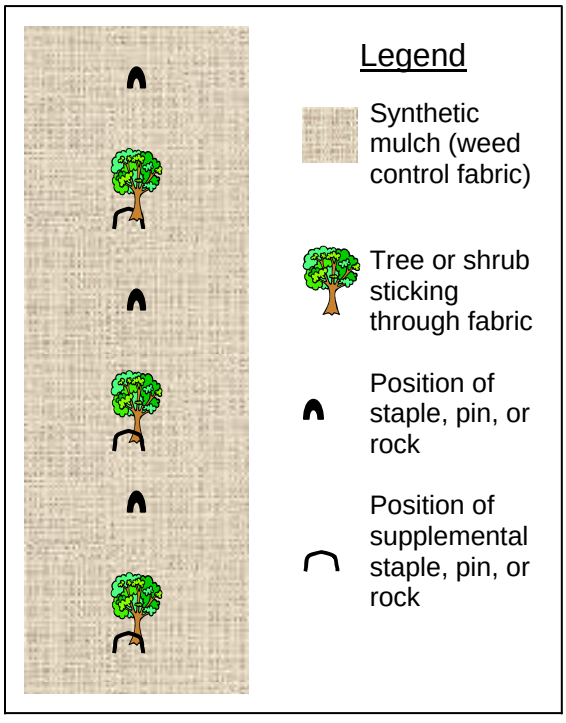


Figure 10: Positions of staples, pins, or rocks for continuous fabric strips.

Fabric strip splices shall be anchored with staples, pins, rocks, or buried. Staples and pins shall be of a length recommended by the manufacturer for the particular soil texture. Rocks must weigh at least 5 pounds. When splices are made with field-cut fabric ends, consider tucking a few inches of the cut end under itself to reduce the risk of snagging the fabric with maintenance equipment.

About every 10 feet, or between each tree, whichever is greater, the fabric may require anchoring with pins, staples, or rocks depending on site conditions. In lighter soils, or in high wind areas, an additional pin, staple, or rock may be needed near each opening in the fabric. See Figure 10.

Machines must be adjusted to ensure 10 -12 inches of both fabric edges are firmly anchored in the soil. See Figure 8. After installation, it is often necessary to run a tractor wheel over both edges of the fabric to ensure a firm seal.

To prevent water from running along the edge of and uncovering fabric, check-dams created perpendicular to the buried fabric edge or slight grading of the site may be necessary.

Where fabric must cross waterways or areas of concentrated flow, the fabric shall be spliced on either side of the waterway. This is to prevent heavy runoff events from washing out an entire strip of fabric and potentially damaging the entire tree row. The smaller spliced section may wash out, but only that section will have to be repaired or replaced.

Pins or staples, instead of soil, may be used to anchor fabric edges. The fabric must lay flat against the soil and the pins or staples must be placed every 3 feet along the fabric edge. On sites exposed to extremely high winds or on loose sandy soil, pins or staples may need to be up to 3 feet in length.

When installing fabric on gentle curves, use extra care to ensure that 10-12 inches along each edge is covered and packed with soil. Use pins, staples, or rocks to tack excessively large "puckers" to prevent wind damage.

Where fabric is desired on a more severe curved planting with a short radius, it may be better to break the curve into short, straighter segments to ensure better quality and easier fabric installation.

Management of Fabric Following Installation

While checking the survival, vigor, and growth of trees and shrubs, during the growing season, inspect the fabric to:

- Ensure all fabric edges are firmly anchored
- Ensure openings in fabric are not damaging or girdling trunks
- Remove weeds, soil, or clippings that may have accumulated on the fabric to ensure they do not become a rooting medium for weeds
- Ensure irrigation system is operating properly

If tilling between fabric pieces, use extreme caution to avoid hooking fabric with tillage tools. Damage to trees and/or fabric may result. Control erosion in tilled areas to prevent silt from accumulating on fabric.

If mowing between fabric pieces, be careful to not damage fabric with mower and do not allow herbaceous matter to accumulate on the fabric. Such accumulations will provide a niche where weeds can become established, reducing the usefulness of the fabric.

Strongly rhizomatous grasses, such as smooth brome, intermediate wheatgrass, Kentucky bluegrass, quackgrass, or reed canarygrass along the perimeter of the fabric piece must be suppressed or controlled with herbicides. If not controlled, their extensive root systems will suppress tree growth, even with fabric in place.

Edges of fabric could be seeded to non-aggressive bunch grasses to help anchor the edge of the fabric and to control annual weeds immediately adjacent to the fabric. Refer to Grass Cover, page 9 of this reference, for grass establishment details.

Every year closely examine the areas where plants grow through the openings to ensure the fabric is not girdling the plant. Fabric in the shade of the plants will last much longer than the manufacturer's minimum life span. Fabric openings may have to be enlarged as tree stem diameters increase to prevent girdling and death of the tree. A box or a utility knife will work well to enlarge openings. See page 21; Weed Control Fabric Advantages and Disadvantages for additional information.

Replanting

Any tree or shrub that fails within the first three years should be replaced with a similar plant. Replanting is essential to maintain the intended function of the planting. Growth rates of most replants (when replanted within 3 years of the original planting date) are usually such that little if any size difference is noted, across the planting, after 10 years. Delays in replanting of longer than 3 years will allow adjacent established tree roots to create greater competition to the replants, resulting in slower growth. On some sites with older established plantings (over 15 years old), replants rarely grow or function as desired.

PREVENTING AND REPAIRING DAMAGE

Inspect planting often to spot damage needing repair, plants needing replacement, fabric or mulches needing repair, weeds needing treatment, irrigation system repairs needed, or insect and disease threats that may be developing. Time of the inspection will depend on the particular threat, but early spring is a good time to spot many problems. Monthly inspection during the growing season is ideal and also recommended.

Weeds

Follow the methods listed above under weed control. Controlling weeds reduces plant stress, improves tree and shrub growth rates, and reduces the plants susceptibility to certain types of insect and disease damage and improves ability to withstand weather extremes. Pay particular attention to aggressive sod-forming grasses and State listed noxious weeds. For more detailed information see:

"Weed Control in Tree Plantings"
http://www.ext.nodak.edu/extpubs/plantsci/weeds/w1097-1.htm

Insects and Diseases

Inspect plantings periodically during the growing season to determine if insects or diseases are threatening the planting. If insects or diseases are observed, contact your local county extension agent to determine if control is possible and warranted. For more detailed information see:

"Insect and Disease Management Guide for Woody Plants"
http://www.ext.nodak.edu/extpubs/plantsci/trees/f1192w.htm

"Deciduous Tree Diseases"
http://www.ext.nodak.edu/extpubs/plantsci/hortcrop/pp697-1.htm

"Common Insect Pests of Trees and Shrubs"
http://www.ext.nodak.edu/extpubs/plantsci/trees/e296w.htm

"Diseases and Related Problems of Evergreens" http://www.ext.nodak.edu/extpubs/plantsci/trees/pp789-1.htm

Pamphlets listed under **ADDITIONAL INFORMATION** at the end of this document are also excellent references for diagnosing disease and insect problems.

Yard and Agricultural Pesticides

Many yard and agricultural pesticides are damaging to trees and shrubs. Misapplication of pesticides may not initially kill trees or shrubs. Depending on the concentration, the product may kill the plant a few months later, or stress the plant so that it is not able to withstand conditions such as drought or frost several years after the misapplication. Regular sub-lethal doses to trees and shrubs as often happen to field windbreaks in cropland fields, make trees and shrubs less able to withstand stresses of frost, drought, weeds, diseases and insects. When applying products adjacent to woody plantings, be alert to wind and temperature conditions and be fully knowledgeable of the label restrictions and precautions for each product applied. Second only to weeds, misapplied pesticides damage more trees than any other cause.

Weather

Other than keeping the plant healthy, there is not much one can do to prevent weather problems; however, when weather damage is swiftly corrected, subsequent storms are less likely to cause additional damage. Proper selection of species for the site and individual plant placement within a planting may reduce weather-related problems such as snow and ice breakage, wind throw, or drought. See details on pruning on the next page for correction of weather damage.

Animal Damage

In parts of the Intermountain West, livestock, deer, elk, moose, beaver, mice, and porcupines have devastated tree and shrub plantings. Hunting, dogs, fences, repellents, and protective shelters have all been used to reduce damage with varying amounts of success. Methods of control vary considerably depending on the species being damaged, the pest causing the damage, and the value of the woody plants. Contact your county extension agent or your local soil conservation district office for specific control measures.

For the most complete reference on wildlife damage and control in North America, refer to "Prevention and Control of Wildlife Damage" by Hygnstrom, Timm, and Larson, published by the University of Nebraska Cooperative Extension Service. This reference can be ordered at:

http://wildlifedamage.unl.edu/

Refer to Idaho Plant Materials Technical Note No. 34 "Guidelines to Reduce Rodent Damage while Establishing Windbreaks" for additional information on dealing with voles or field mice.

Protective Tree Shelters

A wide assortment of tree shelters exists in the market place. They range from 1- 5 feet tall, from solid tubes, to flat sheets that fold into tubes or triangles, to plastic meshes. All are effective in preventing certain kinds of damage.

One of the more common tree shelters consist of tubes, or flat sheets that fold into tubes that range from 2- 4 feet in height and form a 3- 5 inch cylinder around the tree. These shelters protect the tree from wind, sun, small mammals, and deer, encourage faster initial growth, and provide an opportunity for easier herbicide applications. Once trees grow out of the tube, especially the shorter tubes, animals may still browse the tops.

Tubes are usually tied to wood stakes with plastic ties. Tubes should not be removed for several years after the tree has emerged from the top of the tube. This period of time is needed for the tree to develop adequate stem diameter to withstand wind. Removal of the tree shelter just as the tree reaches the top of the tube will often result in a tree that "lies on the ground" or is broken during the first strong wind.

There may or may not be merit in raising the tubes a few inches off the ground in the fall to help the tree "harden off."

Manufacturers should warrant the tubes for at least 3 years before they start breaking down from ultraviolet light.

Follow the manufacturer's instructions for installing specific brands of tubes.

After tubes have served their purpose, the tubes, ties, and stakes should be removed to prevent mechanical injury to the growing tree trunk.

Pruning

When applied in a timely manner and properly completed, pruning can improve the life and function of trees and tree plantings, respectively. As explained in the references below, there are certain times of the season that are more beneficial for pruning certain species. Pruning windbreaks should be discouraged unless the health of the windbreak or safety is at risk.

For pruning storm damage, it is best to prune soon after the storm to reduce the area of jagged open scars and potential for disease infestation. Another reason to prune storm damage immediately is to reduce hazards to life and property from weakened and damaged trees. Attempt only those pruning jobs commensurate with skills, experience, and equipment of the person doing the pruning. Pruning can be hazardous to those not properly prepared.

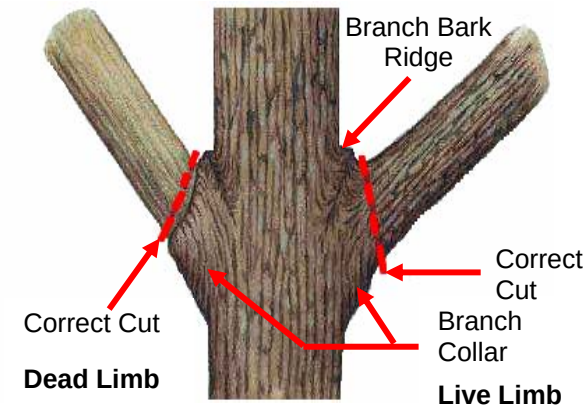


Figure 11: Proper Pruning

The branch bark ridge is a raised ridge on top of the limb between the main trunk and the limb. It is a good indicator of the proper pruning position. The branch collar is a slightly swollen area around the base of the limb where it attaches to the trunk. The branch collar contains specialized cells that help the wound to close after a pruning cut. The branch-bark ridge and the branch collar are excellent guides for properly locating pruning cuts. Avoid damaging the branch collar or branch-bark ridge, as the wound will take much longer to callus over.

In most cases, weather and animal damage resulting in broken, scarred or twisted limbs, along with double leaders can be easily corrected with a hand pruner. See Figure 11.

Generally, trees should be trained to have a single main stem without v-shaped branch angles on the main trunk. Double leaders and weak branch angles leave a tree susceptible to subsequent breakage, loss of function, and decreased life.

More detailed instructions for pruning are in:

"Pruning Trees and Shrubs"

http://www.ext.nodak.edu/extpubs/plantsci/trees/h1036w.htm

Staking

Most newly planted trees less than 5 feet in height do not need staking. For those with smaller root balls or those greater than 5 feet in height, the following diagrams illustrate staking methods. Trees should not be staked for more than 2 years, in most situations. Tree trunks need to develop wind hardiness, which is not possible when tightly staked for longer periods of time.

Figures 12 and 13 illustrate two different ways of staking trees. Wires and ties used in staking should not be so tight that the tree can not move at all. Some movement is desirable. Stakes are to restrict movement during high winds that could uproot the tree.

Ties and posts should be positioned in such a way that the tree trunk or limbs will not be

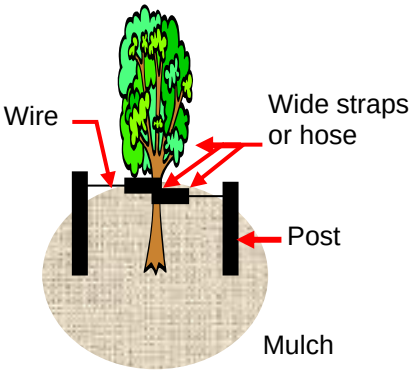


Figure 12: Staking With Two Posts

abraded against the post(s). When using steel fence posts, orient the steel plate on the posts parallel to a line between the tree and the post to minimize damage to roots when the post is removed. When using the single post method, place the post on the prevailing wind side of the tree.

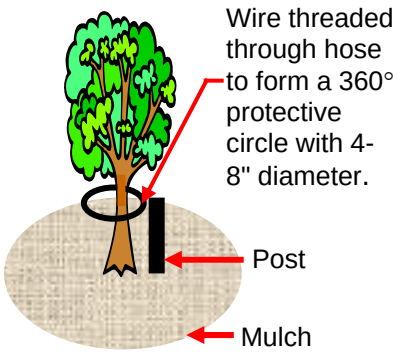


Figure 13: Staking With One Post

Tipped Trees

Trees older than 2- 5 years that have tipped due to high winds and saturated soils can rarely be pulled back straight, nor will they likely develop a strong, supportive root system. Establish a new planting near the one that has been damaged.

Once the new planting is established and functioning as intended, the damaged planting can be removed.

Younger trees not older than 5 years and not tipped more than 30 degrees may be pulled back straight immediately after the storm event while the soil is saturated and staked for 1- 2 years. These straightened young trees may develop a root system strong enough to withstand future strong winds. Trees tipped more than 30 degrees will most likely never develop wind hardiness.

REQUIRED SURVIVAL PERCENTAGE

To determine when a planting can be labeled a success, refer to **Table 1**. Required survivability of individual plants will vary as the purpose of the planting varies. Wildlife plantings can function perfectly well with considerably more missing trees and shrubs than can a windbreak. Table 1 assumes that the proper numbers of trees were planted originally, according to a sound design.

Table 1 - Required Survival Percentages For a Successful Tree Planting
Inventoried after "leaf out" during spring or summer of the second to third year (% of number planted)

Practice	Percent Survival
380 - Windbreaks / Shelterbelt Establishment Home – Livestock protection Field protection Sound Barrier Visual Screen Airborne chemical drift Wind borne dust barrier Living snow fence	85 % of all trees or shrubs planted with no two adjacent plants missing
311 Alley Cropping	
391 Riparian Forest Buffer	75 % of all trees or shrubs planted
422 Hedge Row Planting	
612 Tree / Shrub Establishment	
580 Streambank/Shoreline Protection 644 Wetland Wildlife Habitat Management	50 % of all trees or shrubs planted, unless specific sites require a higher survival percentage
645 Upland Wildlife Habitat Management	

Weed Control Fabric Advantages and Disadvantages

Thousands of miles of polypropylene woven fabric have been applied to conservation tree plantings for weed control throughout the mid-west and western United States. This material both eases and complicates subsequent management of conservation plantings, even when properly applied.

"Ideal" fabric installation

Fabric Advantages

- Applied only once
- Greatly increases tree and shrub establishment and survival (Increases survival from 20 to 80%+)
- Increases growth rates immediately following planting
- Easier and more timely weed control
- Long lasting weed control
- Comparable cost to other weed control methods averaged over 5- 10 years

Fabric Disadvantages

- Initially expensive
- Requires specialized machinery and trained crew to install properly
- Proper installation is critical to prevent pulling loose in high winds
- Does not break down, especially within the shade of trees and shrubs
- Stems may be girdled by fabric as trees and shrubs grow
- Suckering of some shrub species is greatly restricted
- Dense sod can become established on top of fabric, negating benefits and complicating future maintenance

Sod growing on top

Fabric Management

- Inspect annually or more often if needed
- Ensure edges are firmly anchored
- Ensure openings are not parallel to grain of fabric to avoid stem damage
- Keep soil and organic matter off surface of fabric
- Control aggressive weeds that may establish in fabric openings
- Enlarge openings as needed to prevent stem girdling
- Consider alternative weed control where shrub thickets are desired

Reduced suckering outside fabric. Chokecherry roots on top of soil immediately under, and parallel to fabric edge. Fabric has been removed.

Stem girdling after 8 years

Conclusion

Fabric has greatly increased tree planting success and vigor in conservation plantings. However, it requires regular maintenance to prevent future damage to the planting. Since fabric can inhibit suckering of some shrub species another weed control method may be more appropriate for certain types of plantings and/or landowners. Research continues to develop weed control materials that will provide effective initial control without long term negative impacts. New fabric types with varying amounts of photo degradation to address potential girdling problems have been developed and released. Conclusions as to the success of these new fabric types will not be fully determined for several years.

ADDITIONAL INFORMATION:

Please note that all the Internet links in this document were current at publication time. Since then some sites may not be maintained.

"Common Insect Pests of Trees and Shrubs in North Dakota"
http://www.ext.nodak.edu/extpubs/plantsci/trees/e296w.htm

"Deciduous Tree Diseases"
http://www.ext.nodak.edu/extpubs/plantsci/hortcrop/pp697-1.htm

"Diseases and Related Problems of Evergreens"
http://www.ext.nodak.edu/extpubs/plantsci/trees/pp789-1.htm

"Insect and Disease Management Guide for Woody Plants in North Dakota"
http://www.ext.nodak.edu/extpubs/plantsci/trees/f1192w.htm

Idaho Brochure "Living Snow Fence" ftp://ftp-fc.sc.egov.usda.gov/ID/programs/plant/snowfence092605.pdf

Idaho Forestry Technical Note No. 14 "Water Needs of Windbreaks for Trickle Irrigation System Design." ftp://ftp-fc.sc.egov.usda.gov/ID/programs/plant/trickle_irrigation.pdf

Idaho Plant Materials Technical Note No. 24 "Grass, Grass-Like, Forb, Legume, and Woody Species for the Intermountain West." ftp://ftp-fc.sc.egov.usda.gov/ID/programs/technotes/seed_species07.pdf

Idaho Plant Materials Technical Note No. 32 "Users Guide to Description, Propagation, and Establishment of Native Shrubs and Trees for Riparian Areas in the Intermountain West." ftp://ftp-fc.sc.egov.usda.gov/ID/programs/technotes/riparian_woodys.pdf

Idaho Plant Materials Technical Note No. 34 "Guidelines to Reducing Rodent Damage While Establishing Windbreaks." ftp://ftp-fc.sc.egov.usda.gov/ID/programs/technotes/windbreaks_rodents.pdf

Idaho Plant Materials Technical Note No. 39 "Waterjet Stinger: A tool to plant dormant unrooted cuttings of cottonwoods, dogwoods and other species." ftp://ftp-fc.sc.egov.usda.gov/ID/programs/technotes/waterjet_stinger06.pdf

Montana NRCS Planting Guide "Planting Guide for Bareroot Trees and Shrubs" ftp://ftp-fc.sc.egov.usda.gov/ID/programs/plant/planting_guide_bareroot3.pdf

Montana NRCS Planting Guide "Planting Guide for Container, Balled and Bur-lapped Stock" ftp://ftp-fc.sc.egov.usda.gov/ID/programs/plant/planting_guide_balledburlap.pdf

PNW Extension Publication "Trees Against the Wind" ftp://ftp-fc.sc.egov.usda.gov/ID/programs/plant/trees_wind05.pdf

"Pruning Trees and Shrubs"
http://www.ext.nodak.edu/extpubs/plantsci/trees/h1036w.htm

"Weed Control in Tree Plantings"
http://www.ext.nodak.edu/extpubs/plantsci/weeds/w1097-1.htm

"Weed Barrier Fabric Maintenance for Conservation Tree Plantings" ftp://ftp-fc.sc.egov.usda.gov/ID/programs/plant/weed_barrier.pdf

"Windbreak Establishment", University of Nebraska Extension EC 91-1764-B.
http://www.unl.edu/nac/brochures/ec1764/ec1764.pdf

"Windbreak Management", University of Nebraska Cooperative Extension EC 96-1768-X.
http://www.unl.edu/nac/brochures/ec1768/ec1768.pdf

"Windbreak Renovation" University of Nebraska Cooperative Extension EC.98-1777-X
http://www.unl.edu/nac/brochures/ec1777/ec1777.pdf

Table 2: TREE and SHRUB CHARACTERISTICS

DECIDUOUS SHRUBS	SCIENTIFIC NAME	Plant Origin	Windbreak Suitable	Mature Crown Height (feet)	Mature Crown Spread (feet)	Conservation Varieties Available	Growth Rate	Shade Tolerance	Snow/Ice Tolerance	Root or Basal Suckers	Coppicing Potential	Flood Tolerance	Wildlife Food	Wildlife Cover	Bank Stabilization	Detritus Source	Sediment Trapping	Stream Shading	Regeneration Potential	Lifespan	Fall Leaf Color
Almond, Russian	Prunus tenella	I	Y	3-5	3-5	Y	SLOW	N	M	Y	Y	N	M	Y	Y	N	M	NA	N	S	ORG.
Buffaloberry, Silver	Shepherdia argentea	N	Y	6-14	8-14	Y	MED.	N	N	Y	M	N	Y	Y	M	N	N	NA	M	M	NONE
Cherry, Mongolian	Prunus fruticosa	I	M	3-6	3-6	Y	SLOW	N	M	Y	M	N	M	M	M	N	N	NA	N	S	YEL.
Cherry, Nanking	Prunus tomentosa	I	M	6-10	6-10	N	MED.	N	M	N	M	N	M	Y	M	N	N	NA	M	S	YEL.
Chokecherry	Prunus virginiana	N	Y	12-25	10-20	Y	MED.	M	H	Y	Y	N	M	Y	Y	M	M	M	Y	M	YEL.
Cotoneaster, European*	Cotoneaster integerrimus	I	Y	8-12	8-12	N	MED.	M	M	N	Y	N	M	Y	M	N	N	NA	N	S	YEL./BRN.
Cotoneaster, Peking*	Cotoneaster acutifolia	I	Y	6-10	6-10	N	MED.	M	M	N	Y	N	M	Y	M	N	N	NA	N	S	PUR.
Currant, Golden	Ribes aureum	N	M	3-6	3-6	N	MED.	M	M	M	M	N	M	Y	M	N	N	NA	Y	S	YEL.
Dogwood, Redosier	Cornus sericea	N	M	7-10	10-15	N	FAST	Y	M	M	Y	Y	M	Y	Y	N	Y	M	Y	M	PUR .
Forsythia	Forsythia europa x F. ovata	I	M	6-11	6-11	N	MED.	M	M	N	Y	N	N	M	M	N	N	NA	N	M	PUR./YEL.
Honeysuckle, Amur*	Lonicera maackii	I	Y	10-14	10-14	N	MED.	Y	M	N	Y	M	M	Y	M	N	N	M	Y	M	BRN./PUR.
Honeysuckle, `Freedom'*	Lonicera korolkowii	I	Y	6-9	6-9	Y	MED.	N	M	N	Y	M	M	Y	M	N	N	M	M	M	BRN .
Lilac, Common	Syringa vulgaris	I	Y	8-12	6-12	N	MED.	N	M	Y	Y	N	N	Y	Y	M	M	NA	N	L	BRN./PUR.
Lilac, Late	Syringa villosa	I	Y	6-10	5-10	N	MED.	N	M	N	Y	N	N	M	M	N	N	NA	N	M	BRN./PUR.
Peashrub, Siberian	Caragana arborescens	I	Y	6-14	6-12	N	MED.	M	M	N	Y	N	M	Y	M	N	N	NA	M	L	YEL.
Plum, American	Prunus americana	I	Y	8-10	8-10	N	MED.	M	M	Y	M	N	Y	Y	M	N	M	NA	M	S	YEL./ORG.
Rose, Woods	Rosa woodsii	N	Y	3-4	3-4	N	MED.	N	N	Y	Y	N	Y	Y	M	N	M	N	M	M	PUR.
Sandcherry, Western	Prunus pumilla besseyi	N	M	3-6	3-6	N	MED.	N	M	M	M	N	M	M	M	N	N	NA	N	S	YEL.
Sea-Buckthorn	Hippophae rhamnoides	I	M	10-18	8-10	N	MED.	N	M	Y	M	N	M	M	N	N	N	NA	M	M	NONE
Serviceberry	Amelanchier alnifolia	N	Y	6-15	5-12	N	SLOW	M	M	Y	Y	N	M	Y	Y	N	M	NA	M	M	YEL.
Silverberry	Elaeagnus commutata	N	Y	6-9	3-6	N	MED.	N	M	Y	Y	M	Y	M	Y	N	M	N	N	S	NONE
Snowberry	Symphoricarpos occidentalis	N	N	2-3	1-2	N	SLOW	M	N	Y	Y	M	M	M	N	N	M	N	N	S	NONE/BLK.
Sumac, Skunkbush	Rhus trilobata	N	Y	6-8	4-10	Y	MED.	M	M	N	M	N	M	M	M	N	M	NA	M	M	RED/YEL.
Sumac, Smooth	Rhus glabra	I	M	5-15	10-15	N	SLOW	M	M	Y	Y	N	Y	M	N	N	M	M	N	M	RED
Viburnum	Viburnum lentago	I	M	10-14	8-12	N	SLOW	M	M	M	Y	M	Y	M	M	N	N	M	N	M	YEL./RED
Willow, Bebbs	Salix bebbiana	N	M	8-12	4-8	N	FAST	N	M	M	M	Y	M	M	M	N	N	M	N	M	NONE
Willow, Sandbar-Coyote*	Salix exigua	N	Y	6-10	5-10	N	FAST	N	M	Y	Y	Y	M	Y	Y	M	Y	M	N	M	NONE

DECIDUOUS TREES	SCIENTIFIC NAME	Plant Origin	Windbreak Suitable	Mature Crown Height (feet)	Mature Crown Spread (feet)	Conservation Varieties Available	Growth Rate	Shade Tolerance	Snow/Ice Tolerance	Root or Basal Suckers	Coppicing Potential	Flood Tolerance	Wildlife Food	Wildlife Cover	Bank Stabilization	Detritus Source	Sediment Trapping	Stream Shading	Regeneration Potential	Lifespan	Fall Leaf Color
Apricot, sp.	Prunus armeniaca	I	Y	10-15	12-18	Y	MED.	N	M	N	M	N	M	M	N	N	N	NA	N	M	YEL./ORG.
Ash, Black	Fraxinus nigra	I	M	30-50	15-30	N	MED.	M	Y	N	M	Y	M	M	N	Y	N	Y	N	L	YEL.
Ash, Green	Fraxinus pennsylvanica	I	Y	35-65	30-40	Y	MED.	M	Y	N	M	Y	M	M	N	Y	N	Y	M	L	YEL.
Ash, Manchurian	Fraxinus mandshurica	I	M	30-55	25-35	Y	MED.	N	M	N	M	Y	M	M	N	Y	N	Y	N	L	YEL.
Aspen, Quaking	Populus tremuloides	N	N	25-60	20-30	N	FAST	N	Y	Y	Y	M	Y	Y	M	Y	M	Y	N	L	YEL.
Boxelder*	Acer negundo	N	Y	30-60	30-60	N	FAST	N	M	N	Y	Y	M	M	N	Y	N	Y	Y	L	YEL./BRN.
Cottonwood, sp.	Populus sp.	N	Y	50-99	40-75	Y	FAST	N	M	N	Y	Y	M	M	Y	Y	N	Y	N	L	YEL.
Crabapple	Malus mandshurica	I	M	10-25	15-25	Y	MED.	N	M	N	M	N	Y	M	N	M	N	NA	N	L	YEL.
Elm, Siberian*	Ulmus pumila	I	Y	25-50	20-40	Y	MED.	M	Y	M	Y	M	M	M	N	Y	N	NA	Y	M	BRN.
Hackberry, Common	Celtis occidentalis	N	M	40-60	25-45	Y	MED.	M	Y	N	M	Y	Y	M	N	Y	N	Y	M	L	YEL.
Hawthorn, Arnold	Crataegus x anomala	N	Y	15-20	15-20	Y	SLOW	N	M	N	M	M	M	Y	N	M	N	M	N	M	YEL.
Linden, American	Tilia americana	I	N	50-70	30-50	N	MED.	Y	M	M	Y	M	M	M	N	Y	N	Y	M	L	BRN./YEL.
Locust, Honey	Gledisia triacanthos	I	M	30-50	30-40	Y	FAST	N	M	N	N	N	M	N	N	M	N	NA	N	M	YEL.
Maple, Amur*	Acer ginnala	I	Y	15-20	15-20	N	MED.	N	M	N	Y	N	N	M	N	M	M	NA	N	M	YEL./RED
Maple, Tatarian	Acer tataricum	I	Y	18-30	15-25	N	MED.	N	M	N	Y	N	N	M	N	M	M	NA	N	M	YEL.
Oak, Bur	Quercus macrocarpa	N	Y	40-70	35-60	N	SLOW	N	Y	N	M	Y	Y	M	N	Y	N	NA	M	L	YEL./BRN.
Pear, Harbin	Pyrus ussuriensis	I	Y	15-30	15-20	Y	MED.	N	M	N	M	N	Y	M	N	M	N	NA	N	L	ORG./YEL.
Poplar, Hybrid	Populus sp.	I	Y	40-60	20-35	Y	FAST	N	M	M	Y	Y	M	M	N	M	N	Y	N	M	BRN./YEL.
Poplar, Simon	Populus simonii	I	Y	36-50	20-35	N	FAST	N	M	M	N	Y	M	M	M	M	M	Y	N	L	NONE
Poplar, White*	Populus alba	I	Y	40-60	35-50	N	FAST	N	M	Y	Y	Y	M	M	M	Y	N	Y	N	L	NONE/YEL.
Walnut, Black	Juglans nigra	I	N	35-60	30-50	N	MED.	N	M	N	M	N	Y	M	N	M	N	NA	M	L	BRN./YEL.
Willow, Laurel	Salix pentandra	I	Y	25-40	20-35	N	FAST	N	M	N	Y	Y	M	M	Y	Y	N	Y	N	L	NONE
Willow, Peachleaf	Salix amygdaloides	N	Y	40-55	30-45	N	FAST	N	M	N	Y	Y	M	M	Y	Y	N	Y	N	L	NONE
Willow, White (Golden)*	Salix alba	I	Y	40-65	30-50	Y	FAST	N	M	N	Y	Y	M	M	Y	Y	N	Y	N	L	NONE

CONIFERS	SCIENTIFIC NAME	Plant Origin	Windbreak Suitable	Mature Crown Height (feet)	Mature Crown Spread (feet)	Conservation Varieties Available	Growth Rate	Shade Tolerance	Snow/Ice Tolerance	Root or Basal Suckers	Coppicing Potential	Flood Tolerance	Wildlife Food	Wildlife Cover	Bank Stabilization	Detritus Source	Sediment Trapping	Stream Shading	Regeneration Potential	Lifespan	Fall Leaf Color
Fir, Douglas	Pseudotsuga menziesii	N	M	40-60	20-30	N	SLOW	N	Y	N	N	N	N	Y	N	Y	N	NA	N	L	NONE
Juniper, Rocky Mountain	Juniperus scopulorum	N	Y	20-40	12-20	N	SLOW	M	M	N	N	N	Y	Y	M	Y	N	NA	M	L	NONE
Larch, Siberian	Larix sibirica	I	M	30-60	15-25	N	MED.	N	M	N	N	N	N	M	N	Y	N	NA	N	L	YEL.
Pine, Austrian	Pinus nigra	I	Y	50-70	20-30	N	MED.	M	Y	N	N	N	N	Y	N	Y	N	NA	N	L	NONE
Pine, Limber	Pinus flexilis	N	N	25-45	15-30	N	MED.	N	N	N	N	N	M	M	N	Y	N	NA	N	L	NONE
Pine, Lodgepole	Pinus contorta	N	N	25-55	15-25	N	MED.	N	N	N	N	Y	N	M	N	Y	N	NA	N	M	NONE
Pine, Ponderosa	Pinus ponderosa	N	Y	50-70	25-30	N	MED.	N	N	N	N	N	N	M	N	Y	N	NA	N	L	NONE
Pine, Scots (Scotch)	Pinus sylvestris	I	Y	25-50	20-35	N	MED.	N	N	N	N	N	N	M	N	Y	N	NA	N	L	NONE
Redcedar, Eastern	Juniperus virginiana	I	Y	30-45	15-30	N	SLOW	Y	M	N	N	M	Y	Y	M	Y	N	NA	M	L	NONE
Spruce, Blue	Picea pungens	N	Y	30-65	15-25	N	MED.	N	M	N	N	N	N	Y	N	Y	N	NA	N	L	NONE
Spruce, Engelmann	Picea engelmannii	N	N	30-60	15-25	N	MED.	N	M	N	N	Y	N	Y	Y	Y	N	NA	N	L	NONE
Spruce, Norway	Picea abies	I	Y	30-65	15-25	N	SLOW	N	M	N	N	N	N	Y	N	Y	N	NA	N	L	NONE
Spruce, White	Picea glauca	I	Y	35-65	15-25	N	SLOW	N	M	N	N	N	N	Y	N	Y	N	NA	N	L	NONE

Legend **Definition of Symbols and Explanation of Characteristics**

* Potentially Invasive - Species may spread.
Russian-Olive, although very drought and saline tolerant, has been removed due to its extreme invasive traits in wetlands - riparian habitats.

RUSSIAN OLIVE SHOULD NOT BE RECOMMENDED IN IDAHO PLANTINGS.

1 Native Plants
N = native plant (naturally occurring in Idaho)
I = introduced plant (introduced from another state or country - may be naturalized)

2 Windbreak Suitability
The ability to withstand the exposed conditions, moisture stress and limited maintenance associated with conservation plantings.
Y = Ability to withstand exposed field conditions and vegetative competition
M = Ability to withstand exposed field conditions, but survival and growth rates may be significantly reduced
N = Inability to withstand exposed conditions and vegetative competition.

3 Mature Crown Height
Height at maturity is that observed within conservation plantings or on sites exposed to the elements in rural settings. Trees and shrubs planted in protected areas and urban settings will often grow taller. Assumes healthy stock planted on the most productive soils with good to excellent weed control. Generally, tree heights will decrease from east to west across North Dakota. Trees will tend to grow taller when planted in blocks or multiple row windbreaks compared to single row or specimen plantings. Use mature crown height to determine space requirements when designing tree and shrub plantings.

4 Mature Crown Spread	Spread at maturity is that observed within conservation plantings or on sites exposed to the elements in rural settings. Trees and shrubs planted in protected areas and urban settings will often grow wider. Assumes healthy stock planted on the most productive soils with good to excellent weed control. Generally, tree size will decrease from east to west across North Dakota. Trees will show reduced crown spread when planted in blocks or multiple row windbreaks compared to single row or specimen plantings. Use mature crown spread to determine space requirements when designing tree and shrub plantings.
5 Conservation Varieties Available	Y = Varieties have been tested and released for conservation plantings. N = Varieties may exist within the horticultural trades for ornamental uses, but have not been used for conservation plantings. At this time, only the naturally occurring species has proven hardy in conservation plantings.
6 Growth Rate	Fast, >2 feet per year Med. (Medium), 1-2 feet per year Slow, <1 foot per year Note: Growth rates assume average weather conditions and appropriate weed control on better soils. Tree growing conditions deteriorate as one progresses from eastern to western North Dakota. Trees and shrubs in western North Dakota may grow at slower rates than shown.
7 Shade Tolerance	Plant's ability to do well when shaded from direct sunlight for most of each day during the growing season. Y = Yes the plant will grow well in shade. The plant is shade tolerant. M = The plant is moderately well adapted to growing in shade. N = The plant will not grow well in shade. It is shade intolerant.
8 Snow/Ice Tolerance	Plant's ability to withstand normal snow drifts and ice loading, without severe deformity or breakage, such as commonly found on the windward edges of multiple row windbreaks. Y = Withstands heavy snow and ice loading with minimal damage. M = Heavy snow and ice loads cause damage to small limbs and branches, but basic plant form and function are maintained. N = Heavy snow and ice loads cause severe deformity and destruction to plant form and function.
9 Root or Basal Suckers	Plant's tendency to produce root suckers or basal trunk sprouts. Does not include basal sprouts arising from the stump when the tree has been cut. Y = Commonly develops root suckers. M = Rarely develops root suckers unless roots are damaged, but may produce basal trunk sprouts or spread by layering. N = Does not develop root suckers or basal trunk sprouts.

10 Coppicing Potential

Plant's ability to initiate sprouting after the top growth has been removed (as in harvest or ice shearing).
Note: For some species, the removal of top growth may not initiate resprouts from the cut stump but rather encourage a flush of basal and root sprouts in the area immediately adjacent to the stump. For the purposes of this characteristic, both are considered as coppice regeneration.
Note: In some situations, by the time that the need for coppicing is noted, the health of the root stock has deteriorated to the point that successful regeneration is not likely. The references in this table to a plant's coppicing potential assumes healthy root stock.
Y = High. Even mature healthy root stock can initiate resprouts of sufficient quantity to reestablish the stand.
M = Moderate. Mature root stock may not initiate enough resprouts to fully stock the stand. Juvenile root stock can reestablish a fully stocked stand after the tops have been removed.
N = Unlikely that a stump will initiate new top growth.

11 Flood Tolerance

An established plant's ability to withstand soil saturation or surface ponding. Note: Most plants will withstand extended periods of flooding when dormant, but some plants are particularly sensitive to excess water during the growing season. Certain plants that may be tolerant to flooding once established may be sensitive to excess moisture during their establishment period.
Y = Plants are able to withstand flooding or soil saturation for more than three weeks during the growing season.
M = Plants are able to withstand one to three weeks of flooding or soil saturation during the growing season.
N = Plants are unable to withstand flooding or soil saturation for more than seven days during the growing season.

12 Wildlife Food

Y = This plant is an excellent source of winter food.
M = This plant provides food prior to winter, with most food utilized during the growing season.
N = This plant provides no food supplies that are carried into the winter and little food is available or utilized during the growing season.

13 Wildlife Cover

Y = Provides three or more of the following cover types; *nesting, loafing, escape, winter cover.*
M = Provides two of the needed cover types.
N = Provides only one of the cover types.

14 Bank Stabilization

Y = Dense roots stabilize soils and supple tops resist tearing out during high water. If tops are sheared by ice, they readily resprout.
M = Root system provides effective soil stabilization, yet mature tops do not bend easily during high water. If sheared off they may not resprout as readily.
N = Neither root systems nor top growth respond favorably to high water depths and velocities.

15 Source of Detritus

Y = Listed plant is able to provide an appropriate source of detritus for the riparian system. (Detritus, as used for this characteristic, is stems and limbs of sufficient size to provide in-water habitat for aquatic species.)
M = Listed plant is only moderately useful as a source of detritus.
N = Due to size or rapid deterioration of stems, the listed plant is not an appropriate source of detritus.

16 Sediment Trapping

Plant's ability to trap sediment in out-of-bank flood flows. (Directly related to the number of stems per unit area.) More stems per square foot translates to more efficient trapping. Note: Larger stems of larger trees may not trap sediment by themselves, but strain debris, increase roughness, and retard velocities which also translates to increased sediment trapping.
Y = This plant exhibits excellent sediment trapping ability, even with out-of-bank stream flows.
M = This plant provides good sediment trapping ability, yet less effectively, during flood conditions.
N = Plant's characteristics reduce its effectiveness in filtering sediments from overland flows.

17 Stream Shading

Y = Dense canopy and effective plant height provide shade and cooling to stream or water body.
M = Crown density and height provide some temperature moderation to stream or water body.
N = Short stature or sparse foliage provide little temperature moderation to stream or water body.
NA = Species usually not adapted to riparian sites.

18 Regeneration Potential

Relative ability of the plant to regenerate from seed spread by birds, mammals, floods, snowmelt or wind.
Y = Plant seeds can become established on sites with existing dense vegetation or mulch layers and minimal amounts of exposed mineral soil.
M = Plant seeds can become established on sites with moderately dense amounts of existing vegetation or mulch
N = Plant seeds will become established only on suitable sites of exposed mineral soil under optimal climatic conditions.

19 Life Span

How long the plant will live under average field conditions found in conservation plantings. Generally plants in the eastern part of North Dakota will survive longer than in the western part of North Dakota. Life span refers only to the survival capability or the originally planted above-ground plant parts. This characteristic does not apply to situations where the above-ground part of the plant dies, but new root sprouts emerge from the existing root stock.

L = Long. Above ground plant parts can be expected to survive for greater than 50 years.
M = Moderately long. Above ground plant parts can be expected to survive for 20-50 years.
S = Short. Above ground plant parts can be expected to survive for less than 20 years.

20 Fall Leaf Color

Indicates the normal fall color of leaves, however, numerous environmental and soil conditions may affect ultimate coloration.

RED = Red
YEL. = Yellow
ORG. = Orange
BRN. = Brown
PUR. = Purple or reddish purple
BLK. = Black
None = Do not turn color in the fall. Will remain green or silvery till leaf drop.

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Note: When differences existed between references, the PLANTS database was generally used for resolution.

Table 3: TREE and SHRUB TOLERANCE to SALINITY (EC)

Compiled by: R. Haas, ND, Craig Stange, ND 2-27-97; Modified D. Ogle, ID, L. St John, ID 4-8-02 & 10-5-07

Plant Species	Not Saline EC 0-2	Slightly Saline EC 2-4	Slightly Saline EC 4-8	Moderately Saline EC 8-16	Strongly Saline EC > 16
Ash, Green 3					
Aspen, Quaking 1					
Boxelder* 1					
Buffaloberry, Silver 1					
Cherry 6					
Chokecherry 7					
Cotoneaster* 1					
Cottonwood 1					
Crabapple 1					
Currant, Golden					
Dogwood 1					
Douglas-fir 1					
Elm, American 1					
Elm, Siberian* 1					
Fir, Balsam 1					
Hawthorn 1					
Honeysuckle, Freedom*					
Juniper, Rocky Mtn 1					
Larch, Siberian 5					
Lilac, Common 1					
Linden, Little Leaf 1					
Mountain-ash 1					
Pine, Austrian					
Pine, Ponderosa 1					
Pine, Scotch 2					
Plum, American 7					
Poplar, Hybrid 1					
Rose 1					
Siberian Peashrub 7					
Silverberry*					
Spruce, Blue 1					
Sumac, Skunkbush					
Viburnum 1					
Walnut, Black 1					
Willow, Laurel 1					

Numbers behind each species refer to specific technical references listed on the following page.
Species with no number indicate no technical reference and listed based on personnal experience.

* Potentially invasive - Species has ability to spread under proper environmental conditions.

Russian-Olive, although very saline tolerant, has been removed due to its extreme invasive traits in wetlands - riparian habitats.

RUSSIAN OLIVE SHOULD NOT BE RECOMMENDED IN IDAHO PLANTINGS.

Important Considerations

Plant species differ in the stages at which they are most sensitive to salinity. Generally trees are more sensitive to salinity during establishment.

Plant stress related to salinity may be evident at levels lower than those listed. The listed values generally refer to the level at which major portions of a plant population show considerable mortality, reduced biomass, or growth rates.

Plants appear less salt tolerant when grown in a hot, dry climate than a cool, humid climate.

Salinity levels are affected by the soil, plants, landscape, climate and the management of the soil surface. Levels change from day to day, from season to season and from spot to spot in the field.

Source of salinity affects the choice of management options available.
Saline seeps from local recharge areas are easier to manage than seeps formed from deep aquifer recharge.

Salinity is usually associated with adequate to surplus moisture and the presence of soluable salts. Sodicity refers to a restrictive soil layer that prohibits root development and causes severe root restrictions in plants.

Management options to minimize the negative aspects of salinity:

Select species most tolerant to salinity that meet the landowner's objectives.

Manage the soil surface around each plant to minimize soil water evaporation and concentration of salts. Practices such as scalp planting and mulching, with either fabric or organic mulches, are effective in keeping the soil surface moist and discouraging salt accumulation near the young establishing plant.

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