This document provides guidance to foresters, conservationists, and private family forest landowners and managers with establishment methods that have proven successful for conservation conifer tree plantings on upland forestlands in Idaho. It provides information for establishing conifer trees as part of the Natural Resources Conservation Service (NRCS) Field Office Technical Guide (eFOTG) Practice “Tree & Shrub Establishment” (practice code 612).
Tree Planting Guide for Idaho Private Forestlands

INTRODUCTION

This Technical Note is intended to be used as a guide for planning and subsequent planting of conifer tree seedlings on privately managed family forestlands in Idaho. It is not intended to guide natural reproduction strategies that utilize silviculturally recognized regeneration harvest methods (i.e. seed tree, shelterwood or selection operation) to achieve reforestation goals, or to guide direct seeding operations on forestlands.

Idaho Tech Note Plant Materials No. 43 is a compatible reference. TN 43 addresses an array of planting situations, including Alley Cropping (practice code 311), Multi-Storied Cropping (379), Windbreak/Shelterbelt Establishment (380), Riparian Forest Buffer (391), Hedgerow Planting (422), and Windbreak/Shelterbelt Renovation (650). For these specific uses, refer to the Idaho eFOTG on the Idaho NRCS web site for guidance.

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RATIONALE FOR PLANTING

Deciding to plant a forest stand in order to achieve regeneration goals, rather than relying on natural regeneration, is usually determined by a number of limiting site factors.

The main obstacle to natural regeneration occurs when the site does not have adequate levels of seed trees of the desired species (or combinations of species) to adequately stock the site. In other situations, where desired tree species are present but the phenotypic characteristics of the potential seed trees are undesirable, it is better to remove the poor quality trees and regenerate the stand by planting.

Natural reproduction can also be limited by the lack of suitable seedbed conditions for germination and establishment. Sporadic production of cone crops, common in many conifer species, coupled with harsh climatic and site conditions, are other major restrictions to natural reproduction and stand establishment.

Tree planting overcomes these limitations while improving forest genetics, controlling spacing and stocking, and facilitating the conversion to a more desirable species component of the stand.

At some point where natural regeneration methods would likely fail to address the resource needs or to satisfy producer objectives, the best and most viable alternative is to plant.

PLANNING THE PLANTING

GENERAL GUIDELINES

Conifer tree planting on private Idaho forestlands will accomplish one or more of these purposes:

- Maintain or improve desirable plant diversity, productivity and health by establishing trees for forest products or ecosystem services.
- Create or improve habitat for native wildlife as determined by the ecological suitability of the site.
- Control long term erosion and improve water quality.
- Treat excessive nutrients and other pollutants in surface and ground waters.
- Sequester carbon.
- Restore or maintain natural plant communities.
- Reduce energy use.
- Initiate or maintain a silvopasture or forest grazing management strategy.
- Improve or maintain air quality.

Part of a long term strategy:

Private forest owners and managers are encouraged to work with professional, experienced foresters in all elements of forest management. This includes the technical elements of a well-designed tree planting project. A forester provides guidance necessary to ensure a successful field planting, and can oversee the completion of necessary maintenance items.

Before the tree planting activity is initiated, the landowner and forest planner should have developed a management plan using the NRCS planning process (through the seventh step of the nine step process) or an equivalent professionally developed plan. Idaho Forest Stewardship plans, or plans written by certified Idaho Tree Farm foresters, are commonly used. Any well-developed management plan will follow the same basic resource conservation planning processes, regardless of the source of the plan.

It is important that the forester understand the basic ecological parameters and resource conditions of the ownership. The forester can assist the land owner to develop an ecologically based conceptual target stand (this is sometimes referred to as a "future desired condition"). The target stand serves as a constant guide which, when attained, will meet the objectives of the landowner as well improving the identified local resource concerns. In many instances tree planting will be a major part of introducing the preferred conifer species documented in the target stand.

All forest management activities, including tree planting, should be done in a manner which provides the greatest chances of attaining the characteristics of the identified target stand.

By NRCS policy the tree planting practice is governed by the national and state conservation practice standards for this practice (Tree & Shrub Planting: NRCS practice, code 612), as well as by overall specifications developed for the practice at the state level. This Tech Note provides the technical basis for tree planning on forestlands in Idaho.
Development of the planting prescription:

A professional forester assists the landowner in deciding appropriate actions to take to apply a tree planting project. The forester will develop a site specific job sheet to guide the tree planting.

The job sheet provides details and requirements that describe the application of this practice at a specific location. It contains contact information for the producer, location of the project (linked to plan maps), amount (acreage) of the practice, and other site specific information critical to the application of the planting.

Tree species identified for planting, instructions regarding spacing, browse protection measures, and information detailing residual regeneration and expected in-fill, and any other elements of the planting which are necessary to ensure the best chances of tree establishment, are included on the job sheet. Job sheets prepared by NRCS foresters or registered NRCS Technical Service Providers (TSPs) are reviewed and signed by the forester and the forest manager or landowner. The job sheet becomes a part of the forest management plan documentation.

The NRCS forestland conifer tree planting job sheet template is available on the Idaho eFOTG.

Associated NRCS practices which support forestland conifer plantings may include Tree/Shrub Site Preparation (practice code 490), Forest Stand Improvement (practice code 666), or other less common forestry practices as needed.

SELECTION OF APPROPRIATE CONIFER SPECIES FOR PLANTING

A number of site factors must be considered when selecting the tree species or species mix for planting. These factors include favorable soil characteristics, site productivity, parent materials (weathering potential/nutrient status), and soil limitations such as hard pans, texture, depth and high water table, as well as climatic attributes.

Of these factors, the parent material is perhaps the single most important factor in determining stand health, productivity and sustainability.

Use the following guidelines for determining nutrient status as determined by rock type.

<table>
<thead>
<tr>
<th>Rock Type:</th>
<th>Good</th>
<th>Moderate</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calc-silicate rocks</td>
<td>Basalt</td>
<td>Felsic</td>
<td>Granite</td>
<td>Amphibolite</td>
</tr>
<tr>
<td></td>
<td>Felsic gneiss</td>
<td>Granite</td>
<td>Granodiorite</td>
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<tr>
<td></td>
<td>Quartz</td>
<td>Diorite</td>
<td>Schist</td>
<td>Dacite</td>
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<td></td>
<td>Diorite</td>
<td>Siltite/Argillite</td>
<td>Amphibolite</td>
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<td></td>
<td>Schist</td>
<td>Tonalite</td>
<td>Alluvium</td>
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<td>Tonalite</td>
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<td>Tonalite</td>
<td>Schist</td>
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</tbody>
</table>

When designing a seeding plan, the current (and potential) stand health, as well as the possible disease and insect problems must be considered. The compatibility of different tree species within a planting mix is important.

There are a number of resources available to foresters to help guide species selections. NRCS soil survey interpretations include “Trees to Manage” (called “Trees to Plant” in the older survey publications) for the common forested soils mapped in NRCS soil surveys. Many of the tree species on that list can be used in planting situations. Be aware that some conifer species naturally regenerate very well under established forest canopies (shade tolerant, generally late seral) and will be listed on the “Trees to Manage” interpretation, even though they are not commonly regenerated by planting, nor are they always the most preferred species for sustainable forest management.

Habitat types are ecologically based systems that identify and separate areas of equivalent environmental parameters. The identified habitat type, along with the fundamental understanding of the forest ecology and succession of that type, is another useful way to identify the best adapted tree species for planting, management and harvest.

Finally, the knowledge and experience of a local forester is an important resource for identifying
forest species that are best suited for management in individual planting units.

**Table 1** shows relative autecological characteristics of common trees. This guide helps to match site conditions with adapted tree species.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade tolerance</td>
<td>WL</td>
<td>LP</td>
<td>PP</td>
</tr>
<tr>
<td>Frost tolerance</td>
<td>WH</td>
<td>WC</td>
<td>GF</td>
</tr>
<tr>
<td>Drought tolerance</td>
<td>WH</td>
<td>WC</td>
<td>AF</td>
</tr>
<tr>
<td>Fire resistance</td>
<td>WH</td>
<td>WC</td>
<td>AF</td>
</tr>
<tr>
<td>Excess water tolerance</td>
<td>PP</td>
<td>AF</td>
<td>WH</td>
</tr>
<tr>
<td>Nutrient requirement</td>
<td>(LP, WL, WH)</td>
<td>PP</td>
<td>WP</td>
</tr>
</tbody>
</table>

Adapted from Fleisher and Likey: *Auteology and Sporology of Western Larch* in USDA GTR INT-319, and others.

The goal in many private forestland plantings is to shift the forest tree composition to early seral species in order to reduce fire risk, increase production, and to lower the risk of insect and disease mortality. These actions can improve forest health and sustainability in the stand.

Tree planting also enables the landowner to control initial species density, and to anticipate future intermediate stand treatments and eventual commercial harvest activities.

The most common conifer tree species planted on private forestlands are Ponderosa pine, Western larch, Douglas-fir, Western White pine (blister rust resistant variety-F2), and lodgepole pine. Engelmann spruce and western redcedar are planted on private lands but to a lesser extent. The best species/seedling for planting will be one that:

1. Meets the objectives of the planting project.
2. Combines the selected species for management with the appropriate seedling type, matching site specific conditions.
3. Originates from an appropriate source.
4. Will best overcome the limitations of the planting site.
5. Is suitable to be planted in the defined panting window at the site.
6. Can be planted with an appropriately matched panting tool.

**SEED TRANSFER**

Selecting the particular tree species (or a mix of species) is just one element in the process of accomplishing a successful tree planting.

Adaptive genetic differences occur throughout the range of any given forest tree species or subspecies. The largest drivers of genetic adaptation reflect temperature, growing season, and moisture patterns of the region. Collecting seed from one area of Idaho and then out-planting it in another area can have serious consequences if the source materials are not suited to the out-planted location.

Limits to seed transfer include geographic, altitudinal, ecologic, and other physiographic constraints across the range of expression for the species.

The characteristics that are the most important in planted seedlings are survivability, cold hardiness, bud break and bud set, shoot elongation, production, insect and disease resistance, and drought tolerance. These are all genetic adaptation responses to the environmental make-up of the seed source area. Genetic adaptations have evolved over long periods of time.

In general the best adapted seed sources are from healthy stands on similar sites that are close to the area where re-forestation will take place, where the likelihood of genetic similarity is the greatest.

Individual seed trees that are selected for propagation within a *Seed Transfer Zone* (an area within which plant materials can be transferred with little risk of being poorly adapted to their new location) come from seed trees that exhibit desirable physiological qualities.

Seed trees are healthy, mature (but not old) and are co-dominant or dominant trees that exhibit good form and structure, and that have straight boles without forks. In addition, favorable height, diameter and volume growth characteristics are important for timber management goals. Seed trees should not have large secondary
branches, or thin and weak crowns. The ability to self-prune and other positive visible attributes are important in the selection of individual seed trees. Seed lots are generally made up from collections of a number of suitable individual seed trees within a transfer zone.

Landowners and their consultant foresters must to be certain that the seedlings that are planted in a treatment area conform to the established seed transfer protocols in Idaho.

Idaho NRCS uses the seed transfer guidelines that are incorporated in the Idaho Department of Lands (IDL) Forest Improvement Handbook (see Appendix A).

**NURSERY PROPAGATION & STOCK TYPE**

The planting objective will only be met when viable, high quality nursery stock is planted in order to successfully meet management objectives, which in turn will address the resource concerns of the site.

The majority of seedling purchases are made from contracted “sow orders”, and not simply purchased from material on hand at local nurseries. Private nursery growers have reduced the risk involved in producing excess seedlings grown on speculation, and the subsequent losses that are incurred when excess stock was discarded. However, each year some amount of planting stock becomes available, usually on short notice. This excess stock is typically from abandoned seedling orders or as undersold excess from local tree planting programs. Landowners should be careful to make sure that “excess” seedlings will fit their overall planting needs and site requirements before making any purchase.

Landowners are encouraged to plan ahead and place seedling orders well in advance of the projected planting date in order to avoid delays. Favorable site conditions can deteriorate rapidly, and a delay in planting at the earliest opportunity reduces the chances for successful establishment.

Appendix B shows a generalized time line and typical nursery process to produce a one year old seedling which was grown from seed.

When the seedlings are ordered, foresters and landowners should already have a good understanding of the tree species transfer requirements, and the amount of seedlings that need to be ordered from the planning process.

In addition to species selection, the type of growing stock will need to be selected. Many interrelated factors come into account when deciding on the proper type of planting stock to order. A forester who is well versed with various seedling types, and who is familiar with the conditions of the planting site, is vital in helping a landowner make an intelligent decision in this part of the process.

The specific type of nursery produced stock will depend on the out-planting site conditions which guide the morphological requirements of the seedling.

Common morphological attributes that may be important on any particular site include minimum and maximum heights, stem diameters, shoot-to-root ratio, root volume metrics, and mycorrhizal needs. Physiological targets may need to account for pest or disease risks, excessive heat or drought, and other factors.

The following schematic illustrates morphological features that address out-planted site conditions and seedling requirements:

Source: Morphology targets-- RMRS-P-65
A relatively new idea in reforestation is the “target seedling” concept. With this approach the forester works backward to identify all aspects of the planting project, including planting methods and tools, and develops the basis of a specific “ideal” stock type that will produce a high level of out-planting success.

The broadest separation in the kind of various seedlings that are produced is between bareroot stock (the roots are not attached to soil or any other growth medium when they are sent to the planting site), and container seedlings that are germinated, grown and shipped with the entire growth medium still surrounding the roots. Container seedlings are often referred to as “containerized” and “plug” seedlings. As with any product, there are advantages and disadvantages with any type of growing stock.

Bareroot seedlings are described by an age based identification system. The first number signifies the years that the seedling was in the original seed growth bed, and the second number indicates the number of years (if any) that the seedling grew in a transplant bed. For example, a “2-0” bareroot seedling spent two seasons growing in the original seedbed, whereas a “2-1” seedling was grown for an additional year in a nursery transplant bed (this can be outdoors).

Bareroot seedlings are a less common stock type than they were in the past. Bareroot has advantages on drier (but not excessively rocky) sites in their ability to extract moisture with their deeper developed root systems. They can be better suited for sites that have brush or grass competition, and for areas that experience big game or rodent damage especially when using larger (older) stock. Bareroot seedlings are also less susceptible to damage from soil activated herbicides. This type of seedling is a good choice on sites where frost heaving can be a problem. Bareroot is generally a less expensive seedling.

Bareroot seedlings require very careful handling and planting and should only be planted by crews that have adequate experience in the proper planting of these seedlings. They are easily “J”-rooted1 and their exposed root system makes them more susceptible to handling and planting mortality. Root desiccation is a very common cause of planting failures with this type of stock.

Containerized seedlings are sown and germinated from seeds in trays or blocks. They are almost always grown entirely in a greenhouse until they are ready to process and ship. The “plug” refers to the intact soil or growth medium that surrounds the root system of the seedling. This protective plug remains intact through the actual planting of the seedling. Different suppliers will describe container seedlings as “8 inch plugs”, “Styro-6’s”, “S-10”, and so forth. 5, 8 and 10” plugs are common.

The basic biology of bareroot seedlings and containerized seedlings is the same. Container seedlings are more forgiving than bareroot in terms of storage, transport, and during the actual field planting operation because the roots are protected by the plug “buffer”. They suffer less transplant shock and will not “J” root nearly as easily as bareroot seedlings will.

Combinations of growing conditions are becoming common, and the distinct line between bareroot and container stock has become blurred. Plug+ stock types combine the early rapid growth of containerized stock with the advantages of bareroot production after being transplanted to the transplant bed where they can further grow and develop. Mini-plugs have also been incorporated into the current technology of nursery production; nursery methods and terminology are complex and are constantly evolving.

Cost, a major consideration, should not be the overriding factor in making decisions regarding the purchase of planting stock. Poorly suited or poor quality planting stock will likely result in unacceptable levels of seedling mortality, requiring expensive replanting efforts. The best chances of success occur during the first planting operation. Planting failures simply add to the cumulative cost of the project, as reflected in the increased time and effort that it takes to finally accomplish successful reforestation goals.

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1 The diagram on page 13 is an example of J-Rooting
PLANTING

GENERAL GUIDELINES

Tree planting Criteria in the Tree/Shrub Establishment conservation practice standard (practice code 612) will be followed on all NRCS conifer tree plantings.

Planting--Site preparation in advance of planting:

After a major forest disturbance episode (i.e. harvest, insect epidemic, wildfire), the balance of light, nutrients and water will change, and secondary succession will begin to occur on the site. Grasses, forbs, brush and common weed species will likely occupy the site in increasing amounts. Land managers need to anticipate the types of competing vegetation that will occupy a site following disturbance, and be prepared to address those plants. At other times competing vegetation is well established as a result of past management of the stand. Regardless of the origin, plant competition is one of the leading causes of post-planted seedling mortality.

Site Preparation (sometimes simply called “site prep”) is applied in advance of the planting operation. As the time period between when the disturbance occurred and when the planting is done increases the problem of plant competition. Plant the site in the earliest planting window as soon after the disturbance as possible, assuming all site conditions are favorable.

Site preparation is important in reducing the habitat of unwanted wildlife species (e.g. pocket gophers and meadow voles in grass habitat) and it can be helpful to control insect and disease problems. It is also used to remove unwanted conifer species, for example the removal of undesirable grand fir sapling or pole sized trees on dry sites, or on sites with low nutrient status.

Site preparation can be accomplished using manual, mechanical, chemical, or prescribed burning techniques. Sometimes a combination of these methods is required, and at times more than one action is necessary. All site preparation activities should be done in a way that does not disturb the soil surface in order to maintain desirable soil quality on the site. If pesticides are used, apply only as needed and use within Federal, State and local regulations. Follow label directions and heed all precautions listed on the container. Be aware of chemical impacts on the different conifer species and on specific types of planting stock.

Tree/shrub Site Preparation (NRCS practice standard 490) guides the application of this practice. Treatments applied at the time of planting and during the maintenance period are described later. Those treatments include scalping, chemical spot treatment, tube maintenance, and other activities.

Planting--Spacing/density & stocking:

The application of the tree planting will follow the parameters and guidance contained in the site specific job sheet, which in turn was guided by information gathered during the planning process. The characteristics of the site, ecological as well as the current condition, supported the selection of the conifer species for planting.

Planting rates (“density”) will be adequate to accomplish the planned purpose of the tree planting. In cases where timber production is a goal for the landowner, planting rates on bare forestland typically range from 300 to 425 seedlings per acre on bare ground. It is important that the planting density is adequate to achieve the establishment goal of the planting, and that the planting accounts for acceptable levels of mortality (defined as the mortality that will likely occur, even with the application of adequate management safeguards).

The planned planting density considers the time until the unit becomes “free to grow”, then to the point when a pre-commercial or commercial thinning operation is needed in the young stand.

The following guidelines matches planting spacing with subsequent stand development up until the projected first stand improvement entry:

<table>
<thead>
<tr>
<th>Number of trees per acre</th>
<th>Spacing (feet)</th>
<th>Species for which spacing is optimal (at 10-15 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>15 x 15</td>
<td>-</td>
</tr>
<tr>
<td>260</td>
<td>13 x 13</td>
<td>Ponderosa Pine</td>
</tr>
<tr>
<td>300</td>
<td>12 x 12</td>
<td>Western Larch</td>
</tr>
<tr>
<td>360</td>
<td>11 x 11</td>
<td>Douglas-fir</td>
</tr>
<tr>
<td>430</td>
<td>10 x 10</td>
<td>Western Hemlock</td>
</tr>
<tr>
<td>540</td>
<td>9 x 9</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Using PCT to Enhance Woodland Productivity
Idaho Department of Lands provides similar spacing guidance from Appendix C-10 of the IDL “Forest Improvement Handbook”:

<table>
<thead>
<tr>
<th>Forest Community Type</th>
<th>Spacing (Ft)</th>
<th>Trees/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Western hemlock * Western redcedar * Moist grand fir</td>
<td>10’ x 10’</td>
<td>435</td>
</tr>
<tr>
<td>* mesic grand fir * moist Douglas-fir * subalpine fir</td>
<td>11’ x 11”</td>
<td>360</td>
</tr>
<tr>
<td>* dry Douglas-fir * moist Ponderosa pine</td>
<td>13’ x 13’</td>
<td>258</td>
</tr>
</tbody>
</table>

The overall number of seedlings needed for the planting project will take into account areas within the project area that are un-plantable due to soil features (e.g. shallow soils), areas of adequate stocking (e.g., patches of residual timber or favorable advanced regeneration) or other conditions. These situations will be documented in the planting job sheet and will be clearly identified in the field (by flagging).

The seeding plan must also take into account existing seedlings or natural regeneration of desired species that are present or is expected to regenerate on the site. For example, a planting target of 360 Western Larch per acre can be reduced if the inventory reveals an average of 100 existing natural seedlings per acre of a desirable management species, or if the site conditions and seed tree sources indicate that predicted amounts of suitable in-fill regeneration will occur.

Not all existing advanced regeneration or expected in-fill will be a desirable species. In this case, planting the desired species can take place with the expectation that the less desirable species will be removed in a thinning or weeding operation (for example, grand fir or lodgepole pine natural reproduction could be removed from a planted Ponderosa pine stand when the stand reaches a suitable size).

Rarely will strict grid type planting in forested areas be desirable or practical, and even though the spacing of any one seedling or group of seedlings can be adjusted, the entire planting unit should be planted as close to possible to the planned density. This is only possible when a good pre-seeding inventory and developed plan account for the entire set of conditions that exist within the planting unit.

Tree planting operations designed to achieve forest restoration, wildlife or other objectives can be planned at different densities and patterns compared to timber production prescriptions. Where these are primary objectives of the landowner, and where the resource concerns support these treatment applications, the landowner should include wildlife biologists, grazing specialists, or forest ecologists on the planning team in addition to the forester.

**Planting--Seeding dates and site conditions:**

In Idaho, the majority of private conifer forest plantings occur in the spring. For that reason the following discussion primarily addresses conditions normally encountered in that season.

There is a window of time when the soil conditions are right, when the plant is dormant, and when climatic conditions are conducive for growth to begin. Soil moisture and temperatures are the most common constraints to the start and end dates of a “planting window”. Planting windows can be surprisingly short.

In low elevation Ponderosa pine forests, the planting window can come early, in mid to late winter. At the opposite end of the spectrum are high elevation sites. For the majority of Idaho forestlands, the planting season begins shortly after the snow has melted and the soil warms, and the probability of severe cold has passed. This is generally early to mid-April. In the highest mountains, where snowpack levels are deepest and where access to the site may be difficult, excessively warm, dry days with high solar angles (leading to high evapotranspiration) may be coming on very soon by the time field crews can reach the site to begin planting.

To ensure root survival, rapid root growth and moisture uptake, seedlings should not be planted before the soil temperatures reach a consistent temperature of 40° F within the zone of the planted tree. This is easy to measure in the field with a pocket thermometer. The planting cannot occur when field conditions are too wet. Wetness is also easy to test in the field by simply digging a small hole and observing the level of free moisture. Favorable soil conditions are indicated by moist, friable soil that doesn’t “work up” to a shiny, wet ball.
In general, the planting date begins after the frost is out of the ground and the soil temperature threshold is reached, and the risk of saturation and extreme cold has passed. It ends when climatic conditions suitable for good spring growing have passed; when warm or hot temperatures have arrived and when the probability of additional moisture is waning. The following guidelines apply:

**General planting dates, forest land**

*All stock will be planted by:*

<table>
<thead>
<tr>
<th>MLRA</th>
<th>Spring <em>(Before)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>8, 9</td>
<td>May 1</td>
</tr>
<tr>
<td>12, 13, 44</td>
<td>May 15</td>
</tr>
<tr>
<td>43A, 43B, 43C, 47</td>
<td>June 1</td>
</tr>
</tbody>
</table>

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

Planting windows have a certain amount of inherent flexibility from year to year. In some years, wet and cool weather extends into late spring across much of the state. In this case, the planting dates listed above can be extended after consultation with a forester or with qualified NRCS staff. The approval of an extended planting date will be documented on the job sheet.

Additional weather and climate related planting considerations will be addressed further in the following sections.

**Planting--Delivery, shipping, storage, care and handling of stock:**

From the time that the seedlings leave the nursery or storage facility and are in the possession of the contractor (and eventually the planting crew), they should be handled as gently and as little as possible and planted as soon as practical.

The majority of nursery produced seedlings in Idaho are lifted in a dormant condition, repackaged in cardboard boxes, and stored in refrigerated units to ensure that dormancy is not broken. Stock is assessed, graded and culled at this time. Delivery from the nursery to planting site requires logistical advanced planning. The seedlings should be planted as quickly as possible after the seedlings are delivered, preferably within 1 to 3 days. All equipment, supplies, and labor should be in place and ready to go as the seedlings arrive at the site.

Transport planting stock to the site in unopened boxes in canopied trucks or vans, or in open pick-up trucks. The boxes should be covered in white or reflective tarps and protected from wind and direct sunlight. Successful transport has occurred when the planting stock moves from the nursery to the field without a decline in seedling quality.

If seedlings cannot be planted immediately, store them in a cool place in the packaging material that they arrived in. Store seedlings as close to 350 F as possible at the planting site or in temporary storage, and keep them out of direct sunlight.

The optimum time to plant seedlings is when the air temperatures are between 35 to 42ºF and winds are minimal. At the planting site, keep the seedling storage boxes in the shade and cover the boxes using reflective tarps with the shiny side facing out. Separate individual boxes so that free air flow is provided between boxes. Utilize shelters or insulated shells or portable coolers when necessary to lessen losses from heat or wind impacts. Insure that proper arrangements have been made for all planting contingencies in advance of the planting operation.

Protecting the seedlings from damage become increasingly important if the planting process stretches over multiple days, and if the weather warms up over the course of the planting.

Bare root stock must be kept moist at all times up until the moment when they are planted. Seedlings can be wrapped and kept in an area that is fully shaded and protected from the wind, preferably inside a building or a canvas shelter. Wrapping should be done shortly in advance of field planting, and bundled wrapped bareroot seedlings placed back in to cool storage. Prior to wrapping the seedlings are dipped or misted. The water used for dipping can be treated with cellulose products designed to enhance moisture retention, but it must not injure the roots. The wrapping material must be clean burlap or specially manufactured tree-wrapping fabric.

Bare root stock is additionally protected and kept moist by placing seedlings in insulated planting
bags. The roots must be covered with wet peat moss, wet cloth, or other suitable material. Never cover with dry peat moss or other dry covering. **Bareroot seedlings should be planted within seconds after they are removed from the planting bag.**

Bareroot stock is best pruned at the nursery. Only minor pruning to long laterals should be done when necessary, and that operation is to be done with the wrapping operation. Do not attempt field root pruning; taproot pruning to any degree, or any pruning of the root ball on the bareroot seedling at any time.

Containerized seedlings commonly arrive in plastic bags or plastic wrap in bundles of various sizes depending on seedling types. They may be frozen for shipment; do not handle or plant the seedlings until they have thawed, and never attempt to accelerate the thawing process by using artificial heat or warmed water. Never attempt to pry (or pull or cut) frozen roots or plugs apart as they are very susceptible to root damage when frozen.

Keep containerized seedlings cool just as with bareroot stock. Since plugs have a growth medium surrounding the roots they are much less susceptible to drying, but they still need to be kept cool and moist while in storage, transport, and when being carried in the field during the actual seeding operation.

Planting conditions can change rapidly in the mountains of Idaho. Planting should be suspended when a change in atmospheric or soil conditions occurs that will adversely impact the chances of seedling survival.

Seedling should not be handled when air temperatures are at or below freezing. Soils may freeze again at a shallow depth with spring storms. Seedlings can suffer significant root damage if they freeze during field planting. Suspend operations if freezing temperatures occur during the daily planting period.

Seasonal spring snowstorms will reduce the ability of planter to see the ground and to select a proper planting site, and noticeable snow accumulation will interfere with the proper preparation and closing of the planting pocket. Planting should be suspended if these conditions occur.

As the planting season progresses, warm, dry conditions severely limit planting success because of the increasing risk of seedling desiccation. Conditions become critical when air temperatures exceed 78°F and relative humidity dips below 30 percent. Wind will add to the risk of seedling desiccation, and the combination of warm temperatures, low humidity, and wind is dangerous. Plant only during times when these factors are not critical, as indicated in **Figure 1** (Climate Stress Chart).

Conditions change through the day. Planting may be suitable during the cooler, early hours but progressively worsen until the planting has to be halted because of hot, windy afternoon conditions. Topography will also impact daily planting suitability because of the variable conditions attributed to aspect.

![Figure 1: Climate Stress Chart](http://weather.noaa.gov/weather/ID_cc_us.html)

Lesser amounts of tree planting in Idaho is done during summer or fall, utilizing “hot planting” techniques to achieve successful planting. These types of plantings are more commonly done on more remote federal lands or on industrial forestlands. Nursery stock has to be properly hardened off (conditioned) by inducing moisture stress, or by shortening photoperiod in the nursery (a technique known as “blackout”), and in some cases introducing changes in nutrient balance or temperature. Combinations of these parameters can occur, and it is important to work with a skilled nursery specialist in order to properly condition the planting stock for summer or fall plantings.

Conditioning and dormancy treatments are species specific, and not all conifers will be
conducive to summer or fall planting. Only use containerized planting stock for late summer or fall plantings because they are best adapted to withstand transplant shock and field handling.

Summer or fall (nearly-dormant) plantings expand the planting window and alleviate site access and solar insolation limitations that occur in the higher elevation planting sites.

Fall plantings should be scheduled for a time when soil temperatures are still warm enough (45°F or greater) to allow for slight root growth. This serves to anchor the plant and to enable optimum growth as soon as conditions allow the following spring. Planting with at least two weeks of time before the possibility of freezing temperatures (and early onset of frost in the soil surface) is recommended with fall planting.

**Planting—Microsites and selecting each planting site:**

It is essential to plant the seedling in the most favorable location possible in order to protect the young tree from harmful conditions. This improves survival. Choosing the best planting spot (or “microsite”) is more important than maintaining exact spacing.

The most important function of microsites is to provide a period of shade on hot, dry summer days in order to protect seedlings from the injurious impacts of intense and constant heat. Although the foliage of the young seedling will suffer from excessive heat, it is most often the elevated temperatures that occur at the soil surface that are ultimately fatal to the shoot of the young seedling.

The availability of shade is critically important on soils with limited water holding capacity, and on southern and western aspects (at 30% and steeper slopes), and in the dry habitat forests of Idaho. Dry habitat types include the Grand fir/ninebark climax habitat types extending down to Ponderosa pine habitat types.

Shade is provided from a variety of sources, but to be effective shade has to be available in the warmest part of summer during the period maximum daily solar insolation (i.e., mid to late afternoon in August). Shade can come from the residual overstory tree canopy or from the bole of residual mature trees on the planting site, or from live or dead brush plants on site. The most common source of shade comes from stumps, logs, and forest debris found on the forest floor. Caution should be practiced when planting next to stumps that exhibit symptoms of root disease, or stumps from those species that are susceptible to root disease.

In order to take advantage of micrositing opportunities, spacing requirements may be adjusted for any individual seedling. Common tree planting specifications will allow the planter to vary any single tree ± 50% of the planned spacing. The overall spacing and density requirements of the planting unit is still achieved by constantly counteracting for the slight adjustments to the location of each single planting spot.

Shade can be moved, such as when nearby debris is relocated a short distance to the planted seedling. But this relies on having suitable and mobile shade materials nearby, and adds time and expense to the planting.

On the harshest sites it may be necessary to install artificial shade. These are commercially made “shade cards”, wood shakes, or other materials.

The source of natural shade has to occur west to south of the planted seedling—the seedling is planted to the north to east azimuth of the shade source in order to provide effective protection.

In addition to lowering harmful temperature, microsites can also reduce damage from livestock trampling and from big game browsing.
In addition to seeking microsite opportunities, avoid planting in the root extraction zone of heavy, live brush where brush occurs occasionally (continuous brush on planting sites should be reduced through site prep treatments prior to the planting season). Seedlings should not be planted underneath the crown of live conifers (the crown extends to the drip line).

Planting should not occur in areas of standing water, on rocky spots, deep duff, in areas of high slash, or on compacted or otherwise unsuited soils. Do not plant on game or livestock trails or in livestock concentration areas. Avoid trenches, low spots, ditches or gullies. Do not plant in gopher mounds or burrows.

Do not plant within 8 feet of permanent roads within the ownership and 10-15 feet of the road edge or the right of way edge of rural public roads. Primary skid trails should not be planted.

**Planting--Spot Preparation and Proper Planting Methods**

Each planting spot will be properly prepared in order to remove surface debris and to clear the planting spot of competing vegetation. This is done just prior to opening up the planting hole and planting the seedling. This operation can be collectively referred to as “scalping.” Scalping will remove all vegetation, sod, live roots, duff, litter, rotten or charred wood, loose rock, ashes, snow and surface frost from the scalp site, and will expose moist mineral soil.

The size of the scalp depends on the type and amount of vegetation at the planting site. Planting in sod forming grasses requires a larger, more vigorous and complete scalp, generally 18 to 24 inches wide area. Removing all vegetation to at least 1 ½ inches below the root crown is recommended. However, the size and intensity of the scalp is moderated by the type (if any) of chemical spot treatment that is applied to the newly planted seedling.

Scalping can be done with different types of tools. The commonly used hoedad has a scalping blade as part of the planting tool. In other cases, when the planting tool is a stand-alone implement, a separate tool is used for scalping. Common tools used just for scalping include the hazel hoe and McLeod.

After the scalp is completed, the seedling should be planted in the center of the scalp, or as near to the center as possible.

The optimum planting tool will vary with the type of ground and kind of stock to be planted, and by the experience of the planting crew. The planting tool will be able to open up or create a

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**Procedure When Planting With a Hoe**

1. Drive the hoe in full length and as near to perpendicular as possible.
2. Raise up the handle to open the bottom of the hole.
3. Pull back the upper part, making a clean square hole.
4. Place the roots straight down in the middle of the hole, setting it in the same depth it was in the nursery.
5. Source: USDS Forest Service Silvicultural Practices Handbook: Chapter 2-Reforestation
   closure
6. Finish filling the hole and tamp firmly.
7. Source: USDS Forest Service Silvicultural Practices Handbook: Chapter 2-Reforestation closure
   improper closure
8. The roots are jammed into one narrow plane, resulting in poor water absorption.

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USDA-NRCS, Idaho June 2017
planting hole which will accommodate the width and depth requirements for the seedling. The dimensions of the planting hole will also allow for proper backfilling and closing of the planting pocket. Lastly, the planting tool must be able to provide a planting hole that is oriented in a way that allows the seedlings roots to be properly aligned for good tree establishment.

Many planting tools are versatile to a degree and can be used on a number of fairly similar field conditions. Planting failure is more likely to be attributed to improper handling and planting techniques (human error), and not to the specific planting tool.

Herbicides applied at planting time or just after are intended to further reduce plant competition during the establishment period. This action is called a “spot” application or spot treatment. Refer to APPENDIX C for descriptions and discussions regarding various tools.

Seedlings will be transported in the field with planting bags that are a minimum of 15 inches deep and which are made of material that insulates and resists heating. Only the amount of seedlings that can be planted in an hour should be carried in the bags, and seedlings should not be tightly packed. The planting hole for bareroot stock must be two inches deeper than the length of the seedling, and at least 3 ½ inches in diameter for the length of the hole. In rare cases when augers are used, the diameter should be at least 4 inches.

For containerized seedlings, the depth of the planting hole should be one inch deeper than the plug, and at least 3 inches in diameter at the top of the hole and 1 inch at the bottom.

The planting hole is excavated in a way that will allow the seedling to be planted with the stem oriented as straight as possible (i.e. vertical). On flatter slopes, the planted stem orientation can vary in any direction by up to 20° from vertical. Stem orientation on steeper sites should be vertical as well, with an allowable variation of 20° or less as long as it deviates mainly toward the uphill side of the planted seedling.

The planting pocket cannot be compressed along the side or bottom. Planters should not “rock” blade type tools back and forth, especially in moist, heavy textured soils, in order to minimize the risk of compacting the sides of the planting pocket. Planting dibbles are not advisable for planting in clayey textured soils.

Once the planting pocket is ready, the seedling should be gently lifted from the bag to avoid root or plug damage and quickly but gently inserted into the planting pocket. Only one seedling at a time is to be removed from the planting bag.

As stated before, bareroot seedlings should be planted promptly after being removed from the planting bag.

The seedling is to be placed at the center of the planting hole and planted at approximately the same ground line as it was in the nursery. The position of the apparent root collar is an indicator of the original ground line. Seedlings need to be planted at the proper depth and not pulled up to that depth after they are planted.

The seedling will sit in a natural configuration with roots radiating downward. Do not twist the roots or plug, and no portion of the roots should be exposed, nor are any needles or branches to be covered with soil. On high insolation sites, it is critical that the thickest part of the stem (the ground line) be at the surface where damaging temperatures are most likely to occur. The planting hole will be closed by backfilling soil material by hand or with the planting implement (depending on the exact implement). In all cases, the planting pocket will remain free of debris, snow, and other non-native materials, and will not have air pockets. Good root to soil contact must be achieved, and the roots and seedling need to remain in a free to grow position. The planting hole can be firmed at the surface by hand, or by a gentle application of pressure from the tip of the planters boot. The stem will be damaged and mortality will likely occur if it is stepped on, be careful to avoid this.

A gentle tug on the seedling will ensure that it has been planted with adequate firmness to ensure proper root to soil contact. Do not tug from the terminal bud area! Not all seedlings need to be tested in this way, it’s done mainly to field check the planting procedure.
Successful tree planting is defined by the number of seedling that survive, and not merely by planting costs or by the planting rate of the field crew.

Planting--Addressing large animal damage--Livestock and big game

Newly planted seedlings must be protected from adverse animal impacts until the period of risk has passed. Large animal damage comes from ungulates, which include livestock and big game such as deer and elk.

The collective damage to seedlings from all categories of animals occurs when plants are scared, deformed, girdled, browsed or clipped, uprooted, or trampled upon.

Using larger (and generally older) planting stock helps individual injured plants to recover from less severe animal damage that isn’t initially fatal to the seedling.

The landowner and the professional forester have to anticipate the degree and magnitude of the potential animal damage to the planting. They need to take appropriate management steps in order to minimize the risk of damage, and the ensuing threat of seedling mortality.

It is almost impossible to completely eliminate destructive animal impacts from a newly planted plantation. The goal is to control the amount of damage to acceptable levels. Animal damage can be reduced by applying preventative measures, mainly done to contain the magnitude of the destruction.

**Livestock:** Cattle damage young seedlings by trampling them, and to a lesser extent from actual browsing. However cattle will occasionally browse seedlings depending on the tree species and on the time of year, as well as on the availability of other feed sources.

Conventional wisdom from industry, federal or state land management foresters is to simply eliminate all grazing from the planted area until the seedlings have become well established (into the sapling stage or beyond). This strategy is a rational solution for eliminating any risk of damage by livestock.

In Idaho, many low and mid-elevation private family forestlands are utilized for cattle grazing, and livestock is an important source of annual income off of grazed forestlands. For that reason long term total exclusion is not always a viable protection measure for all ownerships.

Trampling damage can be reduced by a number of grazing management strategies. Controlling stocking numbers, adjusting turnout time, reducing the duration of the grazing period, and assuring good animal distribution are all viable management tools. These techniques, individually or collectively applied, can be effective in reducing trampling damage.

Plantsing seedlings next to stumps, logs, and other surface materials will decrease the incidence of trampling by providing a physical barrier. These barrier materials are also good sources of shade and microsite protection when seedlings are strategically planted, as previously
discussed, so there is a dual benefit from this planting technique.

Temporary electric fencing is used to exclude cattle from smaller planting units, especially in the initial seasons of plant establishment. The fence needs to be monitored and maintained in order to be effective. Temporary electric fencing can be re-used at a later date to protect additional plantings, so the initial investment in temporary fencing can be reduced over time.

**Big game animals:** Deer and elk present a different problem for the landowner. Whereas the main damage caused by livestock is attributed to trampling, big game animals harm seedlings by browsing the foliage or terminal leaders (top browsing). Browsing can kill a seedling outright, or it can damage larger seedlings it to the point where they die or become malformed from repeated occurrences.

The degree of risk to a newly planted area depend on a number of factors. If the planting is located in a canyon area where big game populations in-migrate for the winter season, the increased concentration of wild animals intensifies the likelihood of browse damage. In addition, as other plant species go dormant in the fall, young tree seedlings can become a sole source of winter forage for big game species.

Conversely, plantings on mid to high elevation forestlands are generally at less risk for browse damage as big game animals naturally return to these areas in the spring. By that time other native plant sources are experiencing rapid new growth, providing palatable food alternatives to the seedlings. In the fall, as snow accumulates at these elevations, the reverse migration of big game animals back to lower elevations occur, with a corresponding decrease in browse incidence. However, an "open" winter, with low mountain snowpack, can change the status quo. When big game animals do not out-migrate, the risk of damage from browsing animals will increase in the mid to higher regions.

Not all conifer species are similar in terms of the risk of browse damaged by big game animals. For example, Douglas-fir and western redcedar are more palatable, whereas Western larch is less impacted. Unfortunately, larch is a preferred species for deer and elk for antler rubbing. In the sapling to small pole stages of tree growth this can cause a significant amount of damage to the succulent bark of these trees.

The amount of predicted injury and eventual mortality from browsing must be addressed when planning a tree planting project. If mortality is expected to be excessive (i.e. in the range which will cause the survival to fall below the target establishment threshold), then protective measures must be applied. Even though initial costs will increase, the increase in seedling survival generally pays off in avoiding the need to replant the site, sometimes numerous times.

Installing mesh type rigid seedling protection tubes (the most commonly used are Vexar® tubes) may be the only way to successfully regenerate the site. Tubes are expensive to buy, install and maintain, but when browse is anticipated to be severe, they are usually the best alternative to protect the planting from catastrophic losses. Vexar® tubes are effective when installed at the same time that the planting occurs. Common Vexar® tube sizes are 3 ¼” to 4” in diameter. They come in a variety of lengths, with 18” or 24” long tubes are common sizes for western conifer seedlings. One or two bamboo stakes of appropriate length are used to anchor the tube into the ground. Stakes should be orientated perpendicular to the prevailing wind to resist breakage in high wind areas. In rocky soils bamboo stakes are difficult to install.

Mesh tubes require regular maintenance to continue to be effective. Tubes can blow over or be broken by snow or animals, and big game animals will often pull the tubes off of the stakes. In these instances the tubes need to be re-set. The seedling can grow through the netting at odd angles, or may bunch up or curl within the netting. Seedlings need to be freed from these constrictions. As the tree grows, the top of the tube must be pulled up so that the terminal leader continues to be protected. It is important to perform maintenance while the terminal bud is dormant to avoid damaging the newly emerging spring bud.

Physical protection from tubes has to remain in place and be effective until the seedling
develops to the size where the probability of browsing of the terminal leader becomes minimal. In general this will occur when the terminal leader grows to the size of the base of the thumb of an average adult, or when the terminal leader is tall enough that big game animals cannot easily reach it in order to browse the terminal leader (for white-tail deer, around 4 ½ to 5 feet).

Solid wall tree tubes are not common on conifer tree plantings in the west.

Animal repellants and bud caps provide an effective alternative for browse protection from big game animals. They are useful in situations where the level of browse damage is expected to be less intense, or where the damage period is primarily seasonal, or where tubes and bamboo stakes are difficult to install and maintain (as with rocky or excessively steep soils).

When alternative browse methods are used to protect the plantation, they are generally less expensive compared to Vexar® tubes. As with tubes, the re-application of liquid based repellants or bud caps may be necessary until the plant grows beyond the stage of susceptibility. In some extreme browse areas, liquid plant protection is applied in tandem with mesh tube protective devices.

The success of repellant or physical measures is measured in terms of damage reduction, not by a total elimination of browse damage. Protecting seedlings with mesh tubes, bud caps, or other animal repellants all can be effective in reducing browse if they are used correctly and in the right situations.

**Planting--Addressing small animal damage—rodents and rabbits**

The majority of seedling and sapling destruction from smaller animals is from rodents (mice, beavers, pocket gophers, porcupines and meadow voles—also called meadow mice). Some of these pests are more damaging to newly planted conifer seedlings than others. Additional small animal plant damage is done by rabbits and hares (these animals have incisors which differentiate them from rodents).

Injury to plants from rodents and rabbits have different characteristics from the browse damage caused by big game species. Deer and elk tear the seedling when browsing, as opposed to the common sharp, angled cut typical of rodents or rabbits.

Rabbits will commonly gnaw at the bark of larger seedlings and small saplings. Mice and voles will girdle the base of seedlings. Pocket gophers operate below the ground and occasionally at the surface, damaging roots and clipping low level stems or pulling seedlings below the ground for stockpiling. The combined feeding needs of these pests can be tremendous.

Collectively, these small animals can cause significant damage when habitat elements are ideal for them to occupy a planted area. In grassy fields, such as in established Conservation Reserve Program (CRP) fields, or where afforestation occurs on grass fields or pasturelands, extensive damage from pocket gophers and meadow voles can occur in a short time following the new tree planting.

Habitat reduction or pest elimination is an important element in reducing damage from small mammals. CRP fields present a unique problem because the establishment of permanent grass cover is a condition of the contract, and it’s common to establish grass cover prior to tree seeding on CRP contracts. Trees are also planted into well-established grass fields in certain CRP contract renewal situations. In CRP, all animal control efforts need to be more intense and integrated than in more common forestland situations.

Scalping the existing grass cover has an added benefit by reducing the amount of continuous, protective ground cover for small rodents, especially in the area immediately next to the seedling. (The bare area corresponds to the scalp, which reduces moisture competition as noted previously).

Although mulches are not commonly used in forest plantings, in heavy grass fields using a natural or artificial mulch may help reduce vole damage. The mulch, when properly applied, will maintain an open, cover free zone around the base of the plant, while continuing to reduce undesirable plant and weed growth immediately adjacent to the seedling. Woven weed fabric mulch is a good choice for seedlings. It controls all weeds, reduces
evaporation from the soil around the roots, and allows water and air to pass through. Other good mulch materials are wood chips, bark chips, straw, and composted sawdust. Mulch should be no deeper than three inches and should not provide unintended hiding cover or habitat for rodents. Grass clippings are not recommended, nor are materials that promote molds/fungus or other damaging root or shoot diseases.

In addition to habitat modification, taking steps to encourage predator activities is largely beneficial. Attracting predators to the planting area can reduce the population of small rodents and rabbits. In open fields, perch poles will provide raptors with an opportunity to hunt target species when no other suitable perch sites exist.

Poisons must be used with caution, placing the poison in a containment structure that only allows the target pest to access the bait. Only licensed applicators can apply poisons within the planting unit, and all licensing and safety requirements must be followed.

Voles and northern pocket gophers do not hibernate, so damage will occur year-round, and heavy snow cover further complicates control efforts.

In some cases the operator can time tree plantings in high risk situations to catch the downward trend of cyclical small animal populations. Population scouting will help determine animal density levels in time to apply protective measures, or to take advantage of population crashes.

There are also other unique cases of population cycles that reduce animal damage potential. For example, some landowners may experience less damage from big game browse following a cyclical outbreak of EHD (epizootic hemorrhagic disease) in white-tailed deer.

**Planting--Contracting, oversight and certification**

Landowners commonly take advantage of federal or state cost share programs to help offset the cost of tree planting on private forestlands. These programs apply tree planting as a viable means of improving forest resource conditions. Technical assistance is coupled with cost assistance contracts by some federal, state and local agencies, but the proper execution of the contract specifications is often the sole responsibility of the contract holder. It is important that all of the technical parameters contained in a contracted tree planting are met in the completed job.

When correctly done, the site specific specification simply lines out and documents all of the guidance regarding stock selection, site prep, planting techniques, handling precautions, and other measures necessary to insure a proper planting project.

The majority of private forest landowners opt to hire an independent planting contractor to complete the tree planting. A planting contractor overcomes limitations in equipment, know-how, labor and expertise that many private landowners simply do not have. The relationship between the landowner and the planting contractor is independent of the contractual obligations under the cost share program, even though the end goal and process are essentially the same.

The landowner will benefit from entering into an independent and detailed technical contract with the planting contractor, especially on larger projects. A well written site-specific job sheet that was developed for the cost share contract could serve as part of the basis of the formal contracted agreement with the planting contractor. Many examples of tree planting contracts can be found on the internet.

The private landowner may also consider hiring an on-site representative (a person well versed in correct tree planting projects) to inspect and oversee the field planting as it is being conducted. In commercial, state and public land planting contracts, this person is sometimes referred to as the “Officer in Charge”. The planting contractor will also have a supervisor on site to direct the planting on behalf of the contractor.

The completed tree planting project has to be certified in writing for cost-share purposes. In non-contracted (independent) tree plantings, it is also advisable to inspect and document the completed planting against the contract. Certification can only be completed in the field.
MONITORING, EVALUATION AND MAINTENANCE

It is important to visit the planting unit on a regular basis in order to further evaluate the treatment unit, and to ensure that nothing has occurred that would threaten the planting. Although follow-up is time consuming and expensive, periodic monitoring of the planting allows the operator to assess current survival, and to address unanticipated problems that inevitably turn up after the planting has been completed.

Tree plantings are normally monitored on a 1, 3 and 5 year basis, generally in late summer or fall. Monitoring can be a simple walk-through, or can be conducted by laying out random fixed plots to measure, quantify and document the assessment of seedling survival. Staked tree surveys are generally not installed in small scale private forestland plantings, but they can be valuable in providing more complete information concerning survival since they reveal the specific causes of damage and mortality on a tree by tree basis in the planting.

Plot data is obtained from randomly located circular plots. If the plot counts are being made as a part of a walk-through, it is not important to have tight statistical thresholds for the observations. The most common plot size for taking the plot observation is the 1/100th acre size. To establish this plot, select a center point and measure a continuous radius which is 11 feet, 9.3 inches from the center. All of the planted, living trees within the circular area are counted, and the result is multiplied by 100 to expand the data in order to obtain an estimation of “surviving trees per acre”. The same sampling process is used to count the number of dead seedlings as well.

The following example illustrates a 1/100th acre plot with three surviving seedlings counted within the sample plot. This calculates to a projection of 300 trees per acre (3 x 100).

To calculate survival:

\[
\text{Survival Percentage} = \left( \frac{\text{live trees}}{\text{total trees}} \right) \times 100
\]

Survival rates should be compared against a pre-set survival threshold developed for the planting unit.

Common Circular Plot size(s) for gathering seedling survival data:

<table>
<thead>
<tr>
<th>Plot Type</th>
<th>Radius in feet</th>
<th>Multiply seedling count to get “trees per acre”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/100th</td>
<td>11.8</td>
<td>100</td>
</tr>
<tr>
<td>1/50th</td>
<td>16.7</td>
<td>50</td>
</tr>
<tr>
<td>1/20th</td>
<td>26.3</td>
<td>20</td>
</tr>
<tr>
<td>1/10th</td>
<td>37.2</td>
<td>10</td>
</tr>
</tbody>
</table>

Appropriate maintenance or corrective action should be applied based on the results of field monitoring evaluations. For example, a rodent population may expand to the point where excessive damage is beginning to occur, in which case the forest manager will need to begin immediate corrective actions.

If the planting unit (or a part of the unit) shows excessive seedling mortality at any time during the monitoring period, replanting may be necessary. Identify the cause of mortality, and if the cause of the failure was avoidable due to management mistakes, take appropriate action to avoid repeating the same type of failure in the replanting action.
Photo Examples:

Select good quality nursery stock which is well suited to the out-planted site requirements.

An example of “micrositing” using a burned log for shade. The log will also provide protection against livestock trampling.

A planted seedling with a protective mesh tube and chemical spot treatment. The chemical has taken affect. Scalping could have been more extensive to provide opportunities for a better planting pocket and to reduce rodent habitat.
Photo Examples, continued:

Planting materials and supplies located at the planting site. The day was cool enough and the planting done quickly, so protective shade was not needed for the boxes of seedlings.

An example of a damaged seedling that grew through the side of the mesh tube—maintenance should have corrected this situation.

Adequate establishment in a small, un-stocked part of a larger forest stand.
REFERENCES:


Dumroese, R.Kasten, Wenny, David L., and Barkley, Yvonne Carree. 2001. Plant your Seedlings Right. University of Idaho, College of Natural Resources, Moscow ID


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.

https://www.for.gov.bc.ca/hfp/publications/00078/

https://www.nsl.fs.fed.us/nsl_wpsm.html
https://www.nsl.fs.fed.us/Chapter%207.pdf

USDA Forest Service & Southern Regional Extension Forestry. "Reforestation, Nurseries, & Genetic Resources" (RNGR), and the "Forest Regeneration Manual" (1990).
https://admin.rngr.net/
https://admin.rngr.net/publications/forest-regeneration-manual

https://www.fs.fed.us/eng/seedlings/index.htm
### Appendix A: Seed Transfer Guidelines

*From: Idaho Department of Lands (IDL) “Forest Improvement Handbook”, C-3*

#### SEED TRANSFER GUIDELINES

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>ELEVATION (FT.)</th>
<th>LATITUDE (ML)</th>
<th>LONGITUDE (ML)</th>
<th>HABITAT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>western white pine</td>
<td>±600'</td>
<td>±46</td>
<td>±50</td>
<td>Blister-rust resistant (tolerant)</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>±600'</td>
<td>±50</td>
<td>±100</td>
<td>up thru dry WRC</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±300'</td>
<td>±50</td>
<td>±50</td>
<td>up to 5800' elevation</td>
</tr>
<tr>
<td>south Idaho</td>
<td>±300'</td>
<td>±50</td>
<td>±50</td>
<td>above 5,800' elevation^2</td>
</tr>
<tr>
<td>Lodgepole pine</td>
<td>±300'</td>
<td>±36</td>
<td>±36</td>
<td>compacted soils, glacial till soils, high elevation and frost pockets</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±200'</td>
<td>±36</td>
<td>±36</td>
<td></td>
</tr>
<tr>
<td>south Idaho</td>
<td>±200'</td>
<td>±36</td>
<td>±36</td>
<td></td>
</tr>
<tr>
<td>Douglas-fir</td>
<td>±325'</td>
<td>±30</td>
<td>±30</td>
<td>DF/PHMA and moister habitat types</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±325'</td>
<td>±30</td>
<td>±30</td>
<td>DF/PHMA and moister habitat types</td>
</tr>
<tr>
<td>south Idaho</td>
<td>±325'</td>
<td>±30</td>
<td>±30</td>
<td></td>
</tr>
<tr>
<td>Western Larch</td>
<td>±750'</td>
<td>±50</td>
<td>±50</td>
<td>DF/PHMA thru warm SAF</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±750'</td>
<td>±50</td>
<td>±50</td>
<td></td>
</tr>
<tr>
<td>south Idaho</td>
<td>±750'</td>
<td>±50</td>
<td>±50</td>
<td></td>
</tr>
<tr>
<td>Grand fir</td>
<td>±500'</td>
<td>±50</td>
<td>±50</td>
<td>moist grand fir sites (ABGR/ASC) and moister</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±500'</td>
<td>±50</td>
<td>±50</td>
<td></td>
</tr>
<tr>
<td>Englemann spruce</td>
<td>±500'</td>
<td>±50</td>
<td>±50</td>
<td>cold and</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±500'</td>
<td>±50</td>
<td>±50</td>
<td>high elevation sites</td>
</tr>
<tr>
<td>south Idaho</td>
<td>±500'</td>
<td>±50</td>
<td>±50</td>
<td></td>
</tr>
<tr>
<td>western redcedar</td>
<td>±60'</td>
<td>±50</td>
<td>±50</td>
<td>Western redcedar/western hemlock habitat types</td>
</tr>
<tr>
<td>north Idaho</td>
<td>±60'</td>
<td>±50</td>
<td>±50</td>
<td></td>
</tr>
</tbody>
</table>

*North Idaho refers to the Priest Lake, Pend Oreille Lake, Kootenai Valley, Mica, Cator, West St. Joe, Ponderosa, Orofino, and Kaniah Supervisory Areas. South Idaho refers to the Craig Mtn., Payette Lakes and the Southwestern Idaho Supervisory Areas.

There are more specific transfer guidelines for DF, PP, and WL available upon request.
Appendix B: Cone to Seedling Timeline

Example of cone to seedling to planting timeline: using Ponderosa pine, mid-elevation*

<table>
<thead>
<tr>
<th>STOCKTYPE</th>
<th>3 YEARS PRIOR TO PLANTING</th>
<th>2 YEARS PRIOR TO PLANTING</th>
<th>YEAR PRIOR TO PLANTING</th>
<th>YEAR OF PLANTING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JULY</td>
<td>AUGUST</td>
<td>SEPTEMBER</td>
<td>OCTOBER</td>
</tr>
<tr>
<td>Months to planting</td>
<td>&lt;32</td>
<td>&lt;31</td>
<td>&lt;30</td>
<td>&lt;29</td>
</tr>
</tbody>
</table>

- **1-0 Conifer containerized:** seed collection to planting

<table>
<thead>
<tr>
<th>Cone Collection</th>
<th>Dry Cones</th>
<th>Cones to Processor</th>
<th>Germination tests/store</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germ results/store</td>
<td>Storage/ back to nursery</td>
<td>Seed Stratification</td>
<td>Seed Sowing</td>
</tr>
<tr>
<td>Grow/Greenhouse</td>
<td>Prep-storage/shipment</td>
<td>Cold Storage</td>
<td>Thaw-transport/plant</td>
</tr>
</tbody>
</table>

- Sow order; submitted by producer to the nursery

**TYPICAL FORESTLAND EXAMPLE OF HARVEST (OR FIRE) TO PLANTING TIMELINE:**

- Stocking is inadequate; species are not suited for forest health, productivity.
- Over-story Removal: remove live seral-plan to plant back fill early seral.
- Stand Replacing fire
- Site Prep: maintain favorable site conditions

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*This example is for a scenario where there is no suitable seed in storage, but viable seed cones are present and are collected from within the transfer zone. When there is seed in storage, the process can be shortened by a year.
Appendix C
Tree Planting Tools

Most private forest landowners will not attempt to plant on their own for a number of very valid reasons—it’s a difficult job that requires skill, stamina and a large time commitment. Other landowners, however, have taken on the challenge of tree planting and have done well, often sharing the task with family members and friends.

This guide is intended to provide a look into the variety of planting tools that are available to plant most private forestlands in Idaho. The majority of conifer tree plantings on upland forests are planted using the “slit” method where a planting pocket is opened, the tree inserted, and the planting pocket is closed, resulting in a firmly planted seedling. These tools can all accomplish that objective.

In addition to the actual planting tools, private landowners need to have suitable planting bags, storage materials, and equipment for applying chemical spot treatment if that is a part of the planting job sheet (those items are not discussed here, but can be found at a number of forest supply outlets).

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoedad</td>
<td>The <em>hoedad</em> is the most common tree planting tool for western conifer tree planting. It will handle a wide variety of soil types and planting conditions including a fair amount of rocky or compacted soils. The back part of the blade can be used to scalp and remove debris at the planting site. Blades come in a variety of sizes and shapes, they are designed to be used with specific types of seedlings (type and length). Select a blade type appropriate to the site conditions (concave, flat or thin). On flat ground, a 100° bracket is preferred; on steeper ground the 90° bracket is better. Hoedads are difficult to use at first and take time to acquire the experience to best use the tool.</td>
</tr>
<tr>
<td>Dibble bars</td>
<td>Dibble bars (or “sticks”) can be used by planters with very little experience. They work best for planting smaller sized containerized seedlings in soft soils with minimum rock fragments. It is easy to prepare a vertically aligned planting pocket with this tool. The dibble bar has one (or two) foot pads which assist the planter in inserting the tool deep enough into the soil.</td>
</tr>
<tr>
<td>JIM-GEM OST (left) and KBC (right) bars</td>
<td>JIM-GEM OST (left) and KBC (right) bars are heavy duty alternatives to the hoedad. They are also easy to learn and use by inexperienced planters. They provide a planting slot and are well suited to soils with moderate rocks, or other impediments. When opening the slot, do not “rock” the blade back and forth which could seal the sides of the planting slot.</td>
</tr>
<tr>
<td>Planting shovels</td>
<td>Planting shovels are becoming more common for planting small acreages of private forestlands. They are easy to use, particularly on flatter soils with limited rocks or compaction. The blade can be used for scalping. These tools should also have foot pads for ease of use. Buy shovels with durable handles.</td>
</tr>
</tbody>
</table>

2 Always use proper safety equipment and practices when tree planting with inexperienced individuals. Supervise all persons, especially younger members of the team.
<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="92x581" alt="Image" /></td>
<td>The “Montana sharpshooter” was designed for soil survey work in rugged conditions. It can be used as a planting tool in much the same way as the JIM-GEM bars. It is virtually indestructible and easy to master. As in other bar type equipment, the planter has to be careful to avoid compacting the sides of the slot from excessive back and forth motion. This tool is heavy and can be taxing to use for a long period of time.</td>
</tr>
<tr>
<td><img src="73x478" alt="Image" /></td>
<td>A pickmattock is the tool to use in the steepest, rockiest and most rugged planning conditions. Some degree of scalping or debris clearing is possible with the flat blade side of the tool, while the sharp point can penetrate difficult planting sites for proper placement of seedlings. This is not the tool (or the site) for a leisurely family experience.</td>
</tr>
<tr>
<td><img src="69x380" alt="Image" /></td>
<td>When using planting equipment that does not have scalping capabilities, the use of a hazel hoe is important in providing proper scalps at the planting site. In this case two tools are required for planting, meaning two persons will be conducting the job in tandem.</td>
</tr>
<tr>
<td><img src="76x269" alt="Image" /></td>
<td>For small, one time tree planting projects, tools that are not specifically designed for tree planting can be pressed into service and used successfully. Visualize the same properly opened, minimally disturbed and properly closed planting slot when using this common household shovel. A foot pad on this type of equipment would be very useful.</td>
</tr>
</tbody>
</table>

Source: University of Missouri Extension Service