THE WOODLAND WORKBOOK

REFORESTATION

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Site Preparation: An Introduction for the Woodland Owner

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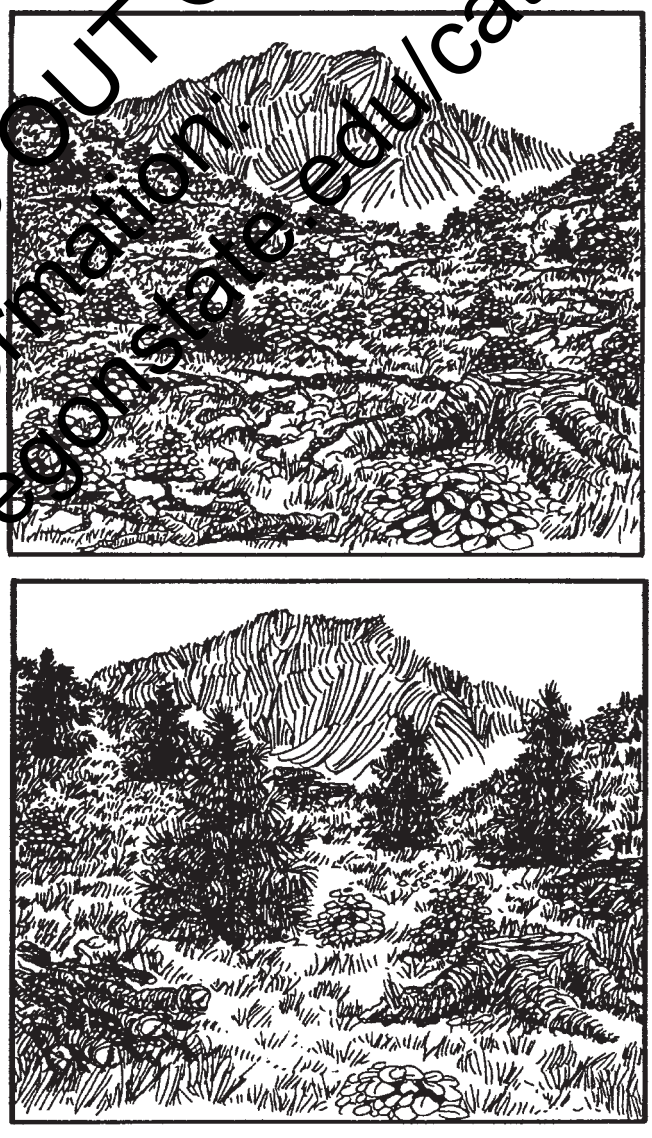

Site preparation is an important first step in reforesting your woodland after harvest operation or in reclaiming brushfields for timber production.
Top: Without site preparation—an understocked plantation.
Bottom: With site preparation — improved seedling survival and growth.

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OREGON STATE UNIVERSITY EXTENSION SERVICE

Brushfields and recently logged sites can be poor environments for survival and growth of newly planted seedlings. Excessive slash, competing grass and shrubs, and wildlife damage can limit seedling survival and growth on these sites. Before you plant seedlings, some form of site preparation usually is required.

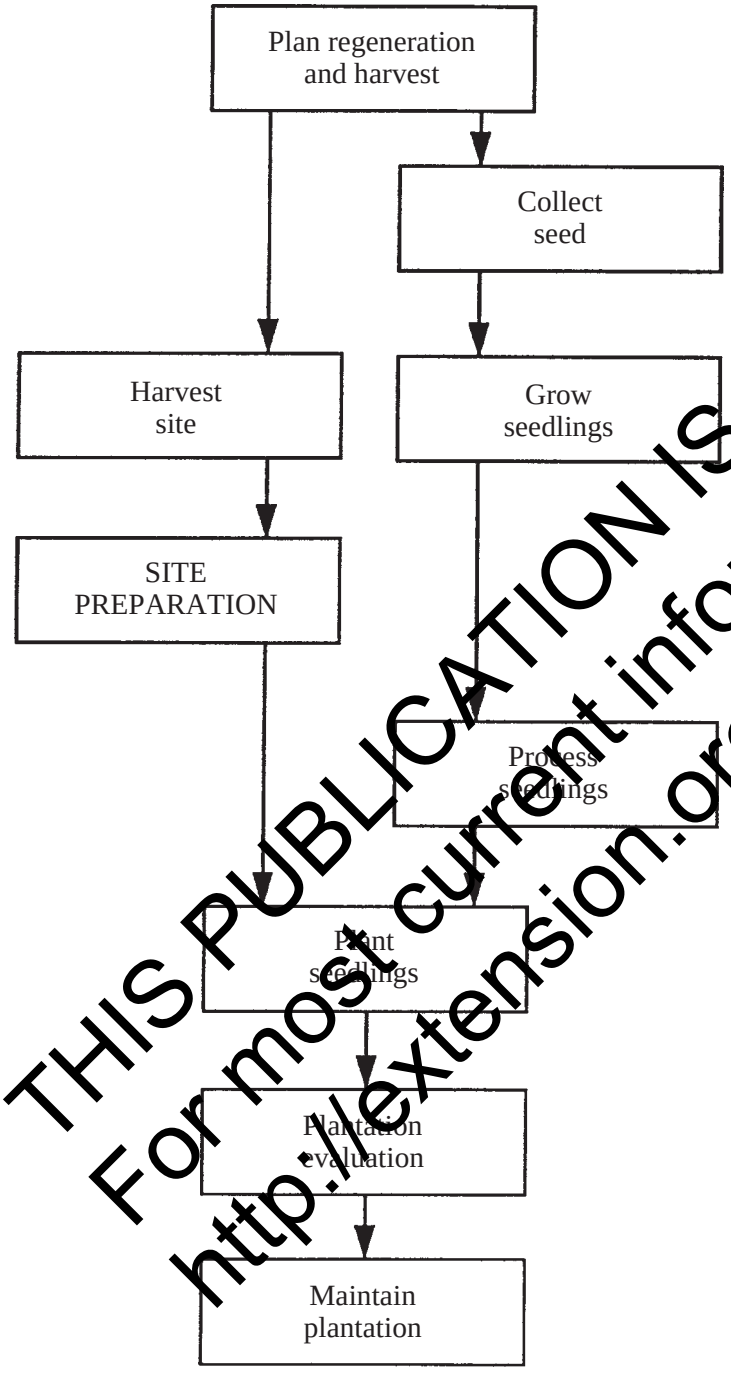

Figure 1.—Major activities associated with reforestation by planting (adapted from OSU Extension Service Manual 7).

Site preparation is any planned operation that enhances natural or artificial regeneration by modifying unfavorable site conditions. Although there are a number of important steps to successful reforestation (Figure 1), site preparation is critical because seedling survival would be very poor without it.

When you complete harvest operations on your woodland, you're required by Oregon's Forest Practices Act to successfully reforest within 3 to 5 years, depending on where your property is located within the state (see EC 1134). Site preparation will help you meet this legal responsibility.

Several site preparation "tools" are available to get seedlings off to a good start. The purpose of this publication is to describe the benefits of good site preparation, what it can accomplish, and the different methods you can use. With this information, you can begin to choose site preparation practices that will improve seedling survival and growth, and maintain the long-term productivity of your woodland.

Objectives

Among the many reasons for doing site preparation, perhaps the most important are: to reduce logging slash, control competing vegetation, and reduce damage from certain species of wildlife (Table 1).

Reduce logging slash

It's important to reduce the amount of logging slash, because slash poses a serious fire hazard to surrounding forested properties.

Reducing the amount of slash also makes the site more accessible to planting crews. Tree planters won't have to waste time "wading" through slash in search of plantable spots, so planting costs are lower; and planting crews plant faster and do a better job, which results in better seedling survival.

Treating logging slash also minimizes the physical damage to seedlings that can occur if slash pins them down or obstructs their development.

***Table 1.*—Common site-preparation objectives.**

Objective	Purpose
Reduce logging slash	Reduce fire hazard; remove obstacles (such as brush and slash) to improve access and facilitate planting or natural seeding.
Control competing vegetation	Improve seedling survival and growth by making moisture, nutrients, and sunlight more available to seedlings.
Reduce habitat of unwanted wildlife	Minimize the buildup of animals that clip, browse, and kill young seedlings.
Expose mineral soil	Provide a seedbed for natural regeneration establishment.
Improve the general appearance	Rid the area of unsightly slash.
Improve soil conditions	Reduce soil compaction or improve soil drainage.
Control insects and disease	Examples: Remove nonmerchantable trees infected with dwarf mistletoe and beetle-infested slash.

Keep in mind that it's not desirable to remove *all* branches and logs from the site. Leaving some of this material is important—slash contains important nutrients, helps control erosion, and provides shade, which can help protect seedlings on harsh, dry sites.

Control competing vegetation

Seedlings planted on cutover land or in brushfields must compete with other plants for sunlight, moisture, and nutrients. On any site, a fixed amount ("reservoir") of these resources is available. Weeds are better able to use these limited resources early in the growing season because they grow fast and quickly colonize the site. They overtop new seedlings and deplete the resources, especially soil moisture.

Moderate to severe competition significantly slows seedling growth and increases mortality. Good site preparation improves seedling survival and growth, because more resources are made available to seedlings during their establishment phase.

Good site preparation also delays recapture of the site by competing vegetation. Though grass and shrubs eventually will reinvade the site, seedlings with 1 to 3 years of little competition will have developed to a size where they can successfully compete with other vegetation.

Reduce habitat of unwanted wildlife

Standing brush and logging slash provide ideal hiding cover for rodents and other animals that clip, browse, or kill seedlings. Site preparation removes this protective cover, preventing a buildup of animal populations by exposing them to natural predators.

Other objectives

Satisfying these main objectives (slash disposal, vegetation control, and wildlife damage reduction) may fulfill other requirements or objectives, such as improved access, insect and disease control, and a more pleasing appearance. However, additional or special site-preparation techniques may be required to correct an unfavorable condition.

For example, when soil is left compacted from skid trail construction, seedling growth and long-term productivity of the

site are reduced greatly. In such a situation, you might consider breaking up this soil (tilling) before planting seedlings (see EC 1109).

Methods

There are several methods you can use to prepare areas for natural and artificial reforestation—manual, mechanical, fire, chemical, and various combinations of these.

Table 2 (pages 8–9) provides a summary of site-preparation methods and lists the advantages and disadvantages of each. Estimated costs for these methods are listed in Table 3 (page 9).

Your choice of one method, or a combination of methods, will depend on the growing conditions on your site, and on the capacity of each method to treat unfavorable conditions that limit seedling survival. Cost also will affect your choice.

Manual

Manual site preparation can be accomplished in two ways:

1. Use a planting hoe or shovel to clear away (scalp) vegetation in the immediate planting area.
2. Use a chain saw or other brush-cutting tool to cut vegetation on the planting spot.

In both cases, competing vegetation in the immediate vicinity is removed to reduce shading, and to improve available soil moisture for seedlings.

Manual clearing provides only a *temporary* advantage to seedlings. Roots from weed species rapidly reinvade scalped areas. Vegetation capable of resprouting when cut quickly can regain a height advantage over seedlings.

On sites where moisture is limited, wider scalps are needed, because even seemingly low levels of competition from less prominent vegetation (grasses and broadleaf forbs) can reduce seedling survival and growth. To maintain seedling dominance, repeated treatments often are necessary.

Mechanical

Mechanical site preparation can be accomplished with a crawler tractor equipped with a toothed brush blade or an earth-moving blade. (The latter is not as effective.) Slash and shrubs are pushed into small piles or windrows. This practice often is referred to as *scarification.*

Brush blades have several advantages over straight blades for site preparation. They're more efficient at piling slash and raking out roots of competing shrubs. Straight blades tend to shear off the tops of brush, leaving the roots intact to resprout later.

Straight blades also can move much topsoil in the process. Brush blade teeth, in contrast, allow soil to fall through, reducing the amount of topsoil displacement. This helps retain nutrients and makes for "cleaner" piles that burn more completely. Also, brush blades can help "break up" or fracture surface soil compaction that restricts seedling growth.

Sometimes, rubber-tired skidders outfitted with grapples are used to pile slash. Piles and windrows can be burned later to reduce fire hazard and to reduce habitat (hiding cover) for rabbits, voles, porcupines, mountain beavers, and other rodents.

Mechanical slash piling may not be required in all cases. Where slash loads are light, the operator simply can break up heavier fuel concentrations by scattering the slash across the unit with the machine, creating evenly distributed planting spots or exposed mineral soil for natural regeneration.

Prescribed fire

Although fire generally isn't used by small woodland owners, it can be an important site preparation tool. When slash and brush are distributed evenly across an area, and fuels are sufficient to carry a fire, broadcast burning is effective for reducing fuel loads, consuming large brushfields, and removing potential hiding cover for unwanted wildlife. Fire is useful particularly on steep slopes where mechanical equipment is restricted.

Fire effectively controls a variety of competing vegetation. The degree of control depends on the type of vegetation and the intensity (amount of heat at the soil surface) of the burn.

"Cool" (spring) burns are less intense; they consume small branches and flammable fuels while leaving most of the organic matter and large woody material intact. Spring burning kills some competing vegetation while conserving site nutrients.

Because fuels dry out over summer, "hot" (fall) burns generate more heat at and below ground level; therefore, they do a better job of killing sprouting vegetation and other hard-to-kill plants. However, dry weather and forest conditions increase the risk that fire will escape. In addition, hot burns cause greater losses of nutrients and organic matter, and they may result in increased soil erosion on steep slopes.

After considering the advantages and disadvantages of hot (consumptive) and cool (retentive) burns, many foresters now are choosing cooler spring burns.

Fire can successfully prepare sites for natural regeneration on clearcuts and under seed trees by consuming some of the surface organic layer (duff) and exposing mineral soil. Most conifers require a mineral seedbed for favorable seed germination (generally, 40 percent mineral soil exposure, uniformly distributed, is enough for natural regeneration). Even so, the objective isn't to remove all the duff.

Ignition

Prescribed fires generally are ignited with hand-held drip torches, or Helitorches suspended beneath a helicopter. For small areas with light slash loads, hand-held drip torches normally are used.

In steep, highly broken terrain with heavy slash loads, the Helitorch works best for rapid ignition, and provides a safe, efficient burn. Several hundred acres can be burned in 1 day with a Helitorch.

Chemical

Chemical site preparation is a method to consider in areas where competing vegetation is limiting seedling survival and growth. Chemicals used to kill vegetation are called *herbicides*. Competition from grasses, broadleaf forbs, deciduous and evergreen shrubs, and undesirable hardwoods can be controlled effectively with a variety of herbicides. Herbicides are administered through the soil, sprayed on foliage and stems, or injected directly into plants.

Chemical site preparation provides better and longer vegetation control than manual, mechanical, or fire alone, because herbicides suppress or kill more of the plant (stem and roots). Other methods often affect only the above-ground portion of plants, leaving the root systems intact to resprout. Furthermore, the soil disturbance created by fire and mechanical methods can encourage other vegetation to invade the site and compete with seedlings.

Contrary to what many people believe, herbicides do not kill all vegetation on the site. Most herbicides are "selective." If they're properly applied and matched to the target vegetation, they kill only the portions of the plant community (weeds) that most seriously threaten seedling survival. Other vegetation is left intact.

References to other publications

When you're referred to another OSU Extension Service publication, you'll find additional information in "For further reading," page 11.

Application methods

On woodland properties, herbicides are applied as a spray by helicopter or backpack sprayer, or injected directly into plants. Let's review each method briefly.

Aerial

For large acreages, herbicides normally are applied in a broadcast fashion by a helicopter. The helicopter operator usually flies the target area in strips along the contour for even coverage and to avoid skipping areas.

Ten acres normally is the minimum size for aerial broadcast spraying, because the helicopter needs at least that much area for maneuvering. Because of high move-in costs for equipment, 40-acre and larger tracts usually are preferred.

If you have a small area to spray, you might coordinate with neighboring landowners to make the overall project cost-effective. Many private timber companies will include nearby woodland owners in their spray projects because it lowers their spray costs.

Backpack

For areas less than 10 acres in size and on gentle terrain, a backpack sprayer can be used to spray competing weeds. Backpack sprayers hold 3 to 5 gallons of spray mix; they're best suited for spot treatments or spraying in a broadcast fashion using a "waving wand" technique (walking forward and spraying side to side).

Approximately 4 to 10 acres per day can be treated with a backpack sprayer, depending on vegetation type and terrain.

If brush is more than 5 to 6 feet high, it's difficult to get good coverage and proper control of target vegetation. On steep slopes and in areas with large slash concentrations, backpack sprayers with a full load can be cumbersome and difficult to use.

Spray drift from a helicopter or backpack sprayer is a potential problem, and the Oregon Forest Practices Act requires buffer areas (where no herbicides are sprayed) adjacent to Class I streams, domestic water supplies, roads, and residences. Within the buffer, you may use manual site preparation.

Injection

When hardwood trees and larger shrubs are scattered across the area, one way to get rid of them is to inject herbicide directly into the stem. A Hypo-hatchet tree injector automatically injects a premeasured dose of herbicide on impact.

Another technique is to drill or hack through the bark with a hatchet and squirt herbicide into the wound. Injection is an easy method for killing problem hardwoods.

Factors affecting success

Herbicide

The most important factor to consider is selecting an appropriate herbicide. Your choice depends on the composition of vegetation. When many brush species are present, you need to determine which species are the dominant competitors. Then select a herbicide, or combination of herbicides, that will provide maximum control. Herbicide cost and method of application also can influence your selection.

Timing

Applying the herbicide at the right time of year is an important consideration. Plants are most susceptible to herbicides during active growth periods, and are most resistant during dormant seasons. For example, spraying herbicides on grasses during mid- to late summer (dormant season) results in little or no control.

The weather can influence greatly the success of your spray project. High winds or heavy rains during or immediately after spraying cause herbicide to drift away from or wash off target vegetation, reducing its effectiveness.

Use herbicides safely!

- **Wear** protective clothing and safety devices as recommended on the label. **Bathe** or shower after each use.
- **Read** the herbicide label—even if you've used the herbicide before. **Follow closely** the instructions on the label (and any other directions you have).
- **Be cautious** when you apply herbicides. **Know** your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from herbicide use.

Carrier

Herbicides normally are diluted in a carrier (either water or diesel oil). Carriers increase the spray volume to obtain good coverage over the treatment area. They also help move herbicide into the plant.

For example, the foliage of some brush species resists herbicide absorption because of waxy layers on their outer leaf surfaces. Diluting the appropriate herbicide in oil or an oil-water mixture helps the herbicide penetrate these layers. Oil carriers also help the herbicide penetrate stem and bark tissue.

Combination treatments

In many cases, one treatment alone may not provide adequate results. For example, an area occupied by a dense brushfield could be treated either by a broadcast burn or mechanical site preparation to provide access for planting.

However, neither method can assure seedling survival, especially on a highly productive site—vegetation would recover too quickly and overtop newly planted seedlings. Using an effective herbicide to kill the brush before the burning or crushing operation can provide the long-lasting result needed to assure plantation survival and growth.

Although combination treatments are more expensive initially, they may save money in the long run by minimizing replanting or repeated site preparation. Therefore, manual, mechanical, fire, and chemical methods often are used in combination to enhance the site preparation treatment, or to meet additional objectives. Here are some examples of combination site preparation strategies.

Pile and burn

Slash and brush are piled with a crawler tractor equipped with a brush blade. The piles are burned later to clear more area, to reduce fire hazard, and to eliminate hiding cover for rodents and other animals.

Spray and crush

In well-established brushfields, the area is sprayed to kill the brush and reduce resprouting. The dead, standing brush is then crushed with a crawler tractor to allow access for planting, and to remove hiding cover for damaging wildlife.

Brown and burn

Brushfields are sprayed with a contact herbicide to brown (dry out) the brush foliage. The area is burned later. The chemical, however, usually does not kill the brush, so resprouting can occur.

Spray and burn

Brushfields are sprayed with a herbicide to kill brush and other target vegetation. After a 4- to 10-week drying period, the area is burned to kill the remaining brush and any resprouts, to provide access, and to rid the area of hiding cover for wildlife.

Spray, pile, and burn

An area first is sprayed to kill competing vegetation. When there are limits on broadcast burning (not enough slash or slash is too scattered to carry a good burn), the area is piled with a brush blade to improve access and increase plantable spots. Piles are burned later to reduce the fire hazard and hiding cover for wildlife.

Getting it done

Site preparation can be incorporated into the harvest operation, or carried out as a separate operation immediately after harvest. For brushfields, site preparation is the first step in reclaiming the site for timber production. Typically, site preparation is done by the logger or another operator who specializes in site-preparation activities after harvest.

In some situations, it's easier and less expensive to combine both harvest and site preparation activities in one operation. This may increase harvest costs, but it eliminates site-preparation costs.

***Table 2.*—Site-preparation methods and how each is accomplished, with advantages and disadvantages.**

Site preparation method	How is it accomplished?	Advantages	Disadvantages
Manual	Manually removes vegetation within a 2- to 6-ft diameter around seedling planting spot, by scalping with a planting hoe or cutting vegetation with a chain saw.	1. Effective spot treatment for some types of brush and grass. 2. Good in areas where other methods might pose an environmental or safety hazard (along roads or streams, or near homes). 3. Effective for removing duff and litter from planting spots.	1. Can be expensive; therefore, limited to small acreages. 2. Provides only a temporary reprieve from vegetation competition; retreatment (release operation) often is necessary to maintain seedling dominance. 3. Difficult to clear planting spots manually in heavy slash. 4. Does not reduce potential animal habitat. 5. Very labor-intensive.
Mechanical	A crawler tractor equipped with a toothed blade (brush blade) moves slash and brush into piles or windrows.	1. Effective for breaking up heavy fuel concentrations. 2. Very effective for exposing mineral soil for natural regeneration; it can be timed to coincide with conifer seedfall. 3. Can reduce planting costs by improving access. 4. Flexible—it can achieve varying degrees of site preparation to meet other objectives and constraints. 5. Not labor-intensive. 6. Moderately effective for controlling competing vegetation. Control increases with use of a brush blade to rake out roots. 7. Effective for eliminating cover for wildlife pests.	1. Equipment limited to slopes of 35 percent or less. 2. Increases chance of soil compaction, topsoil displacement, and erosion, which reduce site productivity. 3. Moderate to high costs per acre. 4. Competing vegetation can reinvade quickly. 5. Equipment scheduling could be a problem.
Prescribed fire		1. Can be used in flat or steep terrain. 2. Doesn't cause soil compaction. 3. Reduces slash and fuel hazard. 4. Can expose mineral soil for natural regeneration. 5. Reduces hiding cover for wildlife. 6. Controls some competing vegetation. 7. Creates plantable spots and improves access for planting crews, which reduces planting costs. 8. Generally low to moderate costs.	1. Smoke pollution. 2. Liability and costs can become very high if fire gets away. 3. Success of burning depends greatly on climatic conditions and moisture content of fuels, which makes results variable. 4. Risk of increased erosion on steep slopes. 5. Timing of burn (which season) is tightly regulated, making it difficult to schedule burning operations. 6. Rapid recovery of sprouting brush and certain grasses after burning. May increase seed germination of some plant species. 7. Potential for heat damage to the soil and for nutrient losses, particularly nitrogen. 8. Labor-intensive; high skill required.

***Table 2.*—Site-preparation methods and how each is accomplished, with advantages and disadvantages (continued).**

Site-preparation method	How is it accomplished?	Advantages	Disadvantages
Chemical	Herbicides are applied in a spray mixture by helicopter, by backpack sprayer, or by direct injection into plants, to kill target vegetation before planting.	1. Kills or controls vegetation longer than other methods. 2. Less expensive than some alternatives. 3. With aerial application, large acreages can be treated at one time. 4. Aerial application is not labor-intensive. 5. Can be used in most terrain conditions. 6. Results in the least disturbance to the site, and doesn't compact, remove, or expose mineral soil.	1. Doesn't rid the area of slash or standing brush, which pose obstacles to planting crews. 2. Doesn't remove animal hiding cover. 3. Doesn't create mineral soil if natural regeneration is your objective. 4. Controversial public issue. 5. Risk of herbicide drift to non-target areas. 6. Restricted by weather conditions. 7. Herbicide can damage or kill crop trees if improperly applied.
Combinations	Combinations of fire/chemical/mechanical methods are: • Pile and burn • Spray and crush • Spray and burn • Brown and burn • Spray, pile, and burn	1. *Very* effective at reducing fuels. 2. *Excellent* vegetation control. 3. Removes animal hiding cover. 4. Provides good access for planting crews. 5. Can be done in most terrain.	1. Moderate to high costs per acre. 2. Possibly more impacts to site, such as soil compaction and erosion. 3. Certain combinations are limited by terrain conditions. 4. Certain combinations are limited by weather conditions (fire and chemical). 5. Certain combinations involve higher risk and liability.

***Table 3.*—Cost comparison for various site-preparation treatments (as of summer 1996).**

Method	Cost per acre	Factors influencing costs
Manual	$100–500	Size of treatment area; height, diameter, and density of vegetation; amount of slash; width of cleared area
Mechanical	$75–250	Size of treatment area; amount of slash; operator skill; amount of vegetation; intensity of site preparation desired
Prescribed fire	$50–500	Size of treatment area; amount and distribution of slash; ignition method; weather conditions; complexity of the terrain; amount of fire trail construction; adjacent land use
Chemical Aerial Backpack Injection	$50–150 $25–100 $25–75	Size of treatment area; amount and type of herbicide used; method of application; density and type of target vegetation
Combinations	$150–500	As listed for all methods above

Planned logging disturbance, where the logging operator deliberately tries to create plantable spots or expose mineral soil, may be all some sites need for site preparation. This method works well when slash loads are light and development of competing vegetation is expected to be low.

Local constraints also may dictate combining harvest and site-preparation operations. For example, you may be unable to burn logging slash on a steep slope because of the risk of the fire getting into adjacent property.

In this situation, it may be possible to have trees yarded with tops and limbs attached (whole-tree). The trees are bucked, topped, and limbed on the landing. Later, slash piles can be burned safely. Logging costs are higher, but burning costs are negligible—and in this case, it may be the only favorable way to treat the slash.

Laws that apply

Site preparation activities are governed by Oregon's Forest Practices Act (ORS 527) and Forest Fire Prevention Laws (ORS 477). These laws protect air, soil, water, and forest resources, and enhance the management of other natural resources, including fish and wildlife.

Oregon's Forest Practices Act regulates the use of machines and chemicals for site preparation and other practices on forest properties. You'll need to submit a notification form to your local Oregon Department of Forestry (ODF) office at least 15 days before you begin any of these activities. Even if you simply plan to use a chain saw or other power equipment for minimal site preparation, you still must file a notification form. You can use the same form to notify ODF of any planned harvest operations.

The forest practices forester may provide technical advice, or inspect the site and point out special problems with your site preparation activity.

Fire prevention law ORS 477 regulates the use of fire on forest properties in forest protection districts. Before prescribed burning, you (or the operator conducting the burn) are required to obtain a permit from your ODF office, and to pay certain fees.

ODF staff will prepare a burn plan with you on request. They'll recommend or require that a certain number of people and certain equipment be on hand to conduct the burn safely.

Under extremely dry weather and forest conditions, burning will not be allowed, as determined by the State forester. Bans may be lifted after adequate rainfall occurs.

Smoke-management regulations further restrict burning. These rules minimize air-pollution problems (from smoke) in populated areas. If weather conditions might allow smoke to funnel into populated areas, you may be required to wait until weather conditions change before you may burn. Check with your local ODF office for more details.

There's "always a risk that a prescribed fire will get away." In Oregon, if your prescribed fire escapes control and a fire protection agency has to suppress it, you could be assessed up to $300,000 for suppression costs. These costs don't include property losses to you or to adjoining neighbors. Therefore, it's a good idea to obtain liability insurance.

If you start a burn without prior approval, or don't follow the required precautions, you could be assessed the total cost of fire suppression and be subject to criminal penalties if the fire escapes.

Final comments

Site preparation is a necessary and important operation to improve reforestation success on your tree farm. When properly matched to the site and vegetative conditions, site preparation helps assure:

- Prompt regeneration establishment
- Increased wood production
- Shorter harvest rotation
- Increased long-term financial gain

Contact a consulting forester or your state service forester to obtain advice and information on how to properly treat your particular site. He or she can help you decide which treatments to use, point out problems you may encounter, and show you how to get the job done.

For further reading

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Adams, Paul W., *Soil Compaction on Woodland Properties*, EC 1109 (Oregon State University, Corvallis, reprinted 1992). $1.00

Adams, Paul W., *Oregon's Forest Practice Rules*, EC 1194 (Oregon State University, Corvallis, revised 1996). $1.00

DeYoe, David R., David S. deCalesta, and Wieger Schaap, *Understanding and Controlling Deer Damage in Young Plantations*, EC 1201 (Oregon State University, Corvallis, revised 1998). $2.00

Campbell, Alan 3rd, *An Introduction to Forest Protection*, EC 1253 (Oregon State University, Corvallis, reprinted 1992). $1.25

DeCalesta, David S. and Kim Asman, *Controlling Pocket Gopher Damage to Conifer Seedlings*, EC 1255 (Oregon State University, Corvallis, reprinted 1993). $1.50

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Single copies are available at no charge; order from Forestry Publications Office, Oregon State University, 227 Forest Research Laboratory, Corvallis, OR 97331-7401. Please include the publication number.

Cleary, Brian D., B.R. Kelpsas, and David R. DeYoe, *Special Publication No. 1, Five Steps to Successful Regeneration Planning (*Oregon State University FRL, Corvallis, 1986).

The Woodland Workbook is a collection of publications prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. The Workbook is organized into separate sections, containing information of long-range and day-to-day value for anyone interested in wise management, conservation, and use of woodland properties. It's available in a 3-ring binder with tabbed dividers for each section.

For information about how to order, and for a current list of titles and prices, inquire at the office of the OSU Extension Service that serves your county.

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