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FOREST WEED CONTROL PRACTICES FOR SMALL WOODLAND OWNERS

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INTRODUCTION

Minnesota's forests are valuable. They contribute to the state's economy through recreation, tourism, and wood-based industries. Approximately one-third of the state's total land area (16.7 million acres) was covered by forests in 1977 and of this amount about 13.7 million acres was classified as commercial forest land (Lewis 1984). Small woodland owners including farmers and private individuals own 38 percent of the commercial forest land in Minnesota (Jakes 1980). Because of this ownership pattern, small woodland owners can have a significant impact on the wood supply and long term productivity of Minnesota's forests.

Productivity can be significantly improved by implementing sound silvicultural practices. Current forest conditions in the Lake States are a result of past forest practices that left non-merchantable trees, brush, and non-stocked areas on many of the lands now owned by small woodland owners. The natural re-establishment of pine was precluded in part by the lack of natural seed sources, poor seedbed conditions, excessive competition from herbs and hardwoods, adverse weather, and frequent wildfires in the late 1800's and early 1900's. It is estimated that an additional 6 million acres once supported red pine stands in the Upper Great Lakes Region (Benzie 1982). Artificial regeneration of conifer species is the best way to insure establishment of plantations and the continued productivity of pine and spruce types. The management of forest weeds is an essential part of the artificial regeneration process.

In the paragraphs which follow, I will describe where forest weed control practices fit in the establishment of conifer plantations, discuss treatment alternatives, and explain the use of herbicides for brush and weed control.

SITE PREPARATION

Site preparation is necessary before planting to insure maximum seedling survival and growth. Site preparation will create additional plantable spots by removing residual debris and vegetation left after logging and if done properly it will control undesirable vegetation that will compete with the seedlings for sunlight, water, and nutrients.

Site preparation can be accomplished by using fire, heavy equipment, herbicides, or a combination of these tools. Fire can be used to reduce slash and debris left on the site after logging, but use of broadcast burning for site preparation in the Lake States is seldom practiced because conditions are rarely suitable to obtain a good burn without risk of causing a wildfire. Fire is often used in conjunction with mechanical methods to eliminate the debris left in windrows and piles after windrowing or brush raking.

Several types of heavy equipment are used to prepare sites for planting. Crawler tractors with blades are often used to remove undesirable brush and hardwoods. Blades are designed to meet varying site conditions and site preparation objectives. The blade rake, for example, promotes more thorough mixing of the soil organic layer with the mineral soil than a straight bulldozer blade. However, the Rome k/G Clearing Blade is advantageous on lowland sites during winter months. Other equipment is available which can be pulled behind a crawler tractor or skidder to plow, disc, or scarify the site. A complete description of all this heavy equipment is contained in a silvicultural equipment reference catalogue for Northern Ontario (Smith 1979). Site preparation with heavy equipment can be done by contractors who usually have the type of equipment that is needed to match conditions on the site.

Herbicides can also be used to prepare sites for planting. Herbicides will not remove physical impediments to planting, but they do an excellent job of controlling potentially competing vegetation. Controlling weeds with herbicides is also easier before planting than afterward because applications can be made without major concern about damage to crop trees.

SITE PREPARATION HERBICIDES

There are many products registered for forest site preparation in Minnesota. The right product to use will depend on characteristics of the site, species of weeds, and the method of application. Sometimes products can be combined to improve the effectiveness of the treatment on certain hard-to-kill species such as red maple.

Following is a description of the major herbicides used for site preparation. Table 1 provides information about the critical elements of herbicide prescriptions: 1. Major weeds controlled; 2. Time of application; 3. Rate of application; and, 4. Method of application. This information highlights details contained in the labels and should not be used in lieu of the label. The label should be carefully read before using any pesticide product.

2,4-D

There are a variety of brand names for 2,4-D including Esteron® 99C, Weedone® LV-4, Formula® 40 and Weed Rhap®. Most formulations of 2,4-D are applied to actively-growing foliage in a mixture with water. Formula 40 is used in undiluted form for tree injection.

The herbicide 2,4-D belongs to a class of herbicides known as growth regulators. Growth regulators affect plant growth and appear to act at the same site as the natural plant auxin IAA (indole acetic acid). Growth regulators are transported within plants by means of the water and food transporting systems. Because of this process, known as translocation, the growth regulators can be effective when only part of the plant is treated and the herbicide can be applied by low pressure and low volume sprays as well as wiping applications. Grasses are generally resistant to growth regulators.

2,4-D + 2,4-DP

The combination of 2,4-D and 2,4-DP is sold under the brand name Weedone® 170. Dichlorprop is a common chemical name for 2,4-DP and it is also a growth regulator. The combination of 2,4-D and 2,4-DP is more effective on hard-to-kill species such as oak than is either herbicide used alone.

Glyphosate

Glyphosate, sold under the brand names Rodeo® and Roundup®, affects plants by inhibiting the synthesis of chemicals within the plant essential for development (the amino acids phenylalanine, tyrosine, and tryptophane). Glyphosate is a broad-spectrum postemergence herbicide that is readily translocated throughout grass and broadleaf plants. Low spray volumes are more effective than higher volumes with glyphosate and injury symptoms are slow to appear. A week or more is required to see control on annual plants and much longer periods for perennials, especially woody plants.

Hexazinone

Hexazinone is available in a liquid formulation under the brand name Velpar® L, a wettable powder formulation under the brand name Velpar, and a granular formulation under the brand names Pronone® 10G and Pronone® 5G. Hexazinone belongs to a class of herbicides that inhibit photosynthesis and it can enter the plant through the foliage and root system depending on the formulation used.

The proper rate of application for hexazinone depends on the soil texture and amount of organic matter where it is applied. Soils with a high amount of clay and organic matter will require higher application rates than light-textured soils with low organic matter. The labels list application rates for various soil types.

Triclopyr

Triclopyr is sold under the brand name Garlon®. It is a growth regulator and therefore has the same mode of action as the phenoxy herbicides, 2,4-D, and 2,4-DP. It is effective on a wide range of broadleaf weeds and hardwoods, but will not affect most sedges or grasses. Garlon 4 is formulated as an emulsifiable concentrate with 4 pounds of triclopyr acid equivalent per gallon and Garlon 3A is formulated as triethylamine salt with 3 pounds of triclopyr acid equivalent per gallon.

Simazine

Simazine is a photosynthetic inhibitor like hexazinone and is sold under several brand names including Princep®. It is available in liquid, wettable powder, and granular formulations. Simazine is most effective if it is applied to bare mineral soil before weeds emerge. It will control a variety of grasses and broadleaf herbaceous weeds.

Sulfometuron methyl

Oust® is the brand name for sulfometuron methyl. It belongs to a fairly new chemical class of herbicides called the sulfonyl ureas which affect target plants by inhibiting synthesis of chemicals essential for proper plant development (branch chain amino acids, leucine, isoleucine, and valine). Oust is formulated as a water dispersible granule and it will control a variety of annual and perennial grasses and broadleaf weeds. Oust can be applied pre-emergent or post-emergent to weeds.

Amitrole + simazine

The combination of amitrole + simazine is sold under the brand name Amizine®. Amitrole affects plants by inhibiting formation of pigments in the leaves. New growth on affected plants become almost white. Amitrole is trans-located throughout the plant by both the water and food transport systems. All plants are affected by amitrole. The combination of amitrole and simazine, therefore, provides both pre-emergent and post-emergent control of weeds.

Picloram

Picloram is available alone in a pelletized formulation called Tordon® 10K or in a liquid formulation called Tordon® K. Picloram is a growth regulator that is highly mobile in the soil and persists for longer periods than other growth regulators. Consequently, some products with picloram in them have been classified as restricted use pesticides by the Environmental Protection Agency. The restricted use classification for picloram was not declared on the basis of its toxicology because it has low mammalian toxicity. Picloram is often tank mixed with other herbicides to improve effectiveness for site preparation.

Picloram + 2,4-D

The brand name for picloram + 2,4-D is Tordon® 101. Tordon 101 is applied as a broadcast foliar spray and will kill a variety of shrubs, hardwood trees, conifers, and various broadleaf weeds. It is not effective on grasses. Tordon 101 and Garlon 4 can be tank mixed to enhance control in areas where there is a rich mixture of hardwoods.

Dicamba

Dicamba is a growth regulator sold under the trade name Banvel®. Banvel will control many broadleaf weeds, brush species, hardwoods, and conifers. Banvel can be mixed with one or more additional herbicides to control grasses, additional broadleaf weeds, brush species, and trees.

RELEASE

After trees are planted, weed control is often necessary to control weeds that were not controlled by site preparation, or weeds that develop in the favorable environments created by site preparation. Woody competitors such as aspen or hazel will resprout from stumps and roots even after mechanical removal and herbaceous weeds may develop on sites where woody plant herbicides are used.

There is currently no objective quantitative method for deciding whether or not a plantation needs release. Professional foresters use their judgment based on the adequacy of plantation stocking and some criteria of competition severity. Their goal is to treat only those plantations in which the cost of treatment is less than or equal to the value of additional wood volume made possible by the treatment. A quantitative method that would insure reaching this goal involves many variables including the inherent productivity of the site, the cost of the treatment, the response of the conifers to control of various species of herbaceous and woody weeds, and the future value of the wood which is grown. Such a system would be complicated and is needed mainly for decisions in marginal situations.

Studies have shown that conifers released from competing vegetation will produce more wood volume than their counterparts left to grow with competing vegetation (Stewart et.al. 1984). Conifers that are overtopped by hardwood trees and woody shrubs or completely surrounded by dense woody vegetation will generally respond favorably to release treatments. The degree of response depends on the conifer species and its age when treated. Dense grass and herbaceous weeds will also compete with tree seedlings, especially during dry growing seasons. Control of herbaceous weeds may even aid survival of newly planted seedlings.

Release treatments can be accomplished by using herbicides, cutting or removing the competitors, using mulches to control herbaceous weeds, or by controlled grazing and browsing. Woody vegetation can be removed or cut with chain saws and other equipment, but these methods are very time consuming, dangerous to implement, and the effects are short-lived. Woody vegetation that has been cut will often produce more shoots than were present originally and reach heights that existed during treatment in just a few years (Roberts 1980). Mulches are effective, but they are expensive and must be maintained. Grazing can be accomplished with sheep or cattle. However, fences are necessary for cattle and herders may be necessary for sheep. Herbicides are the most common and effective method for accomplishing release objectives.

HERBICIDES FOR RELEASE

Most of the herbicides used for site preparation can also be used for release. However, rates and time of application are often different when the herbicides are applied over the tops of conifers. Also, some herbicides can be used in some species of conifers, but not others. Hexazinone, for example, can be used on red pine, but it will damage jack pine. The label or supplements to the label will specify the species of conifers that the herbicide can be used on and it will provide other information about rate and time of application. Following is a list of herbicides that can be used to release conifers from competing vegetation (Information for making prescriptions is contained in Table 1):

2,4-D
2,4-D + 2,4-DP
Glyphosate
Hexazinone
Triclopyr
Simazine
Sulfometuron methyl

HERBICIDE APPLICATION EQUIPMENT

Herbicides can be broadcast, banded, or spotted to the site, injected directly into undesirable hardwood trees, or applied as a spray to the lower stem. The appropriate application method will depend on the age and type of vegetation needing control, the type of herbicide used, and the age and species of the crop tree.

Spot application of herbicides are made with hand sprayers to control individual weeds in a forest plantation, or to control weeds within a specified radius of each crop tree. Spot applications use less herbicide than broadcast, or band applications, but take more labor to apply.

Band applications are made over rows of seedlings with hand sprayers, or with mechanized equipment at variable widths. Less herbicide is needed (probably at less cost) in a band rather than a broadcast application.

Broadcast applications over large acreage needs to be done by motorized ground equipment or aircraft. Broadcast applications are usually necessary for control of multi-layered woody competition. Aerial application of foliar-active herbicides is necessary for control of weed trees beyond the reach of ground equipment.

Basal spray applications, injection, and stump treatment are used to control individual stems or clumps of woody species. Basal sprays are applied to the bottom 12 to 15 inches of the hardwood stem. Injections are made by applying the herbicide in cut surfaces around the trunk, or by using special tools. Stump sprouting can be controlled by treating the cut surface with a selected herbicide. This can be done at any time of year while a foliar application is limited to the growing season.

Herbicide granules can be applied from the ground or the air. Aerial applications are usually made by helicopters equipped with buckets or aerial seeding equipment. Ground applications can be made from skidders equipped with rotary-type application buckets, or with machinery manufactured by Omni Spray, Inc. The Omni Spray equipment uses air-driven streams to distribute the granules through tubes. Granules can also be applied by hand using rotary-type applicators commonly used for grass seeding or fertilization of lawns.

CALIBRATION OF EQUIPMENT

The calibration of application equipment is an essential part of sound forest weed control practices. The application of dosages lower than those recommended on the label may not adequately control weeds and may create the need for another application. The application of dosages higher than those recommended may injure crop trees and at best unnecessarily increase herbicide cost. The cost of poor chemical application is estimated to be \$1 billion nationwide. In almost all cases application errors result from poor calibration, or defects in equipment design or operation.

Determining Herbicide Amount

Recommendations are sometimes expressed in terms of the amount of active ingredient needed per acre rather than the amount of product needed per acre. Consequently, it is necessary to convert the recommendation in terms

of active ingredient to units of product before the herbicide can be mixed. The herbicide label will specify how much active ingredient is contained in the product. The amount of active ingredient in liquid formulations is expressed in pounds per gallon and the amount of active ingredient in wettable powders and granules is expressed as a percent of product weight. The amount of herbicide needed for application to one acre can be easily calculated for each herbicide formulation.

For liquids:

$$\text{gallons/acre} = \frac{\text{lb/acre of active ingredient recommended}}{\text{lb of active ingredient/gallon}}$$

Example: If the recommendation is 2.5 pounds active ingredient per acre and the herbicide contains 4 pounds active ingredient, then the gallons/acre needed of herbicide = $\frac{2.5}{4} = .625$ gallon = 5 pints.

For wettable powders or granular herbicides:

$$\text{pounds/acre} = \frac{\text{lb/acre of active ingredient recommended} \times 100}{\text{percent active ingredient in formulation}}$$

Example: If the recommendation is 5 pounds active ingredient/acre and the herbicide contains 80% active ingredient, then the pounds/acre of herbicide to use = $\frac{5 \times 100}{80} = 6.25$ pounds.

After determining the amount of herbicide product needed per acre, it is possible to determine the amount of herbicide needed in the spray tank by multiplying the recommended herbicide rate (in terms of product units not active ingredient units) times the acreage covered with a full spray tank:

Amount of herbicide needed = recommended herbicide rate X acreage covered with a full spray tank.

The number of acres covered by a full spray tank will depend on the following four variables: 1. nozzle capacity, 2. pump pressure, 3. sprayer speed, and; 4. effective swath width. The proper combination of variables will deliver the specified amount of solution per acre in a uniform pattern. Spray equipment dealers will be able to design systems that meet your particular needs. Nevertheless, once you have a system, it should be periodically checked to insure you are still getting the prescribed delivery rate.

Calibration

Properly calibrated equipment will deliver a known amount of spray solution to a known amount of spray area. The performance of your sprayer can be checked in two ways. In one method the sprayer is filled with a known volume of water, an area of known size is sprayed, and then the amount of water needed to refill the sprayer to the original capacity is measured. Another way is to fill the sprayer with a known volume of water, spray it on an area in the same manner that you would apply herbicide, then measure how much area the spray covered. Both methods allow you to determine the spray delivery rate in gallons per acre by converting the units used for measurement to gallons and acres.

Example: If it takes 3 pints to refill a 4 gallon backpack sprayer that was used to spray 1000 square feet, the gallons per acre delivered by the sprayer can be calculated as shown below:

1. Gallons applied = $\frac{3 \text{ pints applied}}{8 \text{ pints/gallon}} = .375 \text{ gallons applied}$

2. Acres applied = $\frac{1,000 \text{ sq. ft.}}{43,560 \text{ sq. ft./acre}} = .023 \text{ acres applied}$

3. Gallons per acre = $\frac{.375 \text{ gallons}}{.023 \text{ acres}} = 16.30 \text{ gallons per acre}$

The delivery rate of granular applicators can be checked by the same methods used for sprayers with the exception that product and delivery rate is measured in terms of weight and not liquid volume. Manufacturers directions must be followed to determine the effective swath width for rotary spreaders.

SOURCES OF ADDITIONAL INFORMATION

Much more information is available on the use of herbicides. Chemical company representatives will have detailed information concerning herbicide use and characteristics of the chemical. An excellent reference which summarizes chemical characteristics, major uses, and toxicology of all the herbicides is Herbicide Handbook of the Weed Science Society of America. It is available from: Weed Science Society of America, 309 W. Clark Street, Champaign, Illinois 61820.

The use of herbicides in forestry is not well understood by the general public. Herbicides are an effective forest management tool that will not harm the environment or humans if applied according to label directions. A thorough review of the health risks of herbicides in forestry is available in the following publication The Health Risks of Herbicides in Forestry: A Review of the Scientific Record by John D. Walstad and Frank N. Dost. Copies can be obtained by writing to Forestry Business Office, College of Forestry, Oregon State University, Corvallis, Oregon 97331.

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