Preface to the PDF version of the *Southern New England Christmas Tree Grower's Manual*

The *Southern New England Christmas Tree Growers' Manual* was originally published in 1992. Much of the information it contains remains useful and valid. However, the manual contained specific recommendations for herbicides and pesticides as well as information pertaining to taxes and business practices that are no longer current.

We are aware that many people consider this manual an invaluable source, so what we have done is blocked out the obsolete information and provide here a pdf version of the manual as a free download. You may notice that some of the page numbers are missing; these are pages for which the entire content was deleted.

For information on herbicides and/or pesticides, we recommend that you consult your state's Cooperative Extension System, department of agriculture or department of environmental protection. Information on business practices is available from the Small Business Administration and tax information from the Internal Revenue Service or your state's department of revenue services.

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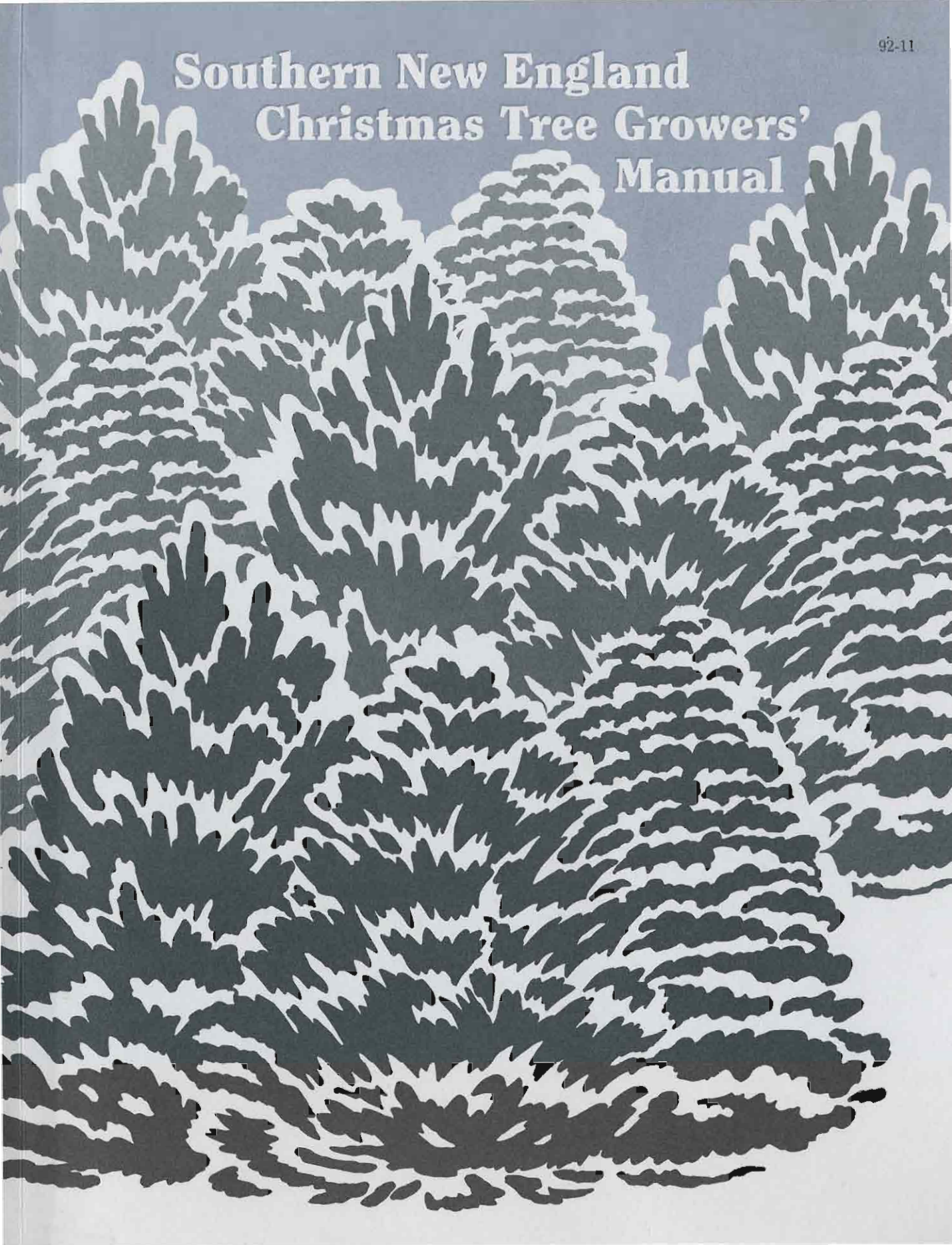
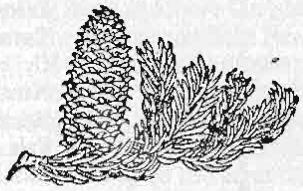
Southern New England Christmas Tree Growers' Manual



Southern New England Christmas Tree Growers' Manual



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The authors wish to thank the following individuals
for their important contributions to this publication:
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Special thanks to
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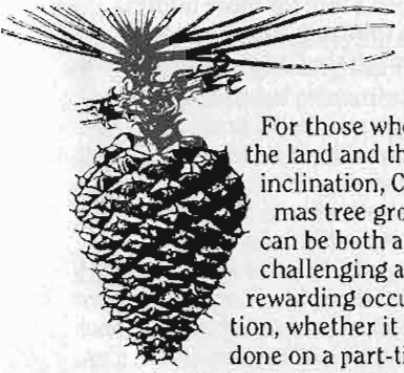
I. Introduction



For those who have the land and the inclination, Christmas tree growing can be both a challenging and rewarding occupation, whether it is done on a part-time or full-time basis. Christmas tree production can be done on as few as two or three acres, or on as many as hundreds of acres.

On all but the smallest of scales, however, Christmas tree growing is a **business**. Too many landowners in the past have planted Christmas trees with little understanding of the care required to bring them to maturity and market. If you decide to grow Christmas trees, you must plan on a considerable investment of time and money. There will be no return until your trees mature in at least six or seven years . You must be prepared to deal with the regular cultural and protection needs of your plantation, and you should keep careful and accurate records from the start. Christmas tree production **cannot** consist of simply planting seedlings in a field and then returning seven years later with the hope of selling the plants.

In the fall of 1989, The University of Connecticut Cooperative Extension System and Department of Plant Science, in cooperation with the Massachusetts Cooperative Extension Service and the Rhode Island Department of Environmental Management, conducted a survey of the Connecticut, Massachusetts and Rhode Island Christmas tree industries. The results of the survey appear throughout this manual and should help prospective growers in estimating the resources needed to perform various management tasks and "get a feel" for current trends in the industry.

Today, more and more people are planting more and more Christmas trees. The average southern New England Christmas tree grower, based on survey responses, has been in business 13 years and manages an average of 10 acres of land (1988). Operations of up to 150 acres can be found in southern New England. An average grower plants over 1,400 trees per year and sells nearly 400 trees annually (1988). The largest operations plant as many as 20,000 trees annually and sell 10,000 trees.

To get an estimate of the productivity of the Christmas tree industry in southern New England, a comparison can be made between the number of trees sold and the number of acres managed. The average grower's productivity (1988) was 39 trees sold per acre managed, per year (the averages for Connecticut, Massachusetts and Rhode Island growers were 42, 30 and 55 trees/acre/year, respectively). The best growers can consistently sell 150 trees per acre managed, per year. Retail prices in southern New England are usually about $4 to $6 per foot (depending on location and species) for the most common sized tree (5' to 7' tall). The total gross income that can be expected per acre will be anywhere from $15,000 to $30,000 for a nine-year rotation. Investments for plants, supplies and labor (not including land or equipment investments) will be a minimum of $3,000 per acre.

A large percentage (27%) of southern New England growers have been in the Christmas tree business five years or less. Since a Christmas tree generally requires five to seven years of growth before it is sold, these farms have sold few, if any, trees, indicating the possibility of an influx of trees into the market in the next several years.

In the past, the supply of trees was not able to keep up with demand. The current situation, however, is less lopsided. More southern New England growers, more imported trees and the popularity of artificial trees have all made the natural Christmas tree industry in this region more competitive. The wise grower of the future, therefore, will have to produce top-quality trees and learn to market them successfully.

Production of Christmas trees in southern New England does have advantages that may not be readily realized in other Christmas tree growing regions of North America. Southern New England is one of the most densely populated regions of the United States and is, perhaps, the largest single Christmas tree market in the world. Demand for these trees can be relied upon, because locally-grown trees reach the market in fresh, needle-firm, fire-resistant condition. Growers who produce high-quality trees at a fair price soon develop a regular clientele of repeat customers.

Environmental awareness is high in southern New England, and Christmas tree plantations are generally viewed in a positive light by the public because of their conservation value. This is a luxury not all seg-

ments of the agricultural community enjoy. Plantings of Christmas trees stabilize the soil, provide wildlife cover and preserve valuable open space.

This manual is designed to be a working tool for Christmas tree growers in Connecticut, Massachusetts and Rhode Island. Most growers will find that personal contact with other growers, foresters and specialists will provide them with additional useful information beyond the scope of this manual. The Connecticut, Massachusetts and Rhode Island Christmas Tree Growers Associations, with their regular newsletters and field meetings, offer excellent opportunities to meet such people and exchange ideas. Contact your Cooperative Extension office for more information on southern New England Christmas Tree Growers Associations.

II. Selecting a Site

Traditionally, Christmas tree growing was recommended primarily for land which was open, but submarginal for other agricultural uses because of slope, stoniness or other factors. Modern Christmas tree growing, however, emphasizes intensive management and production of good-quality, high-value trees, and can be quite competitive with other agricultural land uses.

Some Christmas tree species will grow on virtually any site, except those which are extremely wet or severely shallow and infertile. By the same token, some species may grow poorly on virtually any site. Matching tree species to site is important.

Site factors affecting a Christmas tree operation are:

1. Soil Characteristics;
2. Slope and Aspect;
3. Air Movement and Drainage;
4. Amount of Sunlight;
5. Accessibility.

Chapter IV contains information on specific species of Christmas trees and the relative importance of each of these factors to their growth. Classify each potential planting site according to these characteristics, then use the information in Chapter IV to select one or more species that are best suited to that site. A little time taken in this exercise can go a long way toward ensuring a successful operation.

Soil Characteristics

The ideal soil for most Christmas tree species is a deep, moist, but well-drained sandy loam which is high in organic matter and slightly acidic. Soil depth allows moisture to drain and provides room for root systems to develop properly. Unfortunately, many southern New England soils are either shallow or variably deep and shallow, or have large glacially deposited boulders at or near the surface. Such soils can be planted with certain species, but openings will have to be left where the soil is too shallow or where rock outcrops or stones occur.

Soil moisture is extremely important. Tree roots need oxygen as well as moisture to survive, so no Christmas tree will grow in an area where the water table is at the surface for more than a few days per year. Soils in low-lying areas tend to be wettest, but soil moisture is also affected by the presence or absence of a hardpan layer and by soil particle size. So-called "heavy" soils, with a high percentage of fine clay and silt particles, tend to hold moisture and have low oxygen levels. Conversely, sandy soils allow moisture to pass through much more quickly. Soil pH and nutrient content are also important and are covered in detail in Chapter VII.

The Soil Conservation Service has mapped southern New England for soil types and can provide you with accurate information on your soils and their characteristics. This information, coupled with that in Chapter IV, will give you a good basis for matching a tree species to your soil.

Slope and Aspect

Steep slopes can be planted with Christmas trees, but present a number of problems which ultimately cut into profits. Mowing becomes difficult, if not impossible, and labor costs, in general, tend to increase with steepness. Lower branches will often develop unevenly, resulting in longer rotations (i. e., a greater number of years to sale). Soil erosion can also become a problem, particularly on roadways. If you plan to sell trees by the choose-and-cut method, steep slopes should definitely be avoided, as they become slippery in winter and might result in broken bones and lawsuits. In general, slopes steeper than 30 or 35 percent should be avoided.

Aspect (the compass direction toward which a slope faces) can have a significant effect on the microclimate and the growth of Christmas trees. Southern- and western-facing slopes tend to be drier, warmer and receive more hours of sun, while northern- and eastern-facing slopes tend to be cooler and more moist. Trees often begin to grow earlier in the spring on south-facing slopes and may be more susceptible to damage from late spring frosts. Western exposures are often windy, while eastern exposures

Raised beds allow trees to be grown on imperfectly drained soils.

are more protected from prevailing winds. The steeper the slope, the more pronounced these characteristics will be.

Christmas trees are affected by aspect in varying ways and degrees, depending on species. White spruce, for example, is susceptible to winter injury from drying winds, and may be damaged on exposed west- or northwest-facing slopes. Fraser fir, a shade-tolerant climax species in its natural habitat, is intolerant of high surface temperatures, and may do poorly on dry southern exposures. White pine, on the other hand, seems to do reasonably well on any exposure.

While excessive wind can be a problem, some movement of air through a plantation is desirable. Needle casts and other diseases often get their start in areas where moisture clings to the foliage late into the morning or after rain, due to a lack of air movement. Keeping weeds and grasses low is important in promoting good air drainage. "Frost pockets," valleys where cold air settles on clear, cold nights, should not be planted with species such as Douglas fir and balsam fir which are susceptible to late spring frosts.

Christmas tree plantations must be laid out so they are readily accessible.

Air Movement and Drainage

Excessive wind can cause a number of problems for Christmas trees. Conifer needles will transpire a certain amount of moisture throughout the winter months, and, if the ground is dry or deeply frozen, excessive winds will dry out the tree, causing winter injury or "winter burn". In extreme cases, strong winds can break new leaders in the spring or cause snow loads to build up on branches and break them during the winter. Windbreak species, such as eastern red cedar or hemlock, can be planted to reduce the effects of wind.

Sunlight

No Christmas tree species will grow well in shade. Fraser fir and Norway spruce are probably the most shade-tolerant of our common Christmas tree species, but even these need sunlight most of the day or their growth will be slow and spindly, resulting in open trees. In fields which are adjacent to tall forests or buildings, it is a good idea to run a road around the field's perimeter. This improves access and keeps the trees away from the shadiest portion of the field's edge.

Accessibility

It is important to remember that you will not just be walking to your Christmas tree site, but may, at times, be transporting anything from a backpack sprayer to several hundred pounds of fertilizer. You must also be able to harvest and remove the trees when they are mature. For these reasons, good access to all your plantations is a must.

The primary factors that limit access are steepness, stoniness and wetness. As mentioned earlier, extremely steep slopes should be avoided. Stones are nearly impossible to avoid in southern New England, except in fertile river valleys or previously tilled fields. Some stoniness can be tolerated in Christmas tree plantations, but excessive stoniness makes mowing impossible and adds considerably to management expenses. Stones can be removed with heavy equipment, but the cost can be high and may not be worthwhile if the site is infertile. Contact your local Cooperative Extension educator or your service forester for a recommendation before making a decision to plant in very stony areas.

As stated earlier, Christmas trees will not grow where the water table stands at the surface for a portion of the year. Such sites cannot be planted successfully without raising beds for planting or employing elaborate efforts to lower the water table. Often encountered are soils which are fertile and drain well enough to plant successfully but are, nonetheless, wet enough to cause road rutting and get a truck stuck during the early part of the planting season. Hardpan soils, which have perched water tables at wet times of the year, often cause trouble. These access problems can usually be solved by proper placement and construction of access roads. Again, consult your Soil Conservation Service office, service forester or Cooperative Extension educator.

III. Laying Out the Site and Site Preparation

Before the first tree is planted, careful thought should be given to the layout of your Christmas tree operation. A poor layout can add considerably to the time and expense of management. Once trees are planted, things become difficult to change.

Site Layout

To lay out the site design, make a map of your property which includes all of the land which will ultimately be planted with Christmas trees. A topographic map and an aerial photo of the property are extremely helpful. Divide the area into species blocks or units, based on the following:

1 . Soils data and the results of your species/site matching;

2. Information from other growers on the species that sell well in your area;

3. Features such as slope, streams, existing stone walls, etc., that dictate logical breaks between blocks.

If you will be retailing some trees at the site, you will need to have a sales area which has adequate parking. You should have lighting and a shelter of some kind for sales people. If you plan on selling by the choose-and-cut method, the sales area must be within a reasonable distance of your choose-and-cut plantation.

Protect your plantation from fire and theft. A pond or other water source is advisable. Most people find it hard to imagine taking joy in decorating a stolen Christmas tree, but, nonetheless, theft remains a common problem. Therefore, your plantation should be in a location which is either hard to get to by truck at night, or observable by you or your neighbors. The illustration suggests an ideal layout for a small Christmas tree plantation.

Your main road network should follow the boundaries between species blocks to help make them efficient management units. These roads must be well constructed to withstand heavily loaded trucks used to haul trees to market. Secondary roads should run between main roads, being generally parallel to one another, and about 60' to 100' apart within species blocks. These roads allow you to bring spray equipment, fertilizer and other items to the treatment site more quickly and efficiently. They can also serve as firebreaks if weeds are controlled by burning.

The following publications provide more detailed information on woods road construction:

Permanent Logging Roads for Better Woodlot Management. USDA Forest Service, State and Private Forestry. For sale from Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

Erosion Control on Logging Roads in the Appalachians. USDA Forest Service Research Paper NE-158. For sale from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC, 20402.

Site Preparation

Site preparation prior to planting is done primarily to control competing vegetation and to create a mowable field. Before planting trees in a new site, two-thirds of Christmas tree growers surveyed needed to prepare the plantation site to some extent. While preplant cultivation is rarely required, preplant weed and brush control often is. For over one-half of the Christmas tree growers (58%), site preparation involved applying herbicides to control unwanted vegetation. Section VIII gives specific recommendations for site preparation using herbicides for brush control.

Nearly one-half (45%) of new Christmas tree plantation sites required only minor renovation, such as mowing, tilling or fertilization. In these instances, growers were usually planting recently abandoned agricultural lands, such as pastures and corn fields.

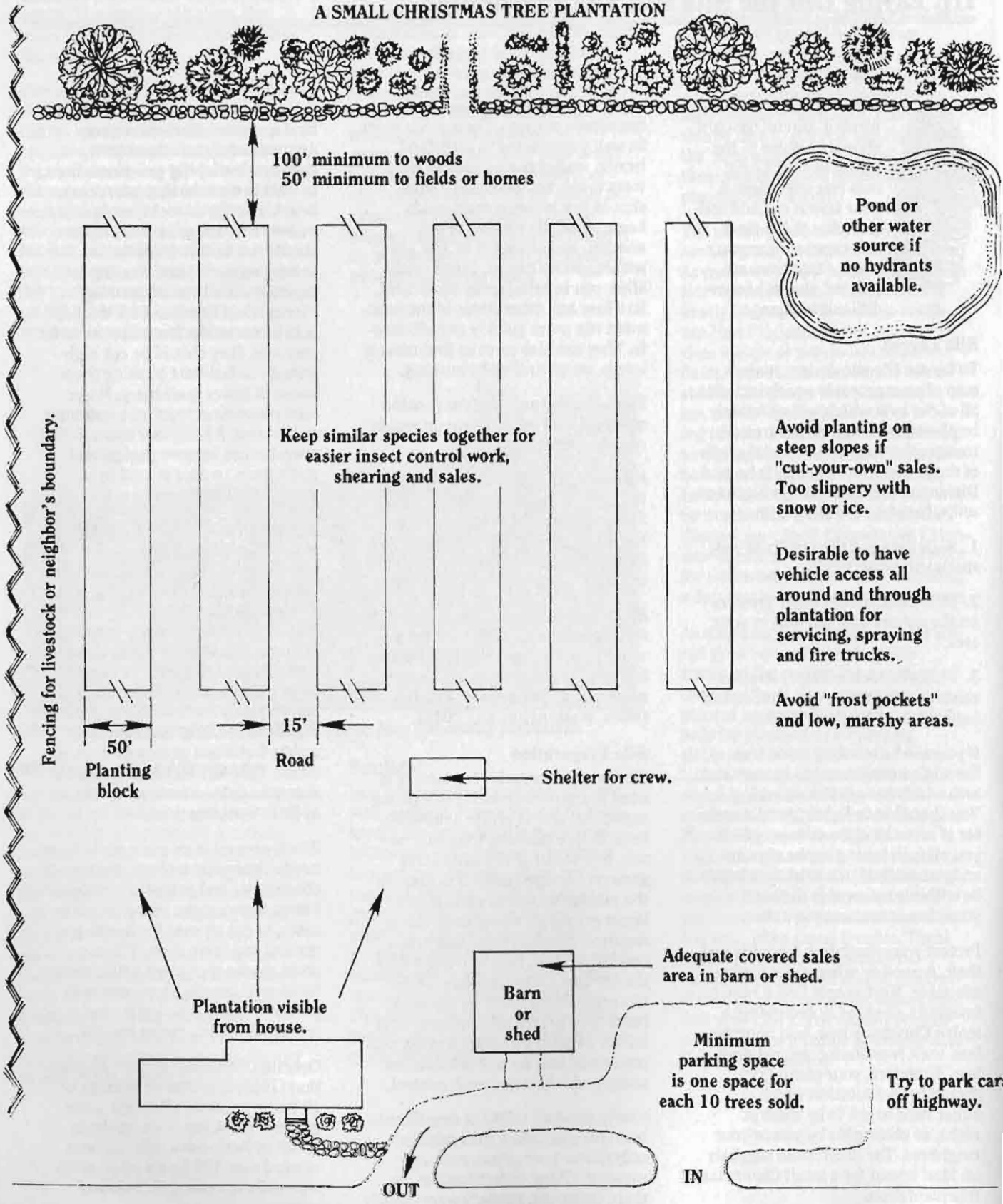
It is entirely feasible to clear forested land and plant Christmas trees. Approximately one-third (29%) of growers developing new plantations needed to clear land, grade, remove brush, stumps or rocks, or do other major renovation. Such a project should not be taken lightly, for several reasons. Land clearing is expensive and time-consuming. Stones must be removed if the field is to be mowable. If stumps are to be removed, they should be cut high enough to facilitate pushing them out with heavy machinery. Major land renovation requires a bulldozer or backhoe. A bulldozer and a skilled operator can remove stumps and rocks from an acre of land in an average of nine hours.

One problem which often results from stump and stone removal is the loss of the humus layer, as well as topsoil, from the planting site. The sandy soils of some parts of southern New England are heavily dependent on organic matter for making nutrients available to plants. Scraping away the humus and topsoil can leave a sandy soil infertile and inhospitable to seedling development, unless fertilizers or a cover crop are added. Care should be taken during stump and stone removal to disturb as little topsoil as possible.

Brush control is an acute problem on newly cleared forest land. Because of the expense and potential soil disturbance, it may make sense, in many cases, to cut stumps flush with the ground and leave them. If this is done, stump treatment with an herbicide will usually be necessary to prevent rapidly growing stump sprouts from occupying the site.

Overall, Christmas tree site preparation (1988) required an average of 12 hours per acre, although some growers spent less than one hour spraying herbicides, while others worked over 100 hours on an acre, manually removing stumps and rocks.

SUGGESTIONS FOR IDEAL LAYOUT OF A SMALL CHRISTMAS TREE PLANTATION



IV. Choosing the Right Species

As discussed in Chapter II, choosing the proper species for your operation is largely a matter of matching species preferences to the characteristics of your planting sites. Determining whether your trees will be sold retail or wholesale is also important. White and Norway spruce, for example, are excellent for choose-and-cut operations, but are less desirable for wholesaling because of their poor needle retention, once cut.

As can be seen in Table 1, white spruce, Douglas fir and Colorado spruce are, traditionally, the most popular species among growers in southern New England. These three species comprise 60% of the total southern New England crop. The popularity of white spruce has been tempered somewhat lately because of its reputation for poor needle retention. Douglas fir is relatively nutrient demanding but has few insect problems and usually commands a premium price. Fungal needle disease can be a severe problem on this species in some locations.

Colorado spruce and eastern white pine have both increased in popularity recently because they will grow on a wide range of soils and hold their needles well after being cut. Scotch pine suffers from many insect and disease problems, and some varieties tend to develop crooked stems. Scotch pine grows rapidly, however, and will do well on infertile sites that other species cannot tolerate. It should be noted that most consumers either hate or love the look of a pine as a Christmas tree.

Fraser fir is a close relative of balsam fir and is similar in appearance. Both are relatively free of serious pests, and both command a good price. Fraser will tolerate both warm sites and frost better than balsam. Both of these firs have become much more popular among southern New England growers in the past 15 years.

Connecticut and Rhode Island tree farmers grow more white spruce than do Massachusetts growers, while Massachusetts growers produce more true firs (see Tables 1 and 2). These variations in species are due to the differing climates of the southern New England states. The montane western part of Massachusetts offers the proper environment for firs (cooler and more moist), while the warmer, drier summer climates of Connecticut and Rhode Island may be less suitable for fir trees, requiring growers to choose less fastidious species, such as white spruce and its varieties.

Although 60% of the southern New England Christmas tree cron consists of three species, a wide array of species are actually grown (see Table 1). This demonstrates a willingness on the part of southern New England growers to experiment with other species, in addition to the old standbys. This is especially apparent in Rhode Island, where growers have branched out extensively into other crops since 1982 (see Table 2).

Descriptions of the most important Christmas tree species are found on the following pages. Brief descriptions of a number of less common conifers, which have been occasionally suggested for Christmas tree growing, are given at the end of this chapter.

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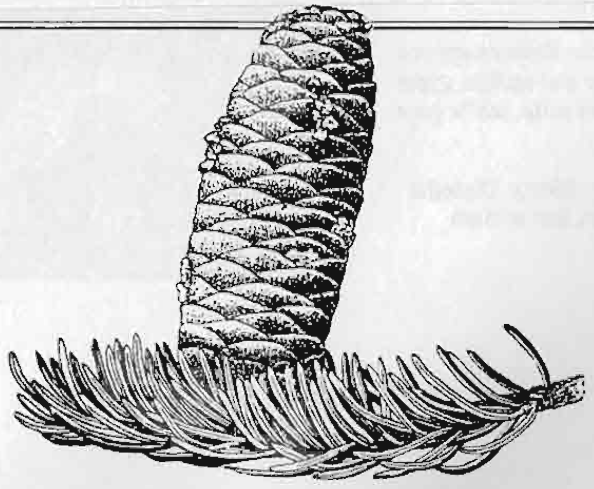

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WHITE SPRUCE

***Picea glauca* (Moench) Voss**

Soil-site requirements: Prefers moist, moderately well-drained to well-drained soils. Will tolerate fairly wet sites but with poorer growth. Tolerates weed competition better than most species.

Growth characteristics: Needles blue-green, 1/3" to 3/4" long, surrounding the twig. Good growth rate. Basic conical form is good, but double leaders are common when small.

Needle retention: Fair.

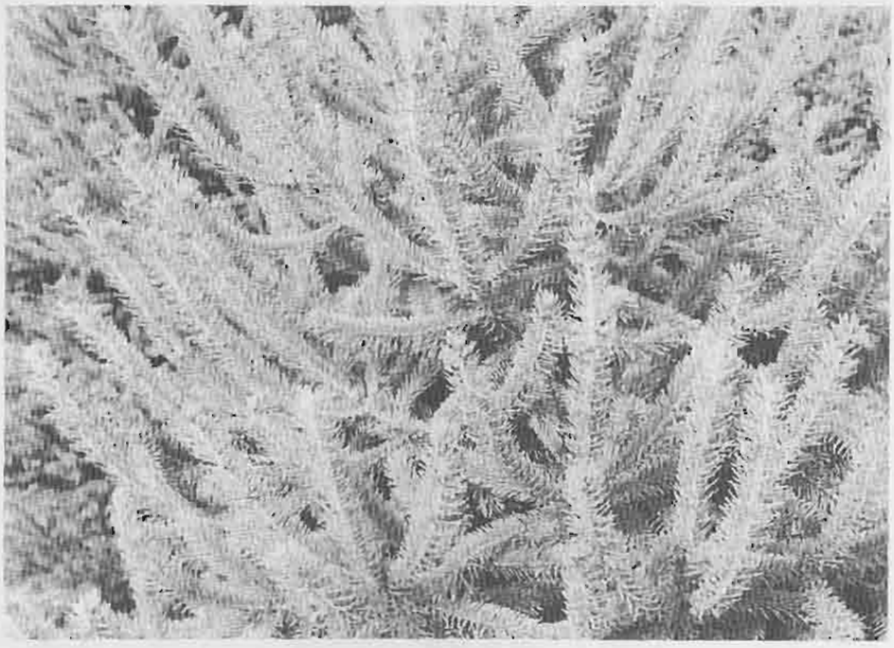
Preferred aspect: Any, but may winterburn on exposed western slopes.

Shade tolerance: Fair-poor.

Frost tolerance: Fair.

Primary insect pests: Eastern spruce gall adelgid, spruce gall midge, gypsy moth, sawfly, spider mite, white pine weevil.

Primary disease problems: Diplodia tip blight (common, but seldom serious).



DOUGLAS FIR

***Pseudotsuga menziesii* (Mirb) Franco**

Soil-site requirements: Douglas fir is nutrient demanding. Requires a moist, well-drained loam or sandy loam. Dry sites or poorly-drained sites should be avoided. Good air movement and weed control are important.

Growth characteristics: Considerable variation exists among seed sources with respect to cold hardiness, growth rate and needle color. Needles 3/4" to 1-1/4" long, green to blue-green, occurring in two rows along the twig. Basic conical form is good.

Needle retention: Excellent.

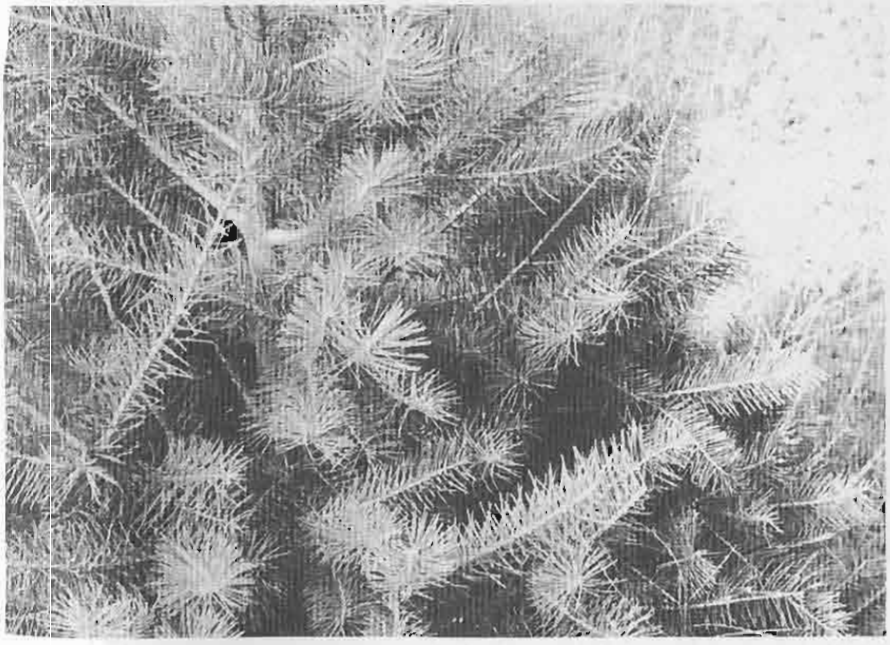
Preferred aspect: Any, does best on cool north- or east-facing slopes.

Shade tolerance: Fair-poor.

Frost tolerance: Poor; avoid hollows or other frost-prone areas.

Primary insect pests: Cooley spruce gall adelgid, gypsy moth, white pine weevil.

Primary disease problems: Rhabdocline needle cast.



COLORADO SPRUCE

***Picea pungens* Engelm**

COLORADO BLUE SPRUCE

Picea pungens* var. *glauca

Soil-site requirements: Grows on a wide range of soils. Best growth attained on moist, well-drained sites. Less tolerant of wet soils than white or Norway spruce.

Growth characteristics: Needles 1" to 1-1/4" long, sharply pointed, green or blue-green to bright blue, depending on seed source. Slower growing than Norway or white spruce. Basic conical form is good.

Needle retention: Good.

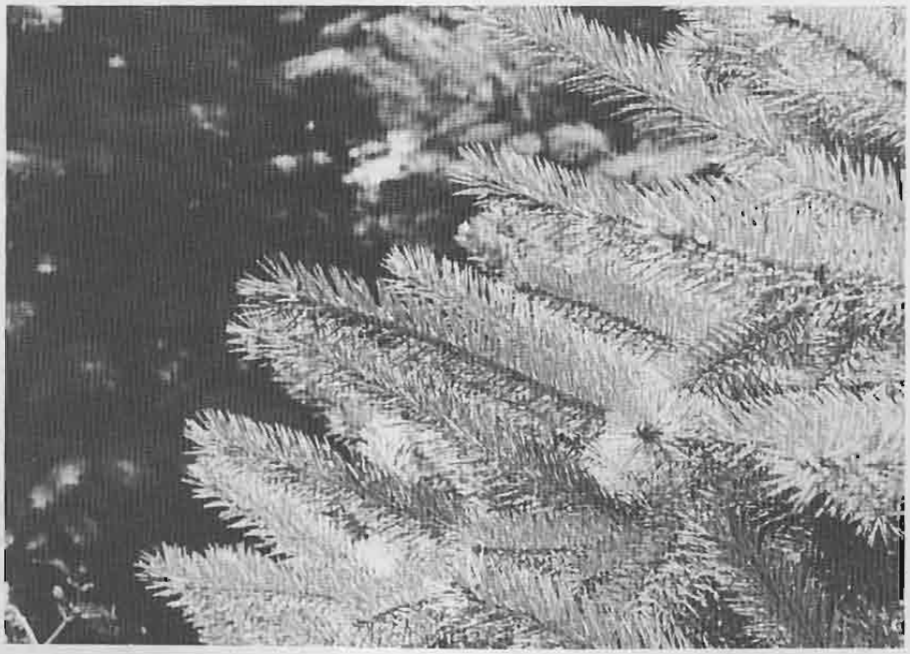
Preferred aspect: Any.

Shade tolerance: Poor.

Frost tolerance: Fair-poor.

Primary insect pests: Cooley spruce gall adelgid, gypsy moth, spider mite, spruce budworm, white pine weevil.

Primary disease problems: Diplodia tip blight (common, but seldom serious).



EASTERN WHITE PINE

***Pinus strobus* (L.)**

Soil-site requirements: Grows on a wide range of soils, from dry to fairly wet. Best growth occurs on moist, well-drained sandy loams.

Growth characteristics: Needles green to blue-green, 2" to 4" long, in groups (fascicles) of five. Fast-growing, but basic conical shape is poor and heavy; timely shearing is required.

Needle retention: Good.

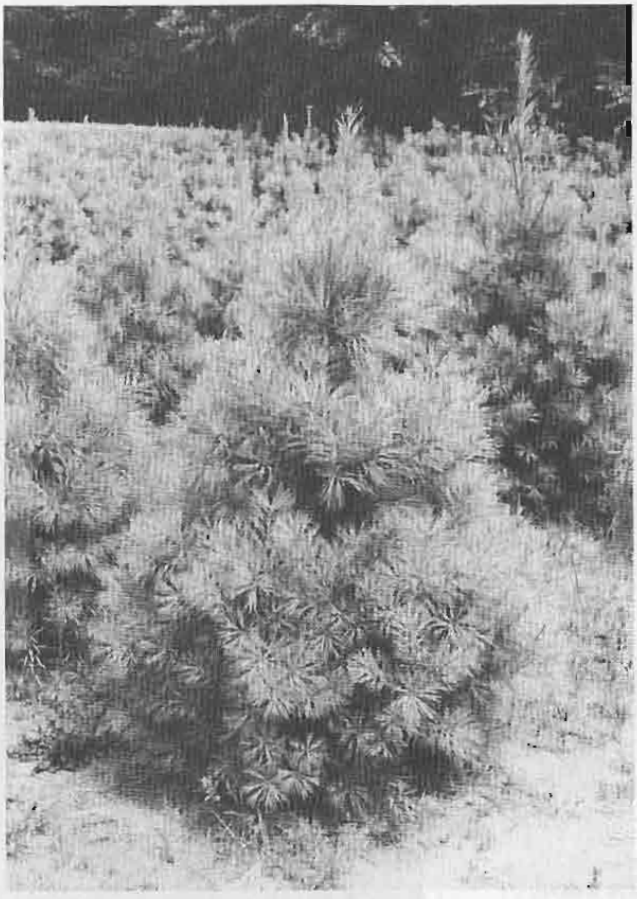
Preferred aspect: Any.

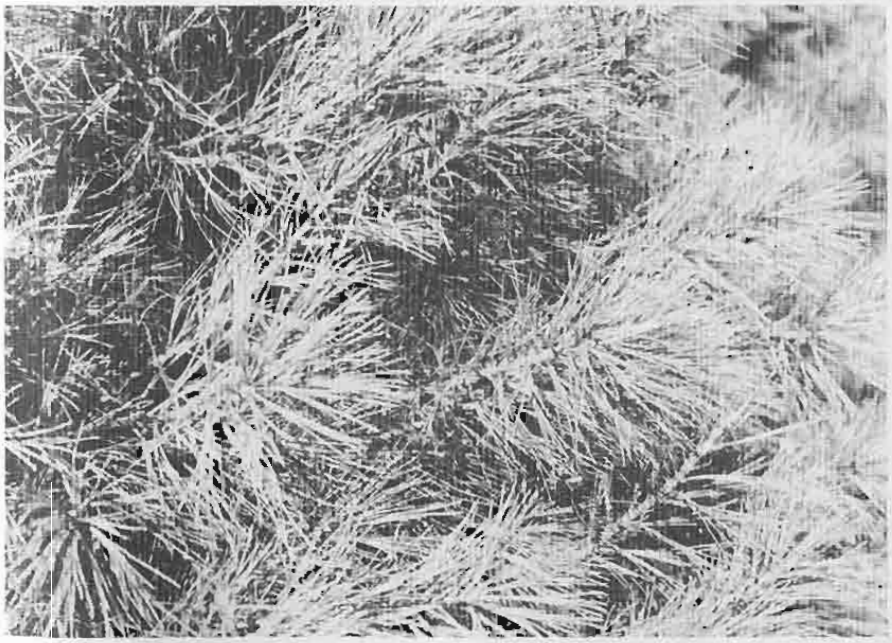
Shade tolerance: Fair.

Frost tolerance: Good.

Primary insect pests: White pine weevil, Pales weevil, gypsy moth, sawfly.

Primary disease problems: None (sensitive to sulfur dioxide air pollutants).





SCOTCH (SCOTS) PINE

***Pinus sylvestris* (L.)**

Soil-site requirements: The least fastidious of Christmas tree species. Grows on all but the very wettest of sites, including dry ridges and infertile sites. Needle fungal diseases may become serious on low-lying sites with poor air movement.

Growth characteristics: Considerable variation among seed sources. Needles generally are blue-green, 1-1/2" to 3" long and slightly twisted in groups (fascicles) of two. Very fast-growing, but basic conical shape is poor and heavy; timely shearing is usually required. Trees from some seed sources develop crooked stems, or discolor in the fall.

Needle retention: Good.

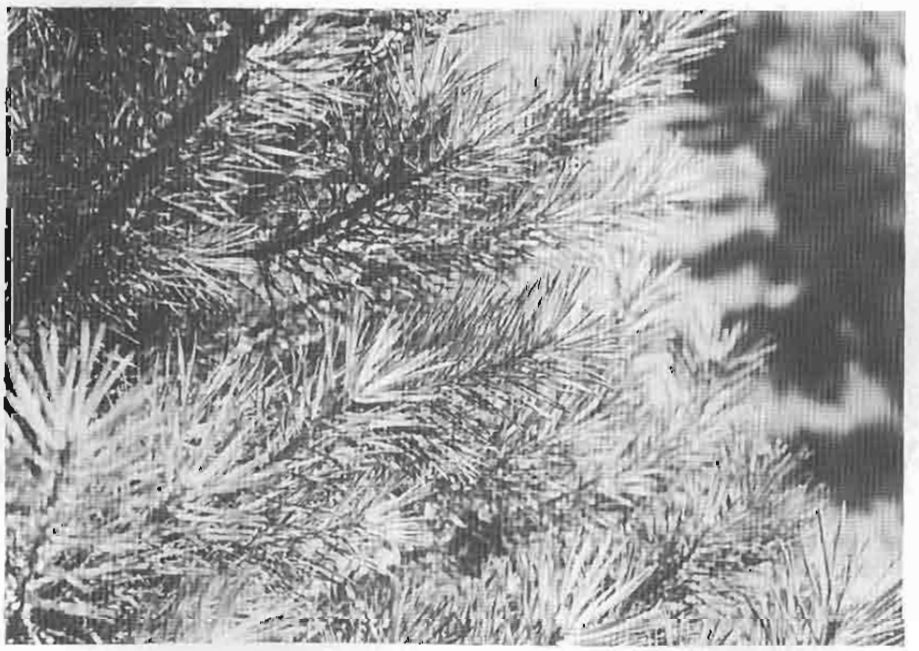
Preferred aspect: Any; has been known to do poorly on exposed northern slopes.

Shade tolerance: Fair-poor.

Frost tolerance: Good.

Primary insect pests: Pales weevil, pine needle scale, pine shoot moth, pine tip moth, sawfly, gypsy moth, white pine weevil.

Primary disease problems: Lophodermium needle cast.



FRASER FIR

***Abies fraseri* (Pursh) Poir**

Soil-site requirements: Fraser fir will stand neither very wet nor very dry soils. Moderately well-drained to well-drained sandy loams are best. When young, it is intolerant of heavy weed competition and high soil surface temperatures and may suffer mortality on hot, bare soils or exposed southern sites.

Growth characteristics: Needles 1/2" to 1" long, shiny green above and silvery white below. Basic conical form is good, but taper is often narrow. Growth rate is similar to balsam fir; slower than some Douglas fir seed sources or varieties.

Needle retention: Good-excellent.

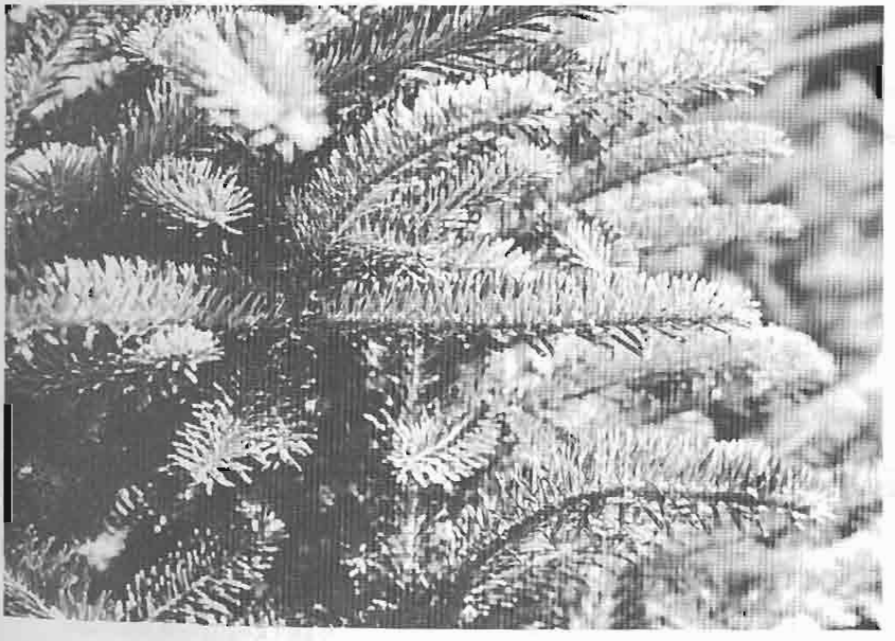
Preferred aspect: Does best on cool, north- or east-facing slopes.

Shade tolerance: Good.

Frost tolerance: Excellent.

Primary insect pests: Balsam twig aphid, balsam wooly aphid, spider mite.

Primary disease problems: Diplodia tip blight (common, but seldom serious).



BALSAM FIR

***Abies balsamea* (L.) Mill.**

Soil-site requirements: Balsam is intolerant of dry soils but will do well on relatively wet sites. It is intolerant of heavy weed competition.

Growth characteristics: Growth tends to be somewhat slow and irregular. Basic conical form is good. Needles dark, shiny green above, silvery white below, 3/4" to 1-1/2" long, often notched at the tip.

Needle retention: Excellent.

Preferred aspect: Cool, north- or east-facing slopes.

Shade tolerance: Fair-good.

Frost tolerance: Poor.

Primary insect pests: Balsam twig aphid, balsam wooly aphid.

Primary disease problems: None.

MINOR CONIFERS WITH POTENTIAL FOR USE IN SOUTHERN NEW ENGLAND

Over the years, a number of exotic conifers have been planted in the Great Mountain Forest in Norfolk and Canaan, Connecticut, and the following comments are based on experiences there. Most of these species have not been grown extensively in commercial Christmas tree plantings because of one or more shortcomings.

SPRUCES

Spruces grow from the Arctic to the high mountains of the temperate regions. In general, spruce trees have a shallow, wide-spreading root system and grow best in cooler regions. Some species tolerate more dryness than others. In most cases, they are much more adaptable and more easily grown than the firs.

Asiatic and European Spruces

Picea abies (Norway spruce—central and northern Europe to the Ural Mountains). A hardy tree of great variability. Shiny green needles are short and sharp, lying rather flat on

the twigs. Open branching habit. A rapid grower which needs shearing but shapes into a beautiful tree. Needle retention is poor.

Picea wilsonii (Wilson's spruce—central and western China). A graceful, pyramidal tree, with dense, light green foliage. The slender, rather sharp needles on whitish-gray branches are very distinctive. Hardy. A nice tree that starts a bit slowly but has done well on a number of different sites. It shapes well.

Picea asperata (Dragon spruce—China). A dense, rapid-growing timber tree from western China. Medium-green needles, remain on the tree for up to seven years. Needles are a little too sharp. A lush tree that has been easy to manage and shapes well.

Picea omorika (Serbian spruce—southeastern Europe). An attractive tree of narrow form; a desirably shaped Christmas tree where space is a factor. The needles are flat, dark green on one side and silvery on the other. A graceful spruce that shapes well. Slight needle burn has been noticed on exposed southwesterly sites after severe winter ground freeze. A nice tree that should do well in most areas.

Picea meyeri (Meyer spruce—North China). This tree is rare in cultivation and is a close relative of *P. asperata* var. *heterolepsis*. It is a handsome tree of a broad, pyramidal habit that is perfectly hardy in northwestern Connecticut. It has the general appearance of the Colorado blue spruce, but the branches are more limber, and the needles are not so sharp. Squirrels do damage to winter buds. It shapes well and makes an excellent Christmas tree.

Picea koyamai (Koyama spruce—Japan, Korea). A hardy, narrow, pyramidal tree with distinctive reddish-brown, upturned limbs. Short, blunt, dark green needles lie close to the twig. This species is fast-growing. The fairly open-spaced, ascending branches need shearing but shape nicely.

Picea glehnii (Sakhalin spruce—Sakhalin Island and Japan). Another handsome, narrow, pyramidal tree from the Orient, with reddish-brown twigs and short, lustrous, deep green needles that lie close to the twig. A hardy, somewhat slow-growing tree that shapes well.

Picea orientalis (Oriental spruce—Asia Minor). An attractive tree with short, shiny, deep green needles that lie close to the branches. A bit slow to start, but it grows well on dry, sandy sites. Subject to weevil damage and, occasionally, severe winterburn. It makes a better ornamental than it does a Christmas tree.

Western Spruces

Picea glauca var. *densata* (Black Hills spruce—Black Hills region of southwestern South Dakota and northeastern Wyoming). Often listed as a cultivar rather than a variety, but the trees grown for Christmas trees are produced from seed collected in the Black Hills. A hardy, slow-growing form of the white spruce. Plants are conical and dense and may reach a height of seven feet in 13 to 15 years. The color of the foliage ranges from bright green to blue-green and is considered to be more attractive than the typical *P. glauca*.

Picea engelmannii (Engelman spruce—Rocky Mountains to Central British Columbia). Shows great variation in color and growth rate. Dense green to silvery-blue foliage. Rather strong, "catty" odor when the needles are crushed, but not much different than that of some other spruces. Makes a nice addition to your plantation if you are looking for a little more shade-tolerant tree, but it will not stand the drought and temperature extremes that the more deeply rooted Colorado blue spruce will.

Picea sitchensis (Sitka spruce—Alaska to California). Very attractive, two-toned green and silvery-white needles and good branching habit. Requires a cool, humid climate. Alaskan and British Columbian sources do better than Californian ones, but a Washington seed source is the best. White pine weevils love it. Needles are too sharp and retention is poor. A good one to know, but probably not to grow!

FIRS

Firs are mostly slow-growing trees with shallow, spreading root systems that require a cool, humid climate.

While they do best on moist, well-drained soils, they grow on almost any soil that is not too dry or too hot. Firs are less adaptable than pines or spruces. They require considerable attention, particularly when young. In southern New England, unprotected trees are subject to severe deer damage.

Asiatic and European Firs

Abies koreana (Korean fir—Korea). A lesser-known tree with stiff primary branches. Needles are crowded on branchlets and are lustrous above with broad, whitish bands beneath; they are distinctive and attractive. A bit slow in the

seedbed, but 3-2 transplants set out in 1972 are growing 12" to 20" per year in reasonably good soil on a north-facing slope. The only complaint might be the fairly heavy cone crop on some trees. A hardy tree that shapes well when the leader is sheared shortly after attaining the desired height. A top-choice, exotic-looking fir.

Abies veitchii (Veitch fir—Japan). A graceful tree with soft, flexible branches that is receiving considerable attention from some growers. Dense foliage is lustrous dark green above, with two chalky white bands underneath. Winter bud is resinous purple. Late spring bud break reduces chance of frost damage. Several 40-year-old trees in the forest are perfectly hardy, retaining lower branches. Has some difficulty getting a leader started when young. Some needle yellowing occurs in late fall. Poor terminal dominance may occur on sheared leaders. An excellent bet for Christmas tree growers where the site isn't too dry.

Abies homolepis (Nikko fir—Central Japan). Frequently planted in the eastern United States and doing well. This species possesses lustrous, deep green foliage with white bands beneath on upturned branches. Slightly sharp needles spread outward along the branchlets, forming a V-shaped depression. Branches are deeply grooved. The tan bark is soft and scaly. Wide-spreading branches can be shaped nicely with the usual shearing methods. Bud break occurs in late spring. Some yellowing of foliage can occur on heavy soils. Forty-year-old trees as well as younger plantings are growing well.

Abies sachalinensis (Sakhalin fir—Northern Japan and Kurile Island). The soft, broad, deep green foliage with striking white bands beneath and the resinous white buds are very attractive. A hardy tree, but new growth is very susceptible to frost damage with late spring frosts. Due to its open habit and rapid growth, it requires frequent attention during the growing season to shape properly. Do not put it on your driest site.

Abies nordmanniana (Nordmann fir—Asia Minor). A better-known fir than other exotics. Large, flat, dark green needles show white beneath. Lush foliage is crowded on horizontal branches. It suffers some from winterburn and late spring frosts. We have had best results on a northeast slope. This species has a good growth rate and good Christmas tree potential.

Abies cephalonica var. *apollonis* (Greek fir variety—mountains of Greece). The Greek fir is a beautiful, sturdy tree. Needles are deep green with white bands beneath, stiff and crowded on yellowish branchlets. Needles are sharp on the species, but blunt on the variety. The variety is also more hardy. It has performed well for over 25 years on average sites. Slight winterburn has occurred occasionally. It is an excellent prospect for a climate that is a bit milder than Norfolk, CT.

Abies borisii regis (King Boris fir—the Balkans). Related to the Greek fir but appears to be hardier. It has softer needles on more limber branches than the Greek fir. Early bud break makes it susceptible to late spring frost damage. Does well on a cool, moist site but needs more trial.

Abies bornmuelleriana (Bornmueller fir—Asia Minor). Another rarely planted, little known species which is closely related to the Greek fir. A handsome tree, with long, blunt, dark green needles on glabrous branchlets. Has done well on northeast slope but also needs more trial.

Abies cilicica (Cilician fir—Asia Minor, Northern Syria). A vigorous and hardy tree of sturdy, pyramidal form. Narrow, bright green needles form a V-shaped depression on firm, nonresinous, gray stems. A neat tree, with foliage that is not too dense and shapes well. Shows good promise.

Abies recurvate (Min fir —Western China). An attractive tree. Some needles, usually those at the branch tip, are recurved, or pointed backward toward the trunk. Interesting foliage, with needles up to 1-1/2" long, pointed, lustrous blue-green above and paler beneath. Flaky, soft, tan bark when older. Hardy on good site for 40 years.

Western Firs

Abies concolor (White or Concolor fir—Rocky Mountains). A tree that grows naturally over a wide range in the western United States; there are considerable variations in site requirements, growth habits and foliage color. It is probably the most satisfactory nonindigenous fir growing in the northeast. Being more deeply rooted, concolor fir withstands heat and drought better than

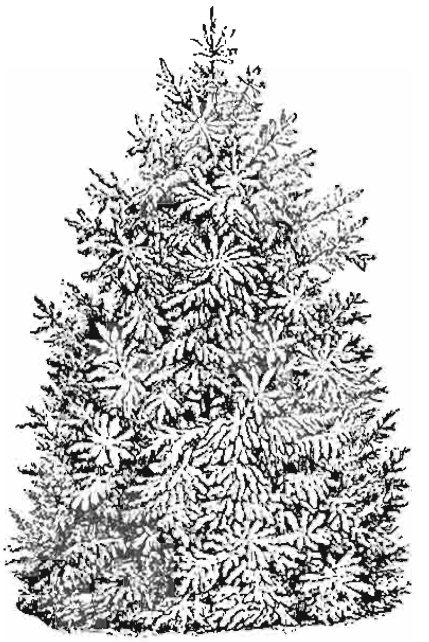
other firs, but it seems to do best in moist, well-drained soils. Colorado and neighboring northern Arizona sources seem to be hardier and bluer than those of California. It is a bit slow and has some difficulty getting a good leader started. The terminal or lateral buds on the leader are occasionally winterkilled, but it is otherwise hardy. May require frequent attention during the growing season to control rampant top growth. A good seller.

Abies lasiocarpa (Alpine or Subalpine fir—Rocky Mountains). According to most writers, this tree is not supposed to do well in the eastern United States, but it has done well in Norfolk, CT, for the last 30 years. Some are growing on a windy, exposed, north- west slope with average soil and moisture and haven't shown any damage. It looks like a lush balsam fir. Its dense needles are pale, blue-green and long. It is a slow starter that doesn't like competition. Usually has a narrow, pyramidal form. A beautiful Christmas tree.

Abies lasiocarpa var. *arizonica* (Arizona corkbark fir—Southern Rocky Mountains). A lovely prospect that grows too slowly. Eight-year-old transplants that were field-planted in 1971 were just coming into room size eleven years later. Also has difficulty getting a leader started. Very attractive, blue-green, almost silvery needles. Soft, cork-like, cream-colored bark on older stems.

Abies procera (Noble fir—Washington to California). A tree with soft, incomparably dense, deep green to blue-green foliage. Demands moist conditions. On dry sites, it grows into a flat-sided bush or dense green ball. Not very cold hardy. Some bud damage with sharp temperature drops to below zero. Winterburn not uncommon. A top seller in the Pacific Northwest. Worth a try (for its foliage alone) on moist, protected sites in milder regions of the northeast. Shapes well if leader is sheared about mid-growth to control tip vigor.

Abies grandis (Lowland White or Grand fir —Pacific Northwest into Montana). A beautiful tree, with long, flexible, shiny green, two-ranked needles. Looks like a green concolor fir. A less hardy tree that shows good early terminal growth and shapes up easily. Subject to some winterburn on exposed sites. Makes a beautiful Christmas tree with excellent needle retention.



PINES

Pines grow widely about the northern temperate regions of the world. They grow on a wide range of soils, from seashore to timberline, presenting the interested grower with a variable collection from which to choose. For the most part, they are more deeply rooted than spruces and firs, and can endure drier conditions. Growth rate may vary greatly between species.

Pinus nigra (Austrian pine—Central Europe). A rugged, hardy pine with long, stiff, dark green needles. Many natural varieties, of which *calibrica*, with dense, pyramidal form and foliage a little lighter than the species, is a handsome choice. Due to infection by needle cast diseases, we are uncertain about future plantings of this species.

Pinus virginiana (Virginia pine—Central and Eastern United States). A native to our south, bearing grayish-green needles in scattered clusters on irregularly whorled branches. Due to its rapid juvenile growth and its ability to thrive on poor sites, coupled with its ability to shape well, it is gaining importance as a Christmas tree in the southeastern states.

Pinus leucodermis (Balkan pine—the Balkans). It is considered by some to be a variety of Austrian pine. A hardy tree, with stiff, bright green needles, but too slow-growing, at least when young. Does not shape well, due to poor bud development on sheared branch tips.

Pinus monticola (Western white pine—British Columbia to California and Idaho). Similar to our eastern white pine, but with stouter and stiffer needles and a narrower, denser growth habit. Susceptible to weevils and blister rust, but a hardy, vigorous tree.

Pinus strobiformis (Mexican border pine—Southern Rocky Mountains). A close relative of the limber pine and the Mexican Ayacahuite pine that is hard to find listed separately in taxonomy books. Hardy in the hills of northwestern Connecticut. A fast grower once it gets started. Needles are silvery blue-green, and are closely set on the branches. Its open branching habit requires shearing to begin at an early age.

Pinus flexilis (Limber pine—Rocky Mountains). Another hardy, five-needled pine, with limber, droopy branches. Needles are clustered and not as spreading as other five-needled pines. Narrow, open habit.

Pinus wallichiana (Himalayan pine). Longest needles of any of the five-needled pines, giving it a weeping effect. Roots are coarse and the tree does not transplant as readily as eastern white pine. Suffers from windburn and sunscald in fall. Probably not hardy enough for cold sections of southern New England.

V. Planting Stock and Planting

The choice of planting stock (seedlings or transplants) will have considerable effect on the success of any Christmas tree planting. High quality, vigorous stock will give greater survival and will grow more rapidly. Any savings realized by purchasing bargain-priced planting stock will be lost through lower survival and slower growth.

Types of Planting Stock

When purchased, Christmas tree planting stock may range from one to five years old. The most common types of planting stock are bareroot seedlings, bareroot transplants and container-grown plants.

Seedlings are usually raised from seed sown directly in the nursery bed. These seedlings may subsequently be transplanted into other beds to provide more room for root and shoot growth. The age of nursery-grown plants will be designated by two numbers, separated by a hyphen. The first number specifies the growing seasons in the seedbed; the second number, the growing seasons in the transplant bed. Thus, a plant listed as a 2-1 will be three years old, and has spent two years in the seedbed and one year in the transplant bed.

In general, older transplanted stock will be hardier and reach harvest size faster than seedlings, provided that the plants were grown properly in the nursery and were cared for and planted correctly by the purchaser. Transplants are significantly more expensive than seedlings, and the grower must weigh this increased cost against the potential benefits of better survival and shorter time until trees are saleable. See Table 3 for southern New England grower preferences for planting stock.

The type of planting stock a grower chooses dramatically affects the number of trees that can be planted in an hour, and can influence the percentage of initial survival and the percentage of trees that live to attain a marketable size. See Table 4 for a summary of this information as reported by southern New England growers.

As might be expected, significantly fewer 2-2 plants can be planted per hour than 2-0 plants. Plant survival data for 1988 do not indicate a clear benefit of using 2-2 transplants over 2-0 seedlings. However, it should be noted that, in 1982, growers reported better survival with transplants than seedlings. It is fair to say that each grower will find the greatest success using the type of planting stock that best suits a particular operation.

Quality of planting stock is also very

OLD INFORMATION DELETED

Table 4. Number of trees field planted per hour and percent survival as reported by southern New England growers (1988).

If Planted With Hand Tools:

Plant Category	# Planted/Hr	% Survival	% Marketable
2-0	64	81	69
2-1	50	82	58
2-2	43	84	57
Overall	46	83	56

If Planted With Machinery:

Plant Category	# Planted/Hr	% Survival
2-0	383	87
2-1	185	66
2-2	135	76
Overall	158	81

important. Quality is rated on the basis of size and balance. Stem caliper and the length and weight of shoots as compared to the length and weight of roots are the best criteria to evaluate the relative quality of planting stock.

Growth and development of planting stock varies considerably among species and often depends on the seed source and individual nursery practices. One learns from experience and from other growers where the most reliable stock may be purchased.

In the 1970s, interest grew in growing seedlings in containers. The seed is sown directly into a specially designed container, and the seedlings are grown in a greenhouse with optimum light, temperature and fertility. The term "accelerated growth" has been applied to this process, because it is possible to produce acceptable planting stock in one year or less. These plants have the advantage of faster, more uniform growth and an intact root system, which should mean greater survival and better growth. Since soil moisture following planting may not be quite as critical, container seedlings can be planted later in the spring than can bare root stock.

Quality, however, will still vary among species, seed source and nurseries. Variations in containers used will lead to differences in root-shoot ratios. Be sure that there is a good balance between tops and roots so that the plants will establish well and be competitive in the field.

Container-grown plants cost more and are more expensive to ship than bed-grown seedlings or most transplants. This higher cost may be justified for those species that are slower-growing or difficult to establish, such as spruces, firs and Douglas fir. It should be noted that, while not all container stock will necessarily be accelerated-growth, they may still retain some advantages. A container seedling has an established, undisturbed root system, which should result in more reliable and quicker establishment in the field.

Transplant beds are used to strengthen two-year-old seedlings before they are planted in the field.

It is important to note that trees grown in containers for too long may develop encircling roots or root systems which fail to grow out into the soil when planted. The result is poor field performance. Always beware of container-grown stock that has been kept in small containers for too long.

Obtaining Planting Stock

Christmas tree planting stock can be obtained from a variety of sources. Most producers of planting stock will require the purchase of large quantities of plants (500-1000, or more).

It is common for Christmas tree growers to buy plants from commercial nurseries that specialize in the production of Christmas tree seedlings and transplants. It may be possible to obtain planting stock from local Christmas tree growers who grow their own planting stock and are willing to sell the surplus at a reasonable price. Some Soil and Water Conservation Districts also offer Christmas tree planting stock. Connecticut landowners can obtain planting stock from the Connecticut Division of Forestry, which operates the Pachaug State Forest Tree Nursery in Voluntown, Connecticut. Rhode Island growers can also obtain Pachaug nursery stock through the Rhode Island Department of Environmental Management. Growers who intend to establish a Christmas tree plantation on at least one acre may purchase seedlings from the nursery for what it costs to raise them. A variety of popular species are available. Orders may be for no less than 250 but no more than 10,000 seedlings of any single species, and seedlings may not be resold with roots attached.

Growing Your Own Seedlings and Transplant Stock

If you do not wish to purchase plants ready for field planting, there is always the option of growing planting stock from seed or buying small seedlings, which can be grown to a larger size in a transplant bed. There are several potential advantages to growing your own seedlings or transplants. As stated earlier, two-year-old seedlings are less expensive than transplants, but transplants have a better growth and survival rate in the field. A transplant bed also serves as a personal nursery and greatly increases flexibility. Fall field planting to replace losses becomes possible, and the spring planting season is less hectic than it would be if all your planting stock arrives ready to plant the same day.

Keep in mind that, although growing your own plant material can provide a number of benefits over buying stock, growing seedlings or transplants is much more management-intensive than growing larger plants in the field. It demands a solid commitment on the part of the plantation manager, since seedlings and young transplants are rather delicate and easily injured or damaged. Only 7% of southern New England Christmas tree producers grow their own trees from seed. However, 60% of the growers regularly maintain their purchased seedlings for a period of time in a transplant bed.

Seed or transplant beds, referred to from this point on as beds, should be located on a well-drained soil, preferably a loam or sandy loam. Excessively-drained soils can be used for beds, but copious amounts of organic matter and probably some dolomitic lime, will need to be incorporated first. Heavy, poorly-drained soils should be avoided; if they must be used, raised beds are required to improve drainage. Ideally, bed soils should have moderate fertility and a pH of 5.5 to 6.2.

Beds should be situated in a sunny location, away from frost pockets and protected from sweeping winter winds. The seedling transplant nursery should be placed where it will be easy to provide intensive management and where there is access to dependable irrigation water.

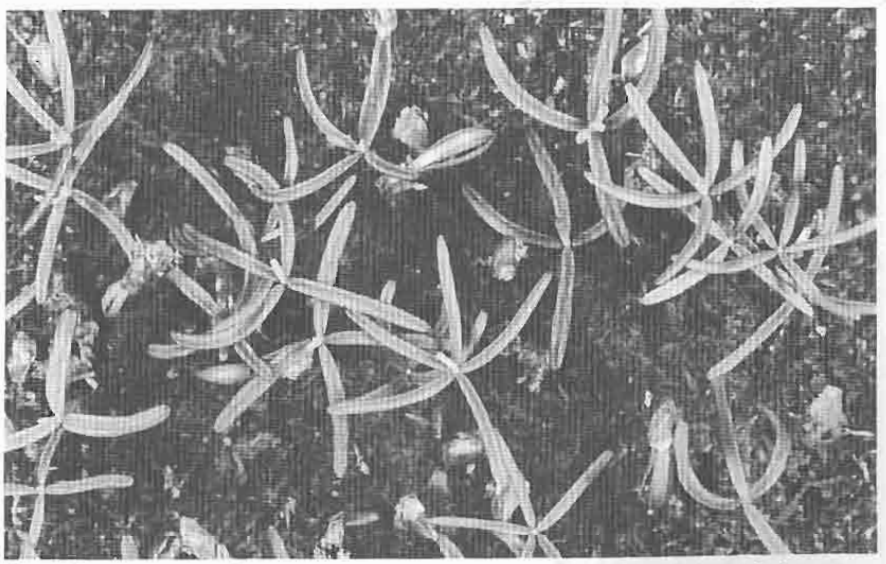
It is important to use seed of good quality from a known source to produce planting stock. For some tree species, the genetic background of the seed or the region from which seed was collected makes little difference in the quality of the trees that grow from the seed. For other species, notably Scotch pine and Douglas fir, seed source selection is critical. These species occur naturally over wide geographical ranges from north to south, east to west, and from mountain ranges to coastal plains. The trees growing in a particular region are well-adapted to that region and less adapted to other regions. Matching your region with the appropriate seed source is a must.

Seed can either be collected or purchased. Purchasing seed is often the best way to proceed. Most conifer seed ripens during late summer and fall, so seed should be ordered at this time to obtain sufficient quantities of the desired seed. Larger quantities of seed can be purchased and stored.

- Most seed can be stored for a period of several years if placed in tightly sealed containers that are kept in a dry, cold (34° to 38° F) spot.

When sown, seeds of some Christmas tree species will germinate readily, while others will fail to germinate, even though they are healthy and viable. This is because the seeds of some tree species require a period of cold or chilling to break an internal dormancy. During the exposure to cold temperatures, seed must be moist or imbibed for the cold to be effective at breaking the seed dormancy. In the forest, seed dormancy is broken naturally by exposure to the cold and moisture of winter. Man can provide seeds with cold and moisture artificially in a process called stratification.

Seeds can be stratified by placing them in a pouch made of plastic screening and burying this pouch in moist peat moss for two to three months at 36° to 40° F. The seed pouch should be soaked in water for 12 to 24 hours before it is buried in the peat moss, to insure that all seeds



Germinating Fraser fir seed and young seedlings with expanded cotyledons.

are moistened. Alternatively, soaked seeds can be placed inside polyethylene bags for their cold storage, provided the moisture content of the bags is checked frequently and maintained. An old refrigerator works well as a seed stratification chamber.

Some seeds don't require stratification when they are fresh, but dormancies can develop after they have been stored a few years. It is often beneficial to stratify older seed, since stratification will make germination faster and more uniform than the same unstratified seed. Likewise, seed of species that have no specific stratification requirement will usually respond better if they receive some stratification. See Table 5 for more information on stratification needs. Keep in mind that fall-planted seed will receive natural stratification, but spring-planted seed will have to be artificially stratified if seed dormancy is known to exist.

Proper bed preparation is needed to insure good growth of seedlings or transplants. Lay out beds so they are four feet wide and have 18" to 24" walkways between each bed. Rototill or cultivate the soil when it is suffi-

Table 5. Seed pretreatment and planting requirements for some commonly grown Christmas tree species.

Species	Stratification Requirements	Approximate Seeding Rate (oz/100 sq ft)[1]	Recommended Planting Season		Comments
			Fall	Spring	
Abies balsamea	Required	20-24	Yes	Yes	Fall planted seed requires no artificial stratification.
Abies concolor	Required	25-50	Yes	Yes	Fall planted seed requires no artificial stratification.
Abies fraseri	Required	10-12	Yes	Yes	Fall planted seed requires no artificial stratification.
Picea abies	Not Required	4	Yes	Yes	Spring planting preferred. Stratification will make germination of spring-sown seed more rapid and uniform.
Picea glauca	Not Required	1.5-2	Yes	Yes	Stratification will make germination of spring-sown seed more rapid and uniform.
Picea omorika	Not Required	2	Yes	Yes	Stratification will make germination of spring-sown seed more rapid and uniform. Seed is expensive, so germinate seed in a greenhouse to maximize yield when possible.
Picea pungens	Not Required	3	No	Yes	Fall planting is risky because seed tends to germinate in cool temperatures in the fall, resulting in high seedling mortality. Stratification will make germination of spring-sown seed more rapid and uniform.
Pinus strobus	Required	7	Yes	Yes	Fall planted seed requires no artificial stratification.
Pinus sylvestris	Not Required	3-4	Yes	Yes	Stratification will make germination of spring-sown seed more rapid and uniform.
Pseudotsuga menziesii	Required by Some Seed Sources	8-12	Some Seed Sources	Yes	Southern seed sources may not possess seed dormancy and may be risky for fall sowing due to fall germination and subsequent seedling death.

[1]Values are based on the following:
- a tree density of 45 trees per square foot
- an average number of seeds per ounce for each species
- an average germination rate for each species
- tree percentages of 0.4 for *Pinus*, 0.3 for *Picea* and *Pseudotsuga*, and 0.2 for *Abies*

Specific calculations should be made for each seedlot; the values listed above are only guidelines.

ciently dry. Stones, roots and other debris should be removed. If the soil in the bed is not friable and is low in organic matter, abundant organic matter additions of composted leaves, composted manure, straw, composted wood chips (supplemented with nitrogen) or composted bark should be incorporated at this point. If soil test results indicate the need for lime or phosphorus, these are also best added now, when they can be incorporated. Be sure organic matter additions are weed-free.

The surface of the bed should be raked to a fine texture and rolled to eliminate any depressions or mounds. It may be desirable to fumigate the soil before planting, to control soil-borne diseases and weeds. Be sure to wait until the soil temperature warms up and use only labeled fumigants according to label directions. Allow sufficient time before seeding to let the fumigant dissipate.

Beds can be seeded either in the fall or spring. See Table 5 for information on proper planting times and seeding rates for some Christmas tree species. The soil surface should be raked lightly to loosen the top 1/4" of soil, to prevent seeds from moving after they land on the bed. Seeds should be hand scattered uniformly over the surface of the bed. Avoid overly-dense seeding, since it reduces seedling quality and vigor.

The number of ounces of seed needed to seed 100 square feet of bed can be calculated using the following formula:

$$S = \frac{100 \times D}{N \times G \times T}$$

S = ounces of clean seed needed;

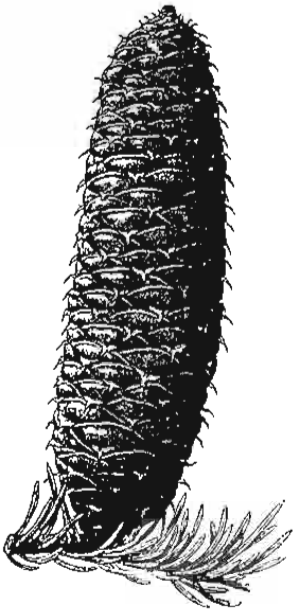
D = desired density (seedlings/sq. ft);

N = number of seeds per ounce;

G = germination percentage (expressed as a decimal); and

T = the tree percentage (percentage of viable seed that result in plantable seedlings, expressed as a decimal).

The value 100 represents 100 square feet of seed bed.



Example: A seedlot of *Picea pungens*, Colorado spruce, contains 6,000 seeds per ounce and a germination percentage of 80%. Most spruce have a tree percentage of 30%. The desired plant density is 50 seedlings per square foot.

$$S = \frac{100 \times 50}{6{,}000 \times 0.8 \times 0.3} = 3.5 \text{ ounces}$$

So, 3.5 ounces of seed are needed for 100 square feet of seedbed.

Press seed in with light rolling or tamping, and cover the seed with a light (1/8" to 1/4") layer of a sand and sawdust mixture. Avoid covering the seed too deeply! Mulch the bed with straw or salt hay, especially for fall sowing, to minimize constant freezing and thawing of the bed.

When the weather is warm enough in the spring for germination to commence, it is important not to let the seed bed dry out. Irrigation is necessary. Overwatering is to be avoided, to prevent damping-off. Germination of spruce and fir seed will occur after three to four weeks of favorable weather, but pine seed will take longer. Once germination is underway, the heavier mulch layer should be removed, leaving only a residual, fine mulch layer.

Protect seedlings from the sun for the first year using lath shades or snow fencing that provide 50% shade to improve growth and reduce mortality. Roots of young conifer seedlings are near the surface, and foliage is not developed sufficiently to shade the soil. The result is elevated surface soil temperatures that can easily kill roots and desiccate seedlings. Shade, watering and mulch will work to moderate soil temperatures.

Shade should be temporarily removed during periods of extended rain to allow for better air circulation. Pines may only benefit from shade for part of the first growing season, while spruces and firs will benefit from a full season of shade. Some slower-growing firs may benefit from a lighter shading in the second and even third years.

Fertilizer will be needed on most seedling and transplant beds to optimize growth of the young plants. It is important not to overfertilize young conifers, since they can be easily burned. See Chapter VII for additional information on fertilizing seedlings and transplants.

Weeds must be effectively controlled in seedling and transplant beds. Although mulching and hand-weeding control weeds well, it may be necessary to use chemical weed control. Refer to the section on transplant beds in Chapter VIII for information on herbicide use.

Young seedlings in beds will benefit from some kind of winter protection. Straw or evergreen boughs used as mulch can be applied in late November or December. Be sure to hold winter mulch in place with slats so it doesn't blow away. Remove mulch in the spring before the seedling buds begin to swell. Seedlings can also be protected from winter winds by placing snow fence, covered with burlap, on the windward side of the bed. If rodent populations are high and rodent feeding is expected, bait should be placed in pieces of drain tile or PVC pipe, underneath the mulch. The pipe will keep the bait dry and will provide a protected area in which rodents will feed.

After two years in a seedbed, pines may be lifted and planted in the field. It is often beneficial to wait until the third year with pines. Spruce and fir usually require three to four years before they can be transplanted to the field. Another option to transplanting directly to the field is to lift

seedlings after their second winter and line them out in a transplant bed in April, where they can be grown for an additional year or two, to develop larger and stronger root systems. By spacing seedlings out, competition is reduced, and they develop into hefty stock that is usually able to withstand field planting better than plants directly from seedbeds.

Many growers prefer to buy 2-0 seedlings to use in their transplant beds, rather than grow their own from seed. If transplants (not seedlings) must stay in the bed for longer than two years, they should be root pruned in the early spring to a depth of six inches by driving a sharp spade between plants with badly intermingled roots. Root pruning between rows of plants helps to keep the root-to-shoot ratio in balance and makes subsequent transplanting of older stock easier.

For those interested in additional information on starting their own seedlings, refer to the following:

Dickson, A., C. E. Heit and E. L. Stone. 1973. *Growing trees in small nurseries*. Cornell University Information Bulletin 68. $.75. Available from Distribution Center C, 7 Research Park, Cornell University, Ithaca, NY, 14850.

USDA Forest Service. 1974. *Seeds of woody plants in the United States*. Agric. Handbook No. 450. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

A Planting Plan

Before planting a single tree, every grower should have a planting plan by species, based on the establishment of a new stand of trees each year, so that when harvesting begins, continuous annual production will be assured with about the same number of trees available for harvest each year. For a variety of good reasons, including work efficiency, market development and tax considerations, it is almost always desirable to plan for a consistent annual production of marketable trees.

Factors to be considered include the total number of acres available to plant; the area involved in buildings, roadways and alleys; the average expected rotation age to grow five- to seven-foot tall trees; the land area deemed unusable for Christmas tree planting; the years required for clean-up and replanting following a harvest; and the number of years it takes to harvest a given crop (at least two years for pines, three years for spruces and five or more years for true firs).

The following formula can be useful in determining approximately how many acres should be planted each year.

$$\frac{T - W - B}{R + H + C} = \text{Area be planted annually (in acres)}$$

T = total land area (in acres);

W = unusable or waste area (in acres);

B = area consumed by buildings, roads, etc. (in acres);

R = average crop rotation age (in years);

H = harvesting period (in years); and

C = clean-up and fallow time (in years).

Example: Assume a total ownership of 53 acres, with a three-acre building site, five acres of roadways and alleys, and three acres of unplantable land. The crop is Douglas fir on a seven- to nine-year rotation, with a three-year harvesting period and one year of fallow. The formula becomes the following:

$$\frac{53 - 3 - 8}{8 + 3 + 1} = \frac{42}{12} = 3.5 \text{ acres}$$

This means that the grower will plant approximately 3.5 acres each year. At the end of seven years, some trees will be ready for market, but only the larger trees will be taken, with the smaller trees left for harvesting in years eight and nine. After the cycle is started, the grower will actually be taking some trees each year from each of three different blocks. This grower should strive to have twelve equal-sized blocks of 3.5 acres each.

For smaller operations, it may not be possible to follow a planting plan as outlined above. What generally happens in plantations of three to ten acres is that blocks of trees, because of differences in growth and customer preferences, are not cleared after each rotation, as is typical in larger operations. Rather than accept large losses by removing unsold trees to clear the block, the smaller operator may be forced to interplant the block by hand with transplant stock. The result is an uneven-aged plantation that makes management, pest and weed control and customer service more difficult. This may not be a problem for the small plantation operator who can likely devote more effort to the management of an individual block than could an operator of a large plantation. It is still important for the operator of a small plantation to sell only a predetermined number of trees each year, so that there are no years when very few trees have reached a marketable size.

Another component of a planting plan is to determine what spacing will be used in each block of trees. Table 6 lists the number of trees per

Table 6. Number of trees per acre for different spacings.

Spacing (feet)	Number of Seedlings	Spacing (feet)	Number of Seedlings
4 x 4	2722	5 x 8	1089
4 x 5	2178	6 x 6	1210
4 x 6	1815	6 x 7	1037
4 x 7	1556	6 x 8	908
4 x 8	1361	7 x 7	889
5 x 5	1742	7 x 8	778
5 x 6	1452	8 x 8	681
5 x 7	1245	8 x 9	605

acre at different planting spacings. Tree spacing in the block will depend on the availability and character of the land, the type of equipment employed, the species grown and the management used. Spacings of 6' x 6' or 5' x 6' have always been common, although some growers plant as close as 4' x 5'. Such close spacings mean more trees per acre but can promote needle casts or other diseases due to restricted air flow. If one is planning to sell by the choose-and-cut method, use larger mechanized equipment, or if acreage is plentiful, 6' x 6' spacing or larger is probably wise. It will allow customers to move freely among the trees and makes the use of larger equipment more feasible.

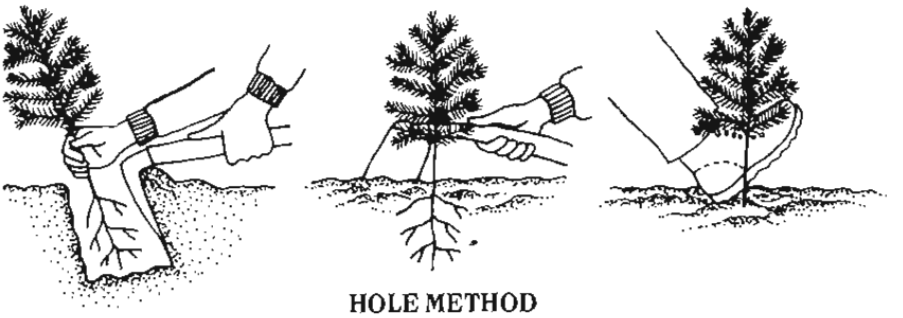
Planting

Once your spacing is decided, lay out your rows carefully so that they are straight, and the spacing is true. Efficiency in mowing, spraying and other practices will be affected if rows meander badly. Rope or cable can be made or purchased with markers at five- or six-foot intervals. Paired sighting poles or lime, if needed, can also be used to mark rows.

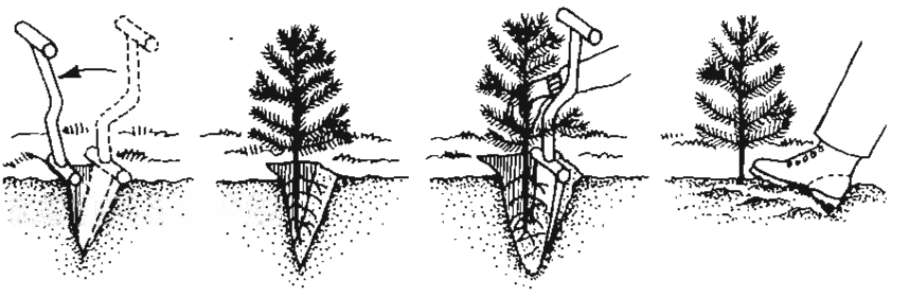
Christmas trees must be planted in the field at particular times of the year. Early spring is the preferred time throughout southern New England. Planting can begin as early as the frost is out of the ground–usually late March to early April. All spring planting should be concluded by early May. Spring planting should be avoided once new growth (candles or shoots) is expanding. Trees moved at this time almost always die. Heavy soils, wet areas and frost pockets should be planted last.

An alternative planting season is fall. If rainfall is adequate and severe cold does not occur, Christmas trees can be planted during October with fairly good success. Spruce transplant better in the fall than do Douglas fir, white pine and, perhaps, true firs.

If you have purchased planting stock, one of the most critical aspects of the entire planting operation is the care of the stock after shipment. Bareroot seedlings are packed tightly in bundles, and, despite the use of good shipping practices, the plants often have received some stress in the form of heating, drying or mechanical injury. They generally are not in a condition to withstand too many additional stresses. Careful handling of stock at this time is important, to insure survival.



HOLE METHOD



SLIT METHOD

If planting is to be done within one week after stock is received, the stock should be separated from the large bundle and the roots should be watered, then packed in a moist medium, such as peat moss, sphagnum moss, excelsior or sawdust. Plants should be stored in a cool (not freezing), moist place. Light is not required in the storage area.

If planting is to be delayed for more than a week, then stock should be healed-in. Plants can be healed-in by digging a sloping trench in a shady, outdoor location. A thin layer of trees should be placed against the side of the trench and the roots covered with moist soil. Monitor the soil and keep it moist but not wet.

Actual planting of the stock can be accomplished with hand tools or with the aid of power equipment. Seventy-eight percent of southern New England Christmas tree growers reported using only hand tools, 6% used only power equipment and 16% used a combination of power and hand tools. Of those using hand tools, 48% made use of round point shovels, 38% planting bars, 30% nursery spades and 18% mattocks. Those operators using power equipment most frequently used power-augers (hand-held and tractor-mounted). Tractor-drawn planters were also used by a number of growers.

Power equipment is used to its greatest advantage on large operations with high acreage and relatively flat, stone-free land. Power augers also work well for growers using large transplants, because the large holes they create allow good root spread and easily accommodate larger root systems. Many growers note that growth seems better on auger-planted trees, and mortality rates are lower. Hand planting tools, on the other hand, are very versatile and can be used on rough, uneven and stony soils and are far less expensive. For a good description of various hand planting tools and their use, see Cooperative Extension Bulletin 82-8, *Planting Forest Trees in Connecticut*, $0.75, available from Agricultural Publications, 1376 Storrs Road, The University of Connecticut, Storrs, CT, 06269-4035.

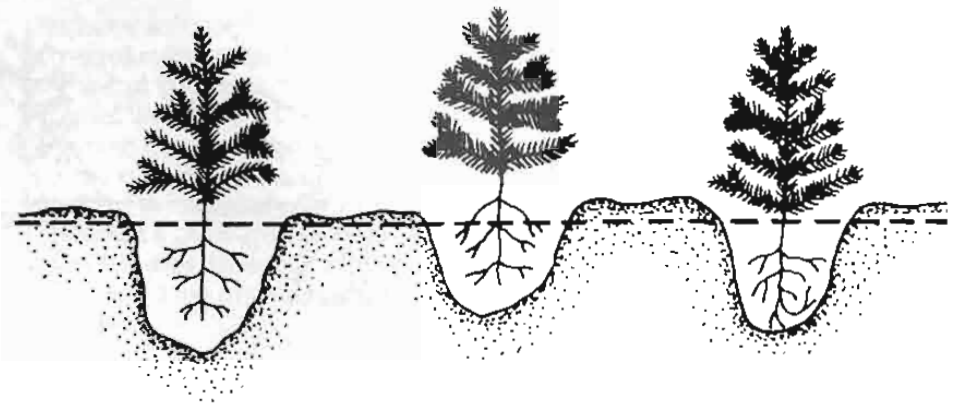
There are basically two methods of hand planting: 1) the hole method and 2) the slit method. With the hole method, one simply digs a hole with a shovel or a mattock, large enough to accommodate the root system. The root system is placed into the hole, and soil is backfilled only up to

the root collar. When backfilling, the root collar should be kept at the soil line. The soil should be firmly packed around the roots.

With the slit planting method, a planting bar, spade or mattock is driven into the soil. The tool is then rocked back and forth and twisted to open a V-shaped slit in the ground. The seedling's roots are placed into the slit and the soil is pushed back firmly around the roots with one's foot. Be careful not to J-hook the roots or bend them upward when planting.

In either the hole or slit method, **it is critical to have the root collar be at the soil line and to firm the soil around the roots.** If seedlings are planted too deep, their roots may not get sufficient oxygen; and if they are planted too shallow, some roots may dry out. Similarly, if air pockets remain around the roots due to poorly firmed soil, roots may dry out and die. When carrying plants around to be planted, always keep the roots in a bucket of water or covered with wet sphagnum moss, so they don't dry out.

If growing trees to be dug and sold as "living" Christmas trees, you may be interested in testing a relatively new innovation in field planting—the plantable container or field grow bag. The bag, made of a nonwoven fabric which is permeable to water and air, is placed in the ground, and the transplant is set into it. Soil from the planting hole is used to backfill the bag and "plant" the transplant. As the roots grow and push through the sides of the bag, they are pruned off as their diameter increases, by the unyielding fabric material. Pruned roots tend to branch more and produce a dense, fibrous root system within the bag. As much as 85% of the root system will be contained within the bag. Fertilizers and water only need to be applied within the confines of the bag.



PLANTING DEPTH

In may ways, field grow bags encompass the advantages of both field and container production. Planting in field grow bags requires considerably more effort than planting directly in the ground, so labor costs for planting will be high. The labor advantage happens during harvest. Since most roots are within the bags, and the filled bags themselves comprise the "ball and burlap," field grow bags can be dug easily and quickly by unskilled laborers and at virtually any time the soil is not frozen.

In stony soils, field grow bags can be difficult to get into the ground, but at least all stones are removed at the beginning of the growing process. As a result, plants in field grow bags do not have their root balls disturbed by stone removal during digging. Digging trees planted directly in stony soils is often complicated by large stones in positions that prevent proper ball formation.

A few other things to consider about field grow bags are the relatively high cost of the bags, the fact that trees in bags tend to require more regular irrigation than trees planted directly and that some time must be spent removing roots that have escaped pruning by the fabric. For most Christmas trees, a 16" field grow bag should be sufficient for a seven- or eight-year growing period.

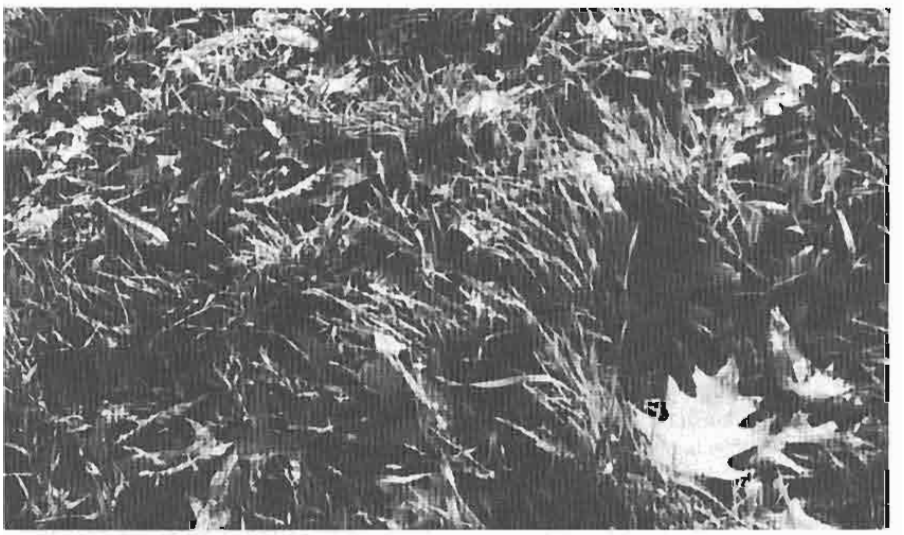
VI. Permanent Cover Crops

In the Christmas tree plantation, one possible management approach is to "clean-cultivate" the entire plantation. In this method, cultivation in coordination with herbicides is used to ensure that little vegetation grows between the planted rows. Although a clean-cultivated plantation looks nice, clean-cultivation is not really a sound management practice. In clean-cultivated plantations where the soil is bare, erosion can cause severe losses of topsoil, even on gentle slopes. Not only is the topsoil lost with erosion, but losses of nutrients, pesticides and herbicides can, and do, occur with surface runoff. The cost of lost nutrients, reduced pesticide and herbicide efficacy, damage done to roadways, silting of streams, rivers and ponds, and other associated environmental consequences preclude the use of clean-cultivation.

The use of permanent cover crops in Christmas tree operations is the preferred management method. Cover crops can prevent soil erosion and losses of pesticides, herbicides and nutrients to streams, ponds and ground water. They provide a firm surface on which to walk or drive equipment. This helps prevent soil compaction and promotes water penetration rather than runoff. Grass clippings from the mowing of cover crops return organic matter to the soil and help support beneficial soil microorganisms. As decay of organic matter proceeds, nutrients are slowly released into the soil.

When excesses of nitrogen fertilizers are available due to overapplication, a cover crop can help to minimize any nitrogen that runs off or leaches away. Research has shown that grass cover crops are highly efficient "sponges" of excess nitrate in the soil profile.

The Christmas tree grower should grow perennial cover crops between rows of trees and in all other areas

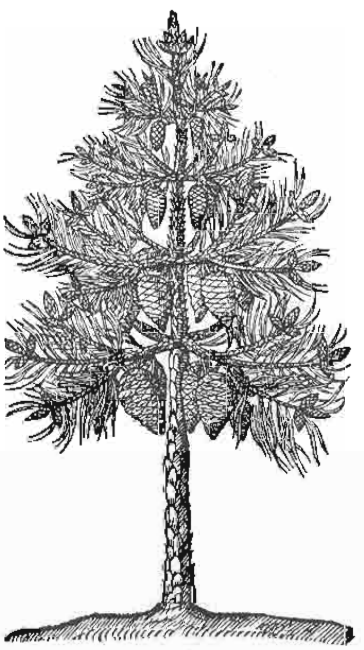


The use of permanent cover crops in Christmas tree operations is the preferred management method.

where it is desirable to control weed and brush growth. Roadways and alleys can be planted with cover crops if they receive only light use. Heavily-used roadways should have a gravel surface. Clean-cultivation can then be employed down each row or just around each individual tree.

Selecting Cover Crops for Christmas Tree Plantings

An ideal cover crop in Christmas tree plantations is one that establishes



rapidly, has dense growth, is low growing, has a low fertility requirement, tolerates a wide range of soil and climatic conditions and is relatively noncompetitive with Christmas trees. While some of the annual covers possess many of the desirable characteristics, their aggressive nature probably precludes their use in most situations. Permanent, perennial covers are likely to be superior to annual covers and will fit well into Christmas tree operations. The advantage of a perennial cover over an annual cover is that perennial crops usually possess deeper root systems, providing year-round protection from erosion and a wear-resistant sod for summer, spring and fall traffic. Perennial cover establishment costs are spread over a number of seasons, but there are yearly costs with annual covers.

In Pennsylvania, low-growing, low-maintenance permanent cover crops for nurseries have been evaluated and identified. Hard fescue, Chewings fescue, sheeps fescue, creeping red fescue, perennial ryegrass and Canada bluegrass have shown the greatest potential. Out of these, the fescues probably offer the most promise for southern New England Christmas tree growers. Perennial ryegrass

and Canada bluegrass may require higher inputs to be competitive with weeds. Other perennial grasses adapted to our climatic conditions could be used, but will probably require more management. Timothy, orchardgrass, bromegrass and Kentucky bluegrass need a relatively fertile soil. Redtop, although highly adapted to low fertility soils, may spread too rapidly resulting in competition problems.

Cover combinations are recommended over pure stands to minimize the risk of one insect or disease problem affecting the entire stand. The following combinations have been recommended by the Pennsylvania State University and the Agricultural Stabilization and Conservation Service in their permanent vegetation establishment guidelines:

hard fescue (95%)
and white clover (5%)

hard fescue (65%)
and red fescue (35%)

Chewings fescue (65%)
and red fescue (35%)

hard fescue (70%)
and Canada bluegrass (30%)

red fescue (70%)
and perennial ryegrass (30%)

Sources of Seeds for Cover Crops

Agway Farm and Garden Centers

The Chas. C. Hart Seed Co.
304 Main St., P.O. Box 9169
Wethersfield, CT 06109-0169.

Hoffman Seed, Inc.
Landisville, PA 17538.

Johnny's Selected Seeds
Foss Hill Rd., Albion, ME 04910.

Seedway Inc., RD2, Box 413A
Emmaus, PA 18049.

Stanford Seed Co., Oxford, MA.

Establishing Cover Crops in Christmas Tree Plantings

To establish a permanent Christmas tree cover crop, the following guidelines are recommended:

1. Eliminate perennial weeds prior to planting. The slow-growing covers do not compete well with perennial weeds during their establishment phase.

2. Have the soil tested and amended according to the needs of the crop. Since the cover is being planted for conservation purposes primarily, be sure to indicate this on the soil test information questionnaire. Be sure that any changes you make to the soil will not adversely affect the growth of the crop. Soils between rows of trees can often be treated differently than soils within rows of trees. Apply 40 lbs. of nitrogen per acre at the time the cover is seeded.

3. Loosen the soil by plowing and then disking, or by rototilling prior to seeding.

4. Seed the grasses at a rate of 40 to 60 lbs. per acre. Spread the seed with a cyclone or drop spreader. After seeding, drag, roll or cultipack the seeding to make sure the seed is firmly place in contact with the soil. A Brillion-type seeder drops the seed and presses it into the soil with one pass.

5. The best time to seed is late August to late September, because the grass has two cool seasons in which to get established before it must compete with warm-season annual weeds. The next best time is April to mid-May.

6. Limit weed competition the year of planting by mowing weeds before they start to bud or reach 8" to 10" in height. Broadleaf weeds can be controlled with directed sprays of 2,4-D. **(Do not use 2,4-D if clover is in the cover crop mix.)** The slower growing covers will not compete as well with weeds the first growing season if spring seeded.

With proper management, Christmas tree cover crops may reduce maintenance and production costs, while improving the soil conditions of the plantation. A small investment in a cover crop could pay big dividends in the form of reduced erosion, increased soil organic matter, weed suppression, reduced mowing costs, and reduced nutrient and herbicide losses.

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Hofstetter, B. 1988. *The New Farm's cover crop guide*. The New Farm 10:17-32.

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VII. Fertilization and Irrigation

There is little doubt that a well-designed program of fertilization and pH modification can improve the color, density, vigor, growth, needle retention and marketability of Christmas trees. Keep in mind that satisfactory growth is dependent not only on nutrition, but proper light, temperature, moisture, soil structure and pest management. In most instances, fertilizer applications will be necessary, to supplement naturally occurring soil mineral elements in order to maintain an optimum supply available for plant growth. Also be aware that improper fertilization can kill or injure trees and waste money. Although it would be convenient, growers should not expect to be able to follow a generic fertilization program that is applicable to all situations. Each Christmas tree plantation is different and should be treated as such.

Soil Testing

The first step toward developing a proper fertilization program is to have the soil tested. A soil test measures the soil acidity or alkalinity (pH) and the levels of nutrients that are available to the plant. The soil test provides the basis for recommendations which specify just how much lime or acidifying agent is needed, and the kind and amount of fertilizer required for best plant growth. A fertilizer recommendation depends on the nutrient supplying power of the soil, the plants being grown, the history of the land and the current management. By taking the guesswork out of estimating the soil's chemical status, soil testing minimizes the chances of adding too much or too little fertilizer, lime or acidifying agent. Sixty-five percent of southern New England growers reported using a soil testing service at least once every few years, but, unfortunately, 35% still reported never having taken advantage of the potential benefits of a soil test. Six percent of growers use a foliar analysis test in addition to a soil test.

Inexpensive soil testing services are available at most land-grant universities and at some state experiment stations. The manner in which a soil sample is obtained for testing is critical to the accuracy of the test. Use the following guidelines to help ensure an accurate soil test.

1. Late October or early November is usually the best time to sample, but samples may be taken at any time during the year when temperature (lack of frost) and moisture conditions permit.

2. It is best to wait at least one month after application of fertilizer, lime or acidifying agent, before taking soil samples.

3. Areas differing in topography, drainage, soil texture, fertilizer applications, soil organic matter content (light colored vs. dark colored) or intended crop use should be sampled and tested separately.

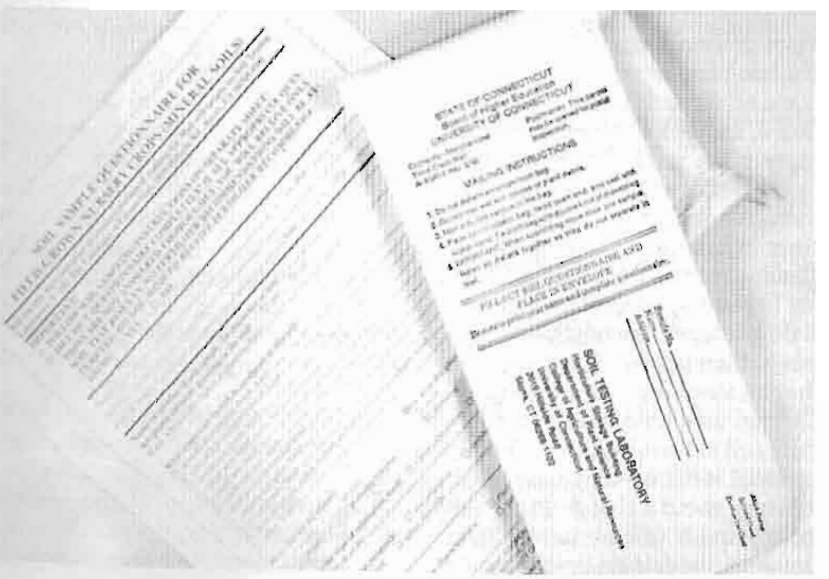
4. Under no conditions should samples represent areas larger than 15 acres. Usually, samples should represent considerably smaller areas. Where poor growth exists, take samples from both good and bad areas, if possible, and submit them separately.

5. Avoid sampling unusual spots, such as former sites of compost piles and areas where lime, acidifying agents or fertilizer has been spilled.

6. To obtain a representative sample, take a uniform core or thin slice of soil from at least 20 evenly-distributed places within a given area. Sample the top 6" to 8" from the plow layer. Put the slices or cores in a clean container and thoroughly mix them. Do not take soil only from the surface of the soil, as this will guarantee erroneous test results.

7. With the exception of excessively wet samples, soil may be sent immediately to the soil testing lab. Wet, muddy samples should be partially or completely dried at room temperature prior to being submitted.

8. Transfer one cup of the soil mixture in the container to a plastic bag and seal with a rubber band. Take the soil sample (or mail it) to the soil testing facility. Be sure to fill out any questionnaire completely and accurately. This is especially important at soil testing facilities that provide fertilization recommendations based on the soil test results.



If you need help understanding the soil test results or fertilizer recommendations, contact your local Cooperative Extension Center. Most soil tests will provide you with information on the texture of the soil, the soil pH and the levels of calcium, magnesium, phosphorus and potassium that are present. Some testing labs can also run tests for micronutrients, as well, but they may cost a little extra. Commonly, nitrogen levels are not tested on mineral soils because the results are somewhat unreliable and not very meaningful. It is safe to assume that most soils will need some annual nitrogen inputs to maintain optimum plant growth, since nitrogen usually gets used by the plant or leaches away during the course of a growing season.

pH Maintenance

The term pH is used to measure the chemical reaction of soil on a 0 to 14 scale. Values below 7 are considered acid and values above 7 are alkaline. Optimum plant growth occurs when the soil pH has been adjusted to the range specific for the crops in question. For most conifers, the optimum soil pH is between 5.5 and 6.5, with perhaps 5.7 to 6.0 being the best. Most conifers are found "in the wild" growing on soils between 4.5 and 6.0. If the pH is too low (acidic) or too high (alkaline), many nutrients either become too readily available or are "locked-up" by the soil and are unavailable to plants. As a consequence, nutrient toxicities and deficiencies can occur.

The majority of southern New England soils are slightly acidic. In most cases, if the soil pH is below 5.5, liming will pay dividends in improved growth, tree density and needle color. Growers should be warned that overliming (resulting in a pH of 7.0 or higher) can have devastating effects on Christmas trees. Conifers are intolerant of high pH soil and will produce little growth, have poor needle color and retention and may eventually die on overlimed soils. A grower is almost always better off growing Christmas trees on soils that are a little too acidic, than on soils that are a little too alkaline. It is always easier to add more lime than to correct an overliming situation.

Table 7. Dolomitic limestone requirements to raise the soil pH to 5.8.

Existing soil	Dolomitic lime, lbs. per 1000 sq. ft.[1]					
pH range	S	LS	SL	FSL	L	SL-CL
5.3-5.7	50	50	50	50	50	100
4.8-5.2	50	100	100	100	100	100
4.3-4.7	100	100	100	150	150	150
3.8-4.2	100	150	150	150	200	200
less than 3.8	150	150	200	200	200	200

S = sand, LS = loamy sand, SL = Sandy Loam, FSL = find sandy loam, L = loam, SL = silt loam, CL = clay loam

[1]If the lime recommendation is 150 lbs. per 1000 sq. ft. or more, it is suggested that half the lime be applied and the remainder a month or more later.

Table 8. Dolomitic limestone requirements to raise the soil pH to 6.3.

Existing soil	Dolomitic lime, lbs. per 1000 sq. ft.[1]					
pH range	S	LS	SL	FSL	L	SL-CL
5.8-6.2	50	50	50	50	50	100
5.3-5.7	50	100	100	100	100	100
4.8-5.2	100	100	100	150	150	150
4.3-4.7	100	150	150	150	200	200
less than 4.3	150	150	200	200	200	200

S = sand, LS = loamy sand, SL = Sandy Loam, FSL = find sandy loam, L = loam, SL = silt loam, CL = clay loam

[1]If the lime recommendation is 150 lbs. per 1000 sq. ft. or more, it is suggested that half the lime be applied and the remainder a month or more later.

If it has been determined that a soil is too acidic and the pH must be raised, decide what type of lime to apply. If the soil is deficient in both calcium (Ca) and magnesium (Mg), then dolomitic lime should be used, since in addition to having an alkaline reaction, it supplies Ca and Mg in roughly proportional amounts. If Ca levels are low relative to Mg levels, then use calcitic lime to raise the pH, since it primarily supplies Ca. Hydrated lime can also be used to raise soil pH and supply Ca, but this material is not as safe to use because it brings about a change in pH very rapidly and is difficult to handle. Dolomitic or calcitic lime is safe to handle, inexpensive and causes a slow and gradual pH change. For a majority of growers, dolomitic lime will be the most appropriate liming material to use. Nearly all southern New England growers report liming their fields, with the majority (73%) finding it necessary to lime only once every few years. See Tables 7 and 8 for approximate liming requirements for a range of pHs and soil types.

After liming with dolomitic lime, it may take several months before the soil pH rises. This is because dolomitic lime is relatively insoluble in water and penetrates the soil profile slowly to bring about a pH

change. Dolomitic lime must dissolve, and this takes some time. A common mistake made by growers is to apply dolomitic lime and then test the soil pH too soon after the lime application. Invariably, the soil test indicates that the soil is still too acidic and the grower applies a second dose of lime. In reality, the dolomitic lime from the first application had not completed its reaction, and the grower has now overapplied lime because he or she did not wait long enough for the lime to fully dissolve and react with the soil. It will generally take four to eight weeks for an application of dolomitic lime to bring about a significant change in soil pH.

Whenever possible, dolomitic lime should be incorporated and thoroughly mixed into the soil profile. This will help insure that a faster change in pH will occur in the top 6" to 8" of soil. If dolomitic lime is applied only to the soil surface, then only the immediate surface (1" to 3") will have the pH adjusted within a reasonable amount of time and it is possible that the soil surface pH may be raised too much. Dolomitic lime applications to the soil surface (when incorporation is not possible), should always be applied evenly over the entire root zone. Keep in mind that tree roots generally extend at least to the dripline and usually well beyond it.

Lime can be applied at any time of the year when the soil is not frozen. The best time to apply dolomitic lime is in the fall to affect growth the following year. Applied in the fall, dolomitic lime has several months to dissolve, penetrate the soil and bring about the desired pH change. Lime and acidifying agents can be applied individually around trees by hand or in bands over rows with a lawn spreader. The best time to adjust the soil pH is before a crop is planted. At this time, lime can be incorporated into the soil easily throughout the anticipated root zone area.

The wise grower will adjust the pH to somewhere in the higher end of the acceptable range, since with time the pH will drift downward on most New England soils. Some growers like to mark planting spots in the spring with a handful of lime. This practice, while convenient, must be used with caution or the pH within the immediate root zone of a young and tender transplant may rise well above optimum levels. One-half cup of dolomitic lime (about a handful) applied to a four square foot area around the planting hole, is enough to raise surface pH of a sandy loam from 4.5 to 6.5.

Although it is rare in the northeast, some soils may have alkaline pHs and may need to have the pH lowered into the acceptable range before a crop can be planted. In addition, accidental overliming may need to be corrected with acidifying agents. Two commonly used acidifying agents are sulfur and aluminum sulfate. Sulfur is usually preferred over aluminum sulfate, even though aluminum sulfate is faster reacting, because there is no risk of aluminum buildup in the soil. On a silt loam, around 10 lbs. per 1000 sq. ft. of sulfur, or 60 lbs. per 1000 sq. ft. of aluminum sulfate, should drop the soil pH about one unit. With both sulfur and limes, the finer the grind of the material, the faster the pH reaction.

Fertility Needs and Fertilizer Types

A number of nutrient elements in the soil are essential for tree growth. Table 9 lists those which are required in the greatest amounts, the general functions they serve in tree growth and some deficiency symptoms. In addition to these more major nutrients, smaller quantities of iron, manganese, boron, zinc, molybdenum, sodium and chlorine are needed. Needed only in small quantities, these elements are often called trace elements or microelements. In most soils, the trace elements will be adequately supplied by the soil minerals. On the other hand, major nutrients, especially nitrogen (N), phosphorus

Table 9. Important nutrients for tree growth, their functions and common deficiency symptoms.

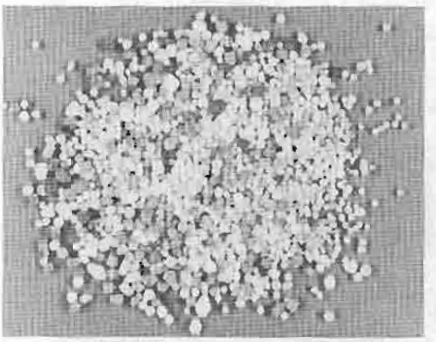
Element	Metabolic functions	Deficiency
Nitrogen (N)	Essential constituent of protein, enzymes and chlorophyll.	General chlorosis (yellowing) of needles. In severe cases, needles short, stiff and yellow green to yellow.
Phosphorus (P)	Essential to energy transfer system, root development of seedlings.	Retarded growth; coarse, poorly developed roots. In severe cases, purpling of older needles.
Potassium (K)	Important in protein formation, growth of new shoots and frost hardiness.	Needles short and chlorotic. In severe cases, needles purplish and dying back from tips.
Calcium (Ca)	Important in root and root hair development, tissue strength.	Rare. In severe cases, chlorosis of youngest foliage, tip or terminal dieback.
Magnesium (Mg)	Essential constituent of chlorophyll.	Yellow tipping of younger foliage.
Sulfur (S)	Important to protein formation and respiration.	Similar to nitrogen.

(P) and potassium (K), are often supplied in insufficient quantities by the soil to support optimum tree growth and quality. To supplement the naturally available nutrients, fertilizers can be applied.

Growers should understand that a lack of deficiency symptoms does not necessarily mean that trees are growing at an optimum rate. There is a range of soil nutrient levels at which tree growth may be reduced, while deficiency symptoms are not readily apparent. Trees growing under a condition of limited nutrient availability will respond to fertilizer applications. To be most effective, nutrients should always be applied based on a soil test, but most nutrients are applied as complete fertilizers containing N, P and K. Complete fertilizers with a ratio of 2-1-1 (N-P-K), 3-1-1, 3-1-2 or 4-1-2 are recommended for established trees in the field.

Research has shown that of all the nutrients, applications of N can have the greatest impact on improving the growth and quality of conifer trees, provided all other nutrients are not severely limited. The most significant component of the recommended complete fertilizers, nitrogen is needed in larger quantities than any other nutrient and produces rapid growth and dark green needle color. When N is suboptimal, trees will grow slowly and exhibit light green or yellowish-green needle color. Because nitrogen is a very mobile nutrient that easily leaches from the soil or is simply used up by the trees, it is likely that some will have to be supplied annually. As stated earlier, there is no satisfactory soil test for N, so recommendations for N applications must be based upon soil type, past cropping history and crop requirements.

Prior to planting, decaying organic matter resulting from plowing, cultivating or herbicide application will provide a fairly sizable nutrient "charge" to the soil for most of the first growing season. This is especially true since research has shown that trees do not benefit much from first year fertilization, at least in outward growth enhancement, unless the soil is especially nutrient poor.



During the first few years of growth, it is preferable to apply N to the trees at a rate of about 0.5 to 0.75 lbs. of actual N per 1000 sq. ft. of soil. This amount should be increased to about 1.0 to 1.25 lbs. of actual N per 1000 sq. ft. for the final few years before harvest. In the harvest year, an additional 0.5 to 0.75 lbs. of actual N can be applied, if needed, in early to mid-fall to produce or encourage additional "greening" of the foliage to enhance tree market value.

Phosphorus (P), another major nutrient of Christmas tree species, is especially needed by young, recently transplanted trees. By stimulating root growth and development, phosphorus helps young trees get established and increases seedling survival rates. Phosphorus (calcium phosphate), like dolomitic lime, is relatively insoluble in water, so it doesn't move into the soil profile easily or leach out of the soil easily. For this reason, the best time to apply P is preplant. Enough can be incorporated into the soil prior to planting to supply the trees with a source of P for several years.

Superphosphate (0-20-0) or triple superphosphate (0-46-0) is the preplant P source of choice. As a general guideline, 7.5-12.5 lbs. of superphosphate or 2.5-5.0 lbs. of triple superphosphate should be incorporated per 1000 sq. ft. of area. If a grower chooses not to provide a preplant charge of P, then a complete fertilizer high in P should be used for the first few years after planting. If possible, this fertilizer should be scratched into the surface of the soil without damaging tree roots.

Potassium (K) is the third major nutrient and, like N, it is relatively mobile and moves down through the soil profile. Because K is mobile, it can be applied to the soil surface with good success. Sandy soils tend to be leached of K more quickly than silty or clay soils, so they will need more frequent supplements. Growers have often noted that trees which go into the winter with adequate K supplies are better able to withstand the stresses of winter and grow better the next spring. Usually, sufficient K can be supplied to trees through the use of complete fertilizers.

In general, higher analysis fertilizers are a better value than lower analysis fertilizers. For example, a 20-20-20 fertilizer will usually cost less in terms of actual nutrients than a 10-10-10 fertilizer, even though the cost per bag is greater for the higher analysis material. Whenever possible, slow release formulations of fertilizers should be used, since they pose less of a threat to the environment than rapidly available formulations and they can be used more efficiently by the crop. Unfortunately, they cost more.

For most growers, dry granular chemical fertilizers will be the most convenient to use. They are easily applied either by hand or by a fertilizer spreader. Proper fertilizer placement is needed to avoid tree injury and to realize the full benefits of the fertilizer. A lump of fertilizer tossed against the tree stem will do little to feed rootlets and may in fact kill or injure the tree, since the salts contained in most fertilizers draw moisture from the plant. Hand-driven or tractor-drawn spreaders work well as long as the equipment

is properly calibrated prior to any application.

Granular fertilizers should be distributed evenly over the root zone either around individual trees or banded down either side of a row, roughly in the area of the drip line (the outermost reach of the foliage). Granular fertilizers should not be applied when the tree foliage is wet (either by precipitation, irrigation or dew), since they can cling to the foliage resulting in "foliar burn". Even if trees are dry, it may be beneficial to shake the trees after fertilizer application to work lodged fertilizer into the soil.

Soluble or liquid fertilizers will likely not be the primary fertilizer formulation used on Christmas trees, but they may be useful on seedling or transplant beds to deliver needed nutrients quickly. For all but the highest value areas, soluble fertilizers are too costly and difficult to handle for most Christmas tree growers.

Manures, if available, can sometimes be used in lieu of chemical fertilizer if certain precautions are taken. Because most manures contain high levels of ammonia which can burn young plants if applied on the surface in warm, wet weather, they should either be well-aged before application or applied in the fall. The humus they add to the soil is beneficial, but the nutritive benefit to the tree is much more slowly available than when chemical fertilizers are used. To use manures as a nutrient source, a grower must be able to handle the large volumes of organic material that must be applied for effective fertilization. Also, manures always contain large volumes of weed and grass seed which can produce detrimental results unless an effective weed control program is maintained. Table 10 lists manure nutrient values which should be used in conjunction with soil test recommendations.

Most fertilizers are best applied during the spring and early summer to allow trees to have the benefit of applied nutrients for the entire growing season. Fertilizers should not be applied too early in the spring because partially frozen soils, snow melt and heavy early spring rains will leach nutrients away, making the nutrients unavailable to the trees and possibly causing nutrient contamination of ground water and surface water. To further minimize the risk of nutrient losses, a grower may choose to split the recommended fertilizer for a growing season by applying half of the nutrients in late April and the other half in early June. Although costing more in labor inputs, use of a split fertilizer application program makes more efficient use of the nutrients that are applied.

Table 10. Nutrient values for manure

Material	Values[1] per ton or 1000 gal. of material applied: lbs. N	lbs. P_2O_5	lbs. K_2O	Basis
Cow manure	5	3	6	per ton
Poultry (cage layer) manure	16	20	12	per ton
Liquid cow manure	16	14	19	per 1000 gal
Liquid poultry manure	25	30	15	per 1000 gal

[1]Values for N should be reduced by 50% if the material is surface applied and not incorporated.
Values for N should be increased by 20% if the material is applied fresh within two months of planting and is incorporated within two days.
Values for N and K_2O should be reduced by 20% if the material is applied more than two months before planting.

Nitrogen fertilizers should be avoided between mid-July and early September, because nitrogen applied at this time may encourage the production of a soft, second flush of growth. This growth cannot "harden-off" sufficiently by winter and will be susceptible to frost and freezing injury.

Fall is the second best time to fertilize, but it should only be necessary when spring season fertilizations fall short of expectations or when trees are being greened-up for market. When fertilizing in the fall those trees that are not yet marketable, be sure the plants are dormant and use fertilizers higher in P and K, and relatively low in N.

Effective Christmas tree fertilization must go hand-in-hand with good weed control. Otherwise, the trees, especially young ones, may be overgrown by the rapid growth of fertilized weeds.

Whenever fertilizing your Christmas tree plantation, do not treat all the trees the same, because not all species have the same nutritional requirements. Douglas fir, the true firs and the spruces are all nutrient demanding, and the most likely to respond to periodic fertilization. White pine is somewhat less demanding. Scotch pine is an excellent nutrient forager and will grow on all but the most infertile of sites. The recommendation not to fertilize Scotch pine is almost universal in research literature. Although fertilization of Scotch pine will not hurt the trees, it will also not stimulate much additional growth for the cost of the applied fertilizer.

Even for species that benefit dramatically from fertilization, overfertilization should be avoided. Research has shown that response to fertilization drops off rapidly above a certain number of pounds per acre. Worse, excessive use of nitrogen in soluble forms, such as urea or ammonium nitrate, can burn roots and injure or kill trees. Once fertilizer has been applied it is nearly impossible to remove. It is always better to underfertilize and have to apply additional nutrients at a later date.

Each grower must decide if the cost of fertilizer and the time to apply the material makes economic sense for a particular operation. Nearly all southern New England growers fertilize their trees, with well over half the

Farm ponds can be a good source of irrigation water for Christmas tree operations.

growers fertilizing on an annual basis. Hand application of fertilizer is used by 86% of growers and 11% report using drop spreaders. On average, 384 trees could be fertilized per hour. The most commonly reported fertilizer formulation was granular 10-10-10, with about 40% of all growers who fertilize using this formulation.

The following is a possible system of liming and fertilizing seedling and transplant beds suggested by Dr. John F. Ahrens at the Connecticut Agricultural Experiment Station.

Transplant Beds

First year: Apply sufficient lime to bring pH to 6.0-6.5. Apply superphosphate if needed, both according to a soil test. Work both into the soil before planting. Delay fertilization for five to six weeks so that roots can establish, then apply 250 to 300 lbs. per acre of 10-6-4 or 10-5-5 fertilizer with 50% organic (slow release) nitrogen. This type of fertilizer is available in lawn fertilizer mixtures. Reapply this amount in early September. Use irrigation to supplement rainfall so the total equals at least one inch of water per week during the growing season.

Second year: Apply 500 to 600 lbs. of 10-6-4 fertilizer per acre one to two weeks before bud break. Repeat if needed in early June. Irrigate as above. Note: 250 lbs. per acre = 1 oz. per 12 sq. ft. A 35mm film canister holds about 1 to 1.4 oz. of this type of fertilizer; a cup holds 8 to 9 oz. Fertilizer can be diluted with sand or soil for easier distribution.

Irrigation

The use of irrigation will depend heavily on the management practices used by the grower and the potential benefits of irrigation against the costs. For larger, well-establish trees, irrigation will not be economically feasible for a majority of growers. The increase in growth resulting from irrigation will not compensate for the cost of getting water to the trees. Irrigation may be useful on established trees during extended periods of drought, primarily to prevent injury or death of the trees resulting from desiccation.

The most common need for irrigation will be in seed and transplant beds and on field planted trees that are not yet established. Although not always necessary in these situations, application of water can dramatically reduce losses of trees and generally increase growth rate. Watering of seed and transplant beds can serve to prevent desiccation, to cool foliage and soil during dangerously hot weather and to protect from frost injury.

Seed and transplant beds can be effectively watered with "lawn-type" sprinklers if the areas are not too large. Portable gas-powered pumps work well to move water from farm ponds to the areas needing irrigation. Keep rain gauges or small cans scattered around in the beds and water 0.75" to 1" every seven days or so throughout the growing season. The volume of water is based somewhat on soil type and weather conditions. A pooly-drained soil may need less water, and a well-drained soil may need more. Also, dry, windy days will quickly dry out foliage and soils. First-year seed beds should be irrigated more sparingly than two- or three-year seedling or transplant beds which are moistened to a depth of about 6".

The best time of the day to irrigate is early in the morning when winds and the evaporative rate are low, so the greatest application efficiency exists. Foliage made wet by irrigation will dry rapidly as the temperature and winds increase, reducing the risk of foliar diseases. Morning irrigation also insures that the soil is moist and cool during the warmest parts of the day.

To protect against late spring frost, water just before sunrise, typically the coldest time of the night, especially on clear nights. A light application of 0.25" is usually enough to hold off light frosts.

VIII. Weed Control

Weeds in Christmas trees can have a major effect on tree survival, growth and quality. Weeds compete with trees for their basic needs—light, nutrients and water. Competition for water, alone, can result in high tree mortality, especially during the planting year, and competition for light causes loss of lower branches and misshapen trees. Trees grown without weed competition usually have more buds, are denser and have better color than those grown in weeds. Competition reduces growth and quality, and extends the period from planting to harvest by three to five years or more, reducing profitability.

Weeds provide good habitat for rodents which can girdle stems or roots and severely damage or kill trees. Weeds also create fire hazards. One runaway fire in the life of a plantation is enough to destroy a crop of Christmas trees. Uncontrolled weeds and brush in plantations can also have a detrimental effect on the morale of the work force involved in operations such as shearing and harvesting, and increase the time and labor required to complete these tasks. Poison ivy in a plantation can result in lost time due to adverse health effects.

Despite the negative aspects of weed growth in plantations, there are at least two benefits of some weed cover. On sloping land subject to erosion, elimination of all soil cover can permit extensive erosion, and on heavy, imperfectly drained soils, complete elimination of soil cover can result in winter heaving and the loss of young trees. Therefore, vegetation control methods are best integrated with soil management practices. Methods of preventing soil erosion and heaving are discussed further in Chapter VI.

Over 94% of growers reported that they employed some kind of measures to control unwanted vegetation in their Christmas tree plantations. Of the growers controlling weeds and brush, 28% used mowing as the only control method, while 68% reported using a combination of mowing and herbicides. Growers reported that, on average, a one-acre plantation could be mowed in three hours.

To apply herbicides, the majority of growers (87%) use hand-held sprayers, but some (10%) use tractor-mounted sprayers. Strip or band herbicide application was used by 65% of growers, and 28% of growers sprayed only the area directly around individual trees. Only 8% of growers reported spraying the entire plantation. According to growers, one can expect to spend three days per year, per acre, on weed control in tree plantings.

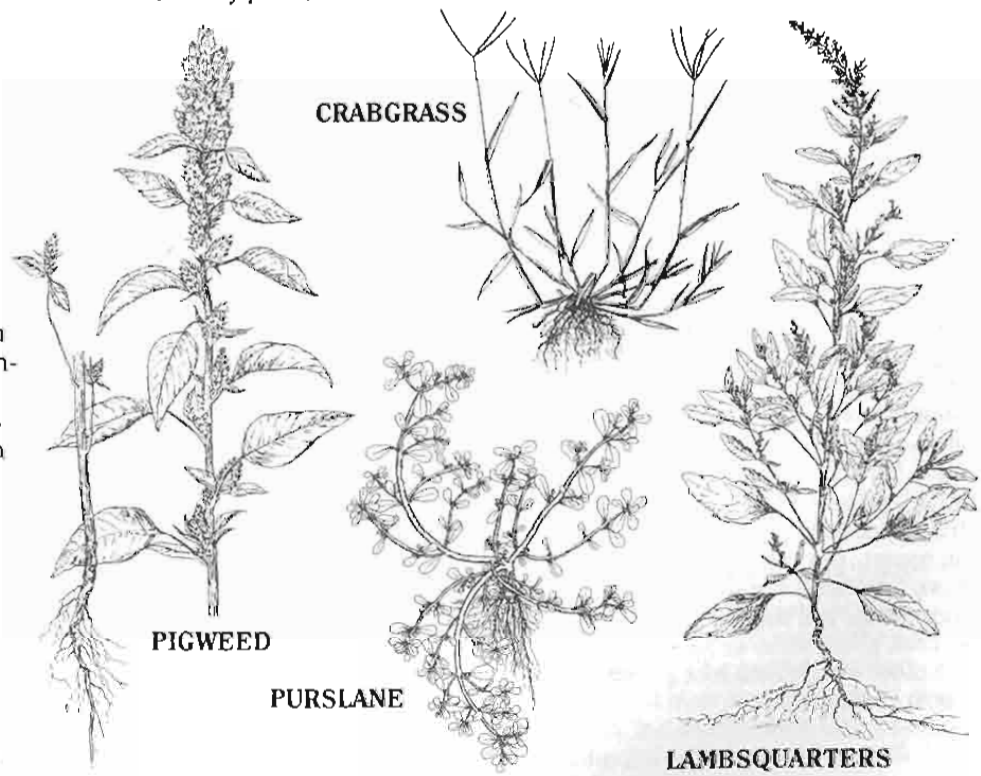
Types of Weeds Encountered in Christmas Tree Plantings

Weeds are defined as plants out of place. Therefore, any of the thousands of plant types growing on Christmas tree sites can be considered weeds. These weeds can be classified as annuals, biennials, perennials or woody plants.

Annual weeds require a single season to complete their life cycle from a germinating seed to a seed producing plant. Examples are crabgrass, pigweed, lambsquarters and purslane. Annual weeds that germinate in the fall and flower the following spring are called winter annuals. Weeds such as common chickweed, groundsel, shepherd's purse and annual bluegrass are winter annuals.

Biennial weeds require two full seasons to complete their life cycle. An example is wild carrot, which germinates and grows vegetatively the first year, overwinters, and then produces a seedhead and dies the second year. Both annual and biennial weeds reproduce only by seeds.

Perennial weeds live from year to year by storing reserves in their roots, tubers or underground stems. These weeds reproduce and spread, not only by seeds, but by perennial tubers, stolons, rhizomes or roots. Destroying the aboveground parts of annual weeds kills the entire plant, but destroying the vegetative portion



of perennial weeds, unless repeated, does not kill the plant. Perennial weeds in plantations include quackgrass, goldenrod, nutsedge, orchardgrass, bluegass, broomsedge, bird vetch, bindweed and many others.

Annual and perennial weeds may be subdivided into monocots (grasses and sedges) and dicots (broadleaves). Monocots have a single seed leaf and usually have long, narrow leaves with parallel veins, whereas dicots have two seed leaves and broader leaves with net veining. Sedges are distinguished from grasses in that their stems are always triangular in cross section, whereas stems of grasses are always flat or rounded in cross section.

Woody plants are perennial in nature with woody stems and roots that overwinter. These plants include trees, shrubs (low-growing woody plants) and vines which, can start from seed or from basal sprouts or root suckers following cutting. Woody plants that commonly invade plantations and become weeds are often collectively referred to as brush.

Cultural Methods of Controlling Weeds

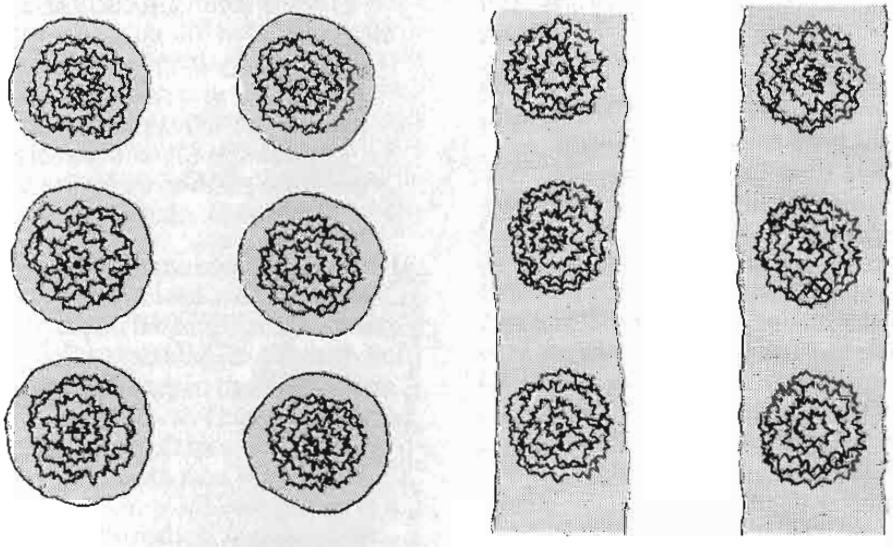
Cultural methods of controlling weeds in Christmas trees include mechanical tillage, mowing, hand weeding, hoeing or mulching. The method chosen can depend on the climate, soil, weed species and economic considerations. Often, combinations of methods provide the best means for managing a plantation.

TILLAGE—Plowing, disking or frequent shallow cultivation can control most annual weeds and some perennials and woody plants by destroying the food source of weeds and depleting their root reserves. These systems work best under dry soil conditions but often fail in humid climates or seasons. Plowing also buries weed seeds, forestalling many infestations. Tillage prior to planting in seedbeds, transplant beds or field sites provides an opportunity not only to control many perennial weeds but also to incorporate soil amendments, such as lime, phosphorus or sulfur, that do not move readily into root zones with surface application.

Band treatment of herbicides over rows reduces soil erosion and herbicide costs.

Periodic mechanical cultivation coupled with periodic weeding or hoeing was the primary method of controlling weeds in clean-tilled crops before the advent of herbicides. Though effective, especially under dry soil conditions, cultivation and hand methods of weed control have high labor costs. In New England, cultivation on a seven- to 14-day schedule and weeding or hoeing on a three- to four-week schedule are usually required to prevent weeds from overtopping small trees.

MOWING—Periodic mowing of the top growth of weeds can control many broadleaf annuals and many woody plants, but has little effect on most perennial grassy weeds, which have growing points at the base of the plant. Mowing can reduce weed competition with trees for light, but does little to reduce competition for moisture and nutrients. Furthermore, mowing alone in small trees is hazardous to the trees. Many small conifers are mowed down because the weeds hide the rows of trees. Three major benefits of mowing are reduction of fire hazard by keeping weed growth vegetative, reduction of habitat for rodent populations and reduction in brush populations.



Clean cultivation, around individual trees or in strips down each tree row, prevents weeds from competing with trees and still maintains vegetation in the interrow areas.

Mowing between rows is a common practice where herbicides are applied in bands down rows of trees. Mowing allows the maintenance of a stable ground cover between rows of trees, which helps to control soil erosion on sloping lands and also provides an aesthetic and practical soil cover in plantations where customers cut their own trees (choose-and-cut operations).

MULCHING—All plants require light for growth, and mulches kill weeds by shading the soil. Many different kinds of mulching materials can be used, such as black plastic, newspapers and many natural organic materials, such as wood chips, sawdust, bark, composted leaves, pine needles, straw, etc. Mulches also conserve soil moisture and reduce erosion and frost heaving. Because of their expense they are most practical in transplant beds or in young plantations where these benefits are most needed. Optimal weed control usually cannot be obtained with mulches alone, but, where practical, mulches can be used in combination with herbicides, often reducing the amounts of herbicide required.

WEEDING—Though impractical for plantations, hand weeding is still an important means of controlling weeds in seedbeds and transplant beds even where herbicides are used. Labor statistics obtained at the Connecticut State Forest Nursery in Voluntown showed that, prior to the use of herbicides in seedbeds, hand weeding required an average of 450 hours per acre per year. Studies at the Connecticut Agricultural Experiment Station have indicated that hand weeding in closely planted seedlings or transplants can vary between 275 and 800 hours per acre per year. Labor requirements for hand weeding vary greatly, depending upon whether perennial weeds have been controlled before planting, the presence of annual weeds on the site and weather conditions.

Weeding requirements usually are greater during the first year than during ensuing years in seedbeds or transplant beds. Hand weeding at weekly to monthly intervals may be required to prevent the growth-retarding effects of weeds and weed removal on seedling conifers. Weeds should be removed while in the seedling stage. Even where preemergence herbicides are used in seedling or transplant beds, it is essential to remove any weeds that exceed one to two inches in height or width.

Chemical Methods of Controlling Weeds (Herbicides)

Modern herbicides are organic, biodegradable chemicals that differ greatly in their effects on specific crop plants and weeds, persistence in soil and other characteristics. The only thing that all herbicides have in common is that, at prescribed rates and methods of application, they kill or prevent growth of weeds. The important specific information for each herbicide as to crops that may be treated, weeds that are controlled, rates and methods of application and other special precautions is given on the herbicide label. Since uses change, the grower can also get the proper information from current federal and state registrations for these herbicides and can also consult with local Cooperative Extension educators on rates applicable to their soil and climatic conditions. Table 11 lists the current registrations of herbicides that have proven useful for Christmas tree plantings in New England. Table 12 lists southern New England Christmas tree growers herbicide preferences, including the preferred season of application.

Growers have a responsibility to use herbicides in ways that do not harm the environment. Reducing the potential for off-target movement of herbicides in the air or on the soil surface, as well as prevention of soil erosion and herbicides leaching into groundwater, are important considerations that should be addressed in weed control programs. Many of the practices mentioned in this chapter provide examples of environmental stewardship.

FORMULATIONS OF HERBICIDES—Herbicides are formulated in ways that allow them to be sprayed or applied dry in the form of granules. The sprayable formulations include the active ingredient and various solvents and additives that either enhance the activity of the herbicide or allow it to be suspended in water or another carrier. Some herbicides make true solutions (clear mixtures that do not settle out), whereas others are formulated as emulsifiable concentrates, flowable suspensions, wettable powders or water dispersible granules. Solutions, emulsifiable concentrates and flowable suspensions are liquids and can be measured by volume, whereas water dispersible granules and wettable powders are dry materials and are measured by weight or in bulk volume measures calibrated to deliver weight equivalents.

Granular formulations consist of the active ingredient andinert materials, such as attapulgite clay, vermiculite or corn cobs. The percentage of active ingredient by weight is given on the label of dry materials. The weight of active ingredient per unit volume is printed on each container of liquid herbicides. Therefore, with both dry and liquid herbicides, it is common to speak in terms of pounds per acre of active ingredient (lb/A ai).

TYPES OF HERBICIDES AND HOW THEY CONTROL WEEDS—Herbicides for Christmas trees may be classified as soil fumigants, preemergence or postemergence, depending on whether they prevent weed growth before planting, before emergence or kill established weeds after they emerge. Some herbicides exhibit both preemergence and postemergence activity (Table 11).

1. Soil Fumigants

Soil fumigants are volatile chemicals that control weed seeds, all living plant parts, such as roots, rhizomes and tubers of perennial weeds, and soil-borne insects, disease organisms and nematodes. A waiting period is required between treatment and planting to allow the toxic vapors to dissipate. Fumigants also control beneficial soil organisms and, therefore, are used primarily when a serious weed problem exists on the site for which no alternate treatment is available.

2. Preemergence Herbicides

Preemergence herbicides are applied on the soil, where they prevent weed growth from seeds, dormant buds or underground plant parts, but usually have little effect on emerged actively growing weeds.

Rainfall, irrigation or shallow incorporation is necessary to activate preemergence herbicides. Poor results are often obtained if dry weather follows application or incorporation is omitted. These herbicides usually are low in water solubility and persist in the soil for one to several months, controlling weeds for long periods.

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Preemergence herbicides usually are safely applied without injury directly over conifers that are specified on the labels.

Conifers, such as Christmas trees, may grow without injury in soils treated with preemergence herbicides for two reasons. The first is that certain conifers are inherently tolerant of herbicide dosages that kill weeds. Secondly, conifer roots are located in a deeper zone than the herbicides and escape contact with them. The same mechanisms of resistance apply to certain weeds and especially to deep-rooted perennial weeds that may appear resistant to preemergence herbicides.

In leachable sandy soils or in soils low in organic matter, herbicides sometimes penetrate to root zones of conifers and cause injury. Clay and organic matter in soil tend to bind insoluble herbicides and prevent their leaching to root zones. Rates of application, therefore, are adjusted according to soil type, organic matter content and rainfall or irrigation patterns. The duration of effective weed control and the safety of a given conifer species and size are dependent upon the rate of application.

3. Postemergence Herbicides

Postemergence herbicides kill established weeds following absorption of the herbicide primarily through leaves and stems, but some herbicides are absorbed through the roots. The herbicide is a contact type if injury is local, with only treated plant portions affected. A systemic herbicide moves into the plant to kill deeper root systems.

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Systemic herbicides are used to kill deep-rooted perennial weeds or woody plants, whereas contact herbicides are effective primarily against annual and shallow-rooted perennial weeds. Contact herbicides usually kill weeds rapidly (within a few days) and are less affected by rainfall soon after application than are systemic herbicides. Weeds sprayed with systemic herbicides take several days, or even

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weeks, to finally die. In all cases, proper spray coverage and penetration of the weed foliage are essential for good results. Spray adjuvants or wetting agents often improve weed control with postemergence herbicides, but they may also increase injury to conifers where sprays contact the conifer foliage.

The selection of postemergence herbicides depends upon conifer type. Some herbicides must be applied before planting or directed to avoid spraying the conifer foliage. Certain conifers may be tolerant of other sprays at specified times and stages of growth.

Since postemergence herbicides have little or no residual effect on germinating weeds, they are often combined or followed with preemergence herbicides to provide longer residual control.

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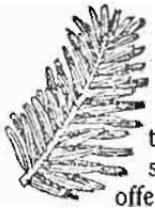
IX. Insect Control



Christmas trees, like shade trees and ornamentals, are highly valued for their aesthetic qualities. Each species or variety of tree offers its own unique characteristics of size, shape, color, texture and fragrance. Insects and mites can seriously affect these desired characteristics. Primarily, it is the feeding habits that cause yellowing and browning, stunting, die-back, swelling and even death of the host plant.

The ideal method for pest control lies in pest prevention. The grower must have a good understanding of the pests associated with each particular species, as well as knowledge of their life cycles and times of emergence. Growers must monitor their plantings on a regular basis and record the current infestation status of all pests. If pest populations are discovered early enough, they can often be controlled by cultural practices such as pruning or perhaps by localized chemical sprays. Spraying should be kept to a minimum to avoid the development of pesticide resistance in the pest population and to protect those insects that are beneficial. Any insect pests that cannot be identified by the grower should be taken to the local Cooperative Extension office for positive identification.

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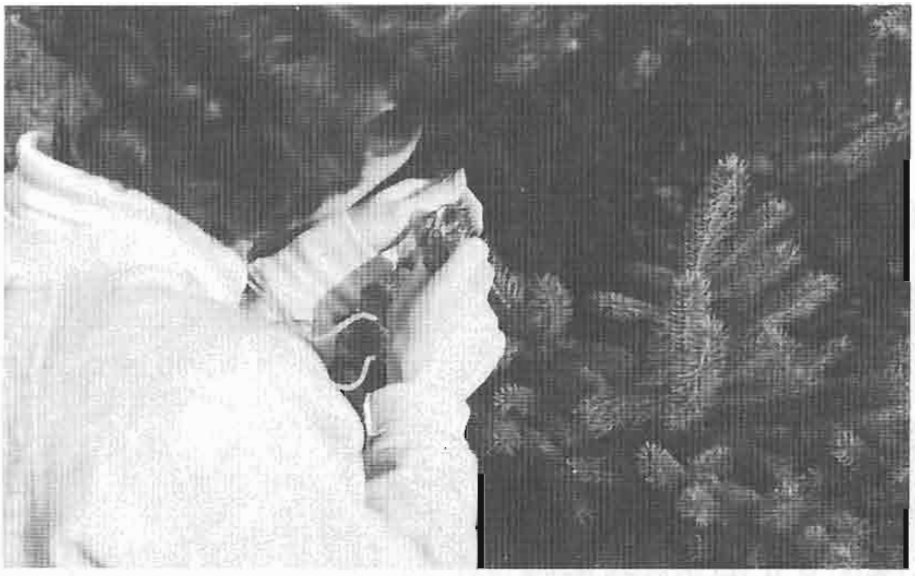
Pesticide labels are always changing; therefore, *it is the ultimate responsibility of the pesticide user to safely and legally use agrichemicals*. This guide is in no manner intended to replace the label. By federal law, it is unlawful to use a pesticide in any manner that is inconsistent with its label. Always carefully read, understand and follow pesticide labels prior to using a pesticide. Stay current with the changes in pesticide laws in your state and, if any questions arise, contact your state pesticide coordinator for current and accurate information.

Growers should become aware of the most common pests, what they look like, when to expect them and how many the trees can tolerate before chemical controls are necessary. This helps to keep pesticide use to a minimum, saves money, protects the environment, protects the beneficial insects and reduces the chances of development of pesticide resistance in the pest populations.

Proper timing of pesticide applications and proper coverage with sprays are extremely important factors in successful use of pesticides. The right chemical, at the wrong time, or improperly applied, is an exercise in futility.

Dormant oil sprays are very effective against pests that overwinter in an exposed form, such as eggs on the bark. As implied in the name, these special mineral oils are applied when



Regular inspection of plantations is important in controlling insect and disease damage.

the host plant is dormant, primarily in late March into April. Late use of dormant oils should be carefully considered, because phytotoxic damage may occur on the host plant. Even though dormant oils are very safe to humans, wildlife and the environment, they are still considered to be pesticides, so *carefully read and follow the directions on the label.* Also, dormant oils and other horticultural oils used at any time of the year will cause the needles of blue spruce to darken and lose their blue color. The original color will return in new growth flushes. Oils can be used against a wide variety of pests with excellent results.

BAGWORM

Thyridopteryx ephemeraeformis

Hosts: Firs, spruces, pines, Douglas fir and many other deciduous and evergreen species not used as Christmas trees.

Description and Injury: Bagworms get their name from a carrot-shaped bag they construct from chewed-up foliage (needles). As the bagworm grows, it enlarges the bag. Adult female bagworms are grub-like and look more like larvae than adults.

Adult males are small, dark-colored moths that have hairy bodies and clear wings. Bagworm larvae are amber-colored, and have shiny black heads. At maturity, bagworms and bags can be approximately 2" long, but, in southern New England, most bags are considerably smaller.

Bagworm larvae cause injury to Christmas trees by feeding on needles. In very heavy infestations, evergreens can be defoliated and either stunted or killed. Some twigs may be girdled by the silken bag attachments. In southern New England, bagworm infestations are usually light, so feeding injury is often minimal, but bags hanging in the tree are unsightly and decrease the marketability of trees.

Life Cycle: Bagworms survive the winter as eggs inside the bag, attached to a twig. The eggs hatch in June, and young larvae soon begin feeding and constructing their bags. Larvae are full-grown by late August, and permanently attach their bags to twigs by spinning a silken band over the twig. In September or October, adult male moths emerge from their bags and fly to other bags containing females. Females do not leave their bags and are fertilized there. Eggs are then laid in the bag to overwinter.

Control: Hand-picking and destroying bags between October and May will eliminate eggs. Several parasitic insects are found in most bagworm populations but, generally, provide insufficient control.

Insecticidal sprays are usually needed for good control and are most effective during mid- to late June, when larvae are still small. Older larvae (after about mid-July) are much more difficult to control with sprays.

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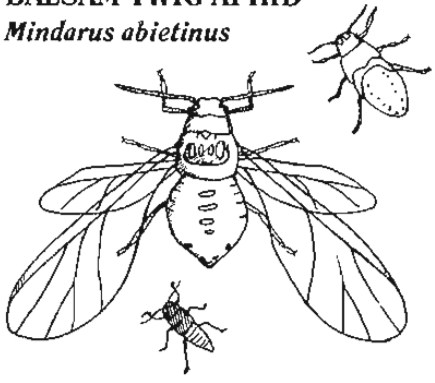
Complete coverage of all foliage and twigs is necessary for good control.

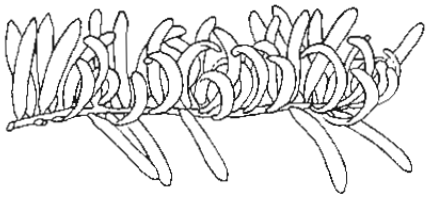
BALSAM TWIG APHID

Mindarus abietinus



Hosts: Firs and spruces. Balsam and Fraser fir are affected to a greater extent than are the spruces.

Description and Injury: These aphids are soft-bodied, pale-green sucking insects. Older individuals are covered with a waxy material that is either white or bluish-gray. Bluish-gray aphid mothers can often be seen in spring surrounded by smaller greenish offspring.



Twisted and stunted growth on balsam fir (Abies balsamea) *that results from feeding by the balsam twig aphid.*

Damage by the feeding aphids results in needles and shoots that are curled, twisted and distorted. Some needles may die as a result of aphid feeding and may fall off. The bark on shoots where aphids have fed develops a rough surface. Balsam twig aphids can produce copious amounts of honeydew, that shows up on the foliage as a sticky, shiny "shellac". Black sooty mold may grow on the nutrient-rich honeydew.

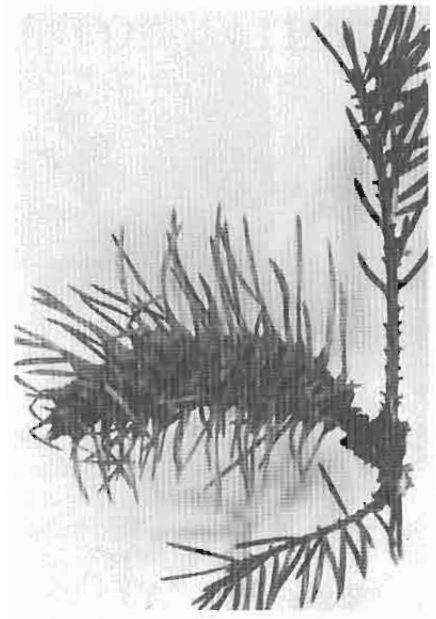
Life Cycle: Eggs of the balsam twig aphid are covered with tiny rods of white wax, which are the overwintering structures. Eggs on the tree bark hatch in early spring, and the new aphids immediately begin to feed on newly emerging, tender shoots and needles. Live young are produced by adult aphids throughout the summer. In early summer, some aphids lay eggs on the bark; it is these eggs that will overwinter and start a new population of aphids the following season.

Control: To prevent the damage caused by this pest, insecticidal sprays should be applied to the foliage and twigs in late April or early may. Follow-up sprays may be necessary to achieve complete control. Because the eggs are so conspicuous on the bark, early season scouting for eggs can provide a grower with a good estimate of how severe the upcoming season's balsam twig aphid population is likely to be.

COOLEY SPRUCE GALL ADELGID

Adelges cooleyi

Hosts: Colorado spruce, Engelmann spruce, Sitka spruce, Norway spruce, Oriental spruce and Douglas fir.



Galls of the Cooley's spruce gall adelgid are larger than galls formed by the eastern spruce gall adelgid and are found primarily on Colorado (blue) spruce, Picea pungens (glauca).

Description and Injury: The primary damage occurs on spruces, in the form of elongated galls that develop on new shoots. Galls are 2 to 2-1/2 inches long, many-chambered and light green to purple. In late summer the galls turn brown, dry out and the chambers open. Twigs that form galls usually die. Galls remain on the tree, reducing the tree quality. Repeated infestations can eventually disfigure trees.

Cooley spruce galls can be confused with Eastern spruce galls, but are distinguishable upon close inspection. Cooley spruce galls are much longer than Eastern spruce galls, and the needles on a Cooley spruce gall are long, while the needles on an Eastern spruce gall are short and scale-like. In addition, Cooley spruce galls are most often found on Colorado spruce, while Eastern spruce galls are most common on white spruce.

Cooley spruce gall feeding damage on the alternate host, Douglas fir, does not result in gall formation. Instead, yellow-spotted and bent needles develop, and the tree can be speckled with tiny cotton-like balls.

Life Cycle: The Cooley spruce gall adelgid requires two years and two hosts (a spruce and Douglas fir) to complete a full life cycle. Immature female nymphs overwinter at the base of terminal buds. In the spring, the nymphs mature, and hundreds of eggs are laid in cottony white masses at the bases of emerging new shoots. Eggs hatch quickly, and young nymphs begin feeding on the succulent needle bases of new emerging shoots when they are only 2 to 2-1/2 inches long. Feeding results in swelling of the tissue and gall formation. The adelgids live inside the galls until mid-summer (usually mid-July) when the galls dry out and the chambers open. Winged adults emerge and migrate to other spruce trees or to Douglas fir.

Adelgids that migrate to Douglas fir lay eggs, and a population of wooly adelgids develops. Some woolly adelgids develop wings and fly back to spruce trees, where they lay eggs that produce an overwintering spruce population. The wingless adelgids that remain on Douglas fir lay eggs that form the overwintering population on Douglas fir. If the Cooley spruce gall adelgid does not move to the alternate host, Douglas fir, it has a life cycle similar to the Eastern spruce gall adelgid.

Control: It is important to realize that once the protective Cooley gall has begun to form, control is difficult using insecticides. Hand removal of galls is effective during the "green" stage, but impractical. Chemical control of the overwintering stages should be emphasized.

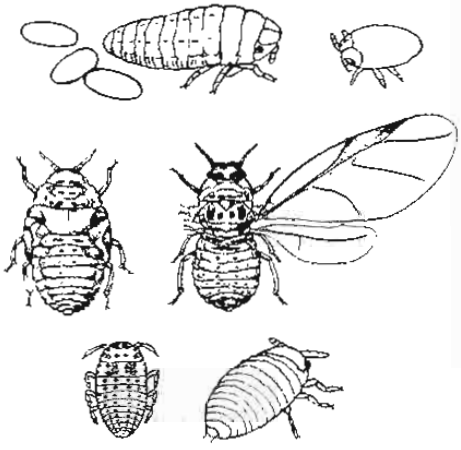
On spruce, foliar insecticide sprays should be applied from late September through mid-October. Alternatively, sprays can be applied in the spring, between mid-April and early May, at the time when buds just begin to break and before the new growth is longer than 3/4". Insecticides may also be effective, if applied when the galls dry, open and release the adelgids (mid-July to early August). On Douglas fir, sprays should be applied at bud-break and/or in October.

Horticultural oils should only be applied to hardened-off foliage and

not to expanding, succulent foliage. Insecticides should only be applied if daytime temperatures are well above freezing. Fertilizers should not be applied to infested trees, since it stimulates heavier feeding and rapid population growth of the adelgids. Only after the insects are controlled should fertilizers be applied to promote growth.

EASTERN SPRUCE GALL ADELGID

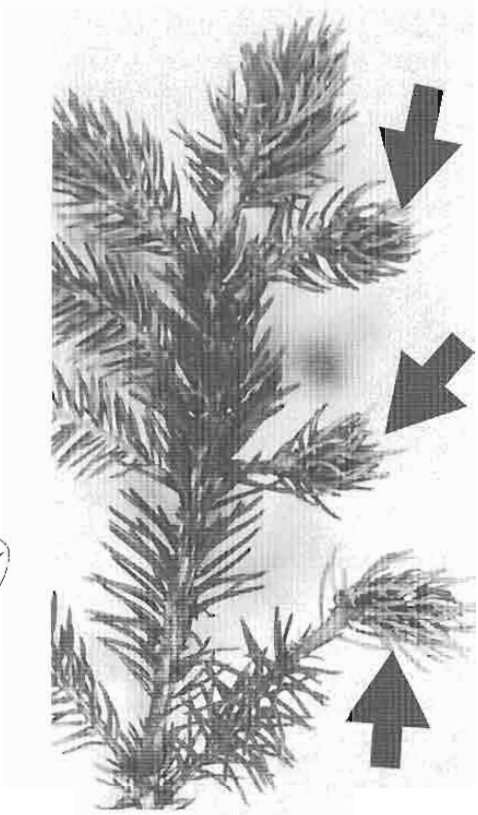
Adelges abietis



Hosts: White, Norway, black and red spruce, primarily; occasionally, Colorado spruce.

Description and Injury: Galls resulting from Eastern spruce gall adelgid feeding resemble small pineapples or pine cones. These swollen parts of the stems are usually 1/2- to 1-inch long. Galls form at the base of new terminal growth, and normal-looking growth continues beyond the galls. Galls change from green to brown during the growing season. Plants often show galls from both current season and seasons past. Galls are unsightly, cause stunting and disfigurement of the tree, and reduce tree quality, but seldom kill the tree.

Life Cycle: Immature female adelgids overwinter at the base of buds. These females become active as buds begin to swell in the spring, and each lays up to 200 eggs at the base of a bud. Young nymphs hatch in less than two weeks and immediately begin feeding on the needles of emerging shoots. Multicelled galls form, with each cell providing shelter for a growing nymph. Sometime during September, the galls dry and



Damage on white spruce (Picea glauca) *caused by the eastern spruce gall adelgid. Arrows indicate where galls have formed.*

open, releasing adelgids that lay eggs on the needle tips. Overwintering adults hatch from these eggs, and settle at the bases of buds.

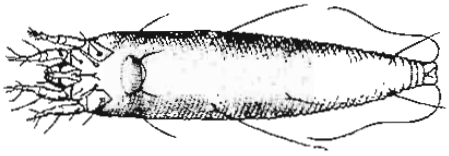
Control: The insects cannot be effectively controlled with chemicals when inside the protective galls. Hand removal of galls is effective during the "green" stage, but on a limited scale.

Chemical sprays should be directed at the foliage, and can be applied in the spring, prior to bud break, or in the fall, between late September and mid-October. Daytime temperatures should be well above freezing when insecticides are applied. The application of fertilizer without controlling Eastern spruce gall adelgid will stimulate more intense insect feeding and enhance insect population growth.

See Cooley spruce gall adelgid information for appropriate chemical controls.

ERIOPHYID MITES

(various species)



Host: Scotch pine is the primary Christmas tree species affected.

Description and Injury: Eriophyid mites are very small and cannot be seen with the naked eye. They are carrot-shaped and are usually light-colored.

Scotch pines injured by eriophyid mites develop rosettes of buds where needles should have developed. Heavy mite infestations lead to stunted, misshapen and unsightly trees. Trees rarely die from this pest. Other symptoms may include chlorotic needles, dwarfed needles and partial defoliation.

Life Cycle: Because there are so many eriophyid mite species, and because they are so tiny, the life cycles are poorly understood. Apparently, they overwinter in all stages, from egg to adult. Mites migrate to shoot tips in the spring to begin feeding. Several generations per season can be expected.

Control: These mites can be controlled any time they are noticed on the tree. Unfortunately, since they are so small, they are rarely noticed until the damage is evident. Sprays in mid- to late May are usually effective at controlling early populations. A follow-up spray two weeks later will clean up any newly-hatched mites, since most sprays do not affect mite eggs.

See Cooley spruce gall adelgid for specifics on using horticultural oils.

EUROPEAN PINE SHOOT MOTH

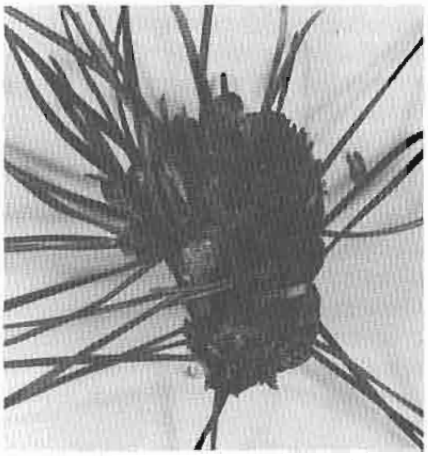
Rhyacionia buoliana

Hosts: Scotch pine is the primary Christmas tree species affected.

Description and Injury: Full-grown larvae (caterpillars) are 5/8" long, and

are brown with black heads. Adults are small moths.

Damage is caused by larvae that bore into the new shoots, making them hollow and weak. The weakened shoots either die, or they bend over and the tips then turn back upward. These shoots are severely deformed and crooked. Dying and injured new shoots stimulate additional basal shoots to develop, resulting in bushy tips. Needles that were fed upon by young larvae usually turn brown and die. Resin-coated webbing can sometimes be found covering clusters of damaged shoots.



Attacks by the European pine shoot moth deform or kill new candles on Scots pine, and often stimulate numerous short basal shoots to develop. Resin-coated webbing is often visible covering affected shoot tips.

Life Cycle: Only one generation occurs per year. Overwintering is accomplished by nearly full-grown larvae that have tunneled into shoots and buds. In mid-April, these larvae resume their feeding on previously undamaged shoots and buds. Pupation occurs in early June, inside the feeding tunnels. Adults emerge from the tunnels between mid-June and Mid-July. The female moths lay eggs on trees; eggs hatch in less than two weeks, and young larvae bore into the bases of needles. As they grow, they tunnel into the shoots; by fall, they are again ready to overwinter.

Control: Foliage can be sprayed in mid-April, to control overwintering larvae that have returned to feeding. Sprays in late June and early July can be effective against young larvae hatching from eggs.

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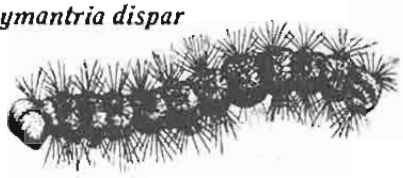
GYPSY MOTH

Lymantria dispar



Hosts: All Christmas tree species.

Description and Injury: Full-grown larvae are dark brown, hairy, two-inch-long caterpillars. There are five pairs of blue spots along the back of a larva, followed by six pairs of red spots. Adults are moths. Male moths are brown and fly well; females are buff-colored and are too heavy to fly but can flutter along the ground. Egg masses are easy to identify: oval, fawn-colored, fuzzy masses, attached to any hard surface.

Adults do no harm to trees, but larvae can cause devastating, extensive damage when populations are large. Larvae consume foliage, causing defoliation. Deciduous trees, such as oak, which are also hosts for gypsy moth larvae, can withstand defoliation fairly well and refoliate after feeding stops. Conifers can also refoliate when feeding stops, but their capacity to do this is less than that of deciduous trees. Repeated attacks by gypsy moths can weaken Christmas trees to the point of death.

Life Cycle: The gypsy moth overwinters as egg masses. Larvae hatch in spring and move up trees to begin feeding. In May and early June, small larvae migrate from tree to tree by hanging from threads and drifting in the wind until they reach new trees. Larvae can easily spread this way from surrounding forest into a Christmas tree plantation.

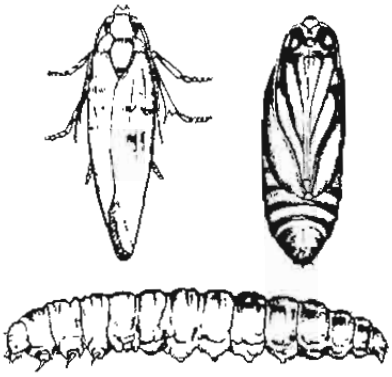
Larvae grow to full size, then pupate along tree trunks and at branch crotches. Moths emerge, mate and lay eggs before fall. One generation is produced per year. Damaging populations seem to occur every five to seven years, and last two or three years.

Control: Sprays should be directed at the foliage of the Christmas trees and surrounding forest vegetation. The best control is obtained when sprays are directed at young larvae that are 1" or less in length. Spray between early May and early June.

Cool, wet springs will often induce disease in young gypsy moths, dramatically reducing gypsy moth populations. Removal of egg masses in the fall may reduce populations slightly but is probably not worth the effort.

NANTUCKET PINE TIP MOTH

Rhyacionia frustrana



Host: Scotch pine is the only Christmas tree species.

Description and Injury: Mature larvae are about 3/8" long, orange-brown and have dark brown heads. Adults are small, gray moths that have some reddish color on the wings.

The damage caused by this insect is very similar to the European pine shoot moth. Damage occurs on the new growth. Webbing is often found around clusters of shoots. Heavily infested trees can be severely stunted.

Life cycle: Pupae overwinter inside tunneled shoots and emerge in early spring as adults. Eggs are deposited on shoots and young larvae begin feeding on the surfaces and bases of needles upon hatching. Eventually, older larvae move to new shoot tips and bore into the buds and shoots,

thereby causing severe damage to new growth. After three to four weeks of feeding, larvae pupate and a second generation begins for the second half of the growing season.

Control: Trees weakened by drought or infertility seem to be most susceptible, so adequate moisture and fertilizer should be maintained. Foliar sprays in May will kill larvae before they enter the stem tissue. Sprays in late July to early August will control the second generation. Good spray coverage of shoot tips is essential for control.

OLD INFORMATION DELETED

NORTHERN PINE WEEVIL

Pissodes nemorensis

Hosts: Can attack most pine species.

Description and Injury: The adult is a 1/4" to 3/8" long beetle with a snout. Weevils are brown with white and reddish irregular spots on the body. Two prominent white spots occur on the rear of the beetle. The larvae are white and legless and have brown heads. Larvae can be as long as 1/2".

Damage is caused primarily by the feeding of adult weevils on twigs and small branches. Small puncture holes (feeding holes) can be seen in stem bark, through which weevils gain access to the inner bark on which they feed. These holes or pits are usually readily visible on branches and indicate areas where the inner bark is likely to be seriously damaged. Damaged inner bark leads to discoloration, browning and flagging of foliage. Affected branches soon die.

Life cycle: Weevils overwinter as adults in debris on the soil surface. They emerge late April, early May and feed on twigs and branches. Egg laying begins in late May and early June and can continue through the growing season. Eggs are deposited on stumps, on logs or on dead and dying trees, usually beneath the bark. Larvae excavate elliptical areas in the wood and make cocoons of excelsior-like wood fiber. Adults emerge in mid- to late summer and feed until fall, when the temperatures get too cold.

Control: Healthy trees are rarely attacked, but trees under stress, such as transplants, may need pesticide applications to prevent injury. Applications in late April through early May will control this insect. An alternative time to spray would be from August to September.

Removal of stumps and dead wood will limit sites for egg laying and larvae to develop. Accurate and efficient pesticide applications can be made when adults are known to be present, through monitoring. Adults are nocturnal, so scouting may need to be done after dark.

PALES WEEVIL

Hylobius pales

Hosts: All pines, especially white pine. May also attack other conifers, to a lesser degree.

Description and Injury: Adults are weevils that are 1/4" to 3/8" long. They are usually black or reddish-brown and have small, scattered patches of yellow on their wing covers.

Injury is caused by weevil feeding on the bark of stems. Feeding results in puncture holes, or pits, in the bark. When feeding is heavy, feeding pits can run together, effectively girdling entire shoots. Feeding is usually confined to small branches and stems, often only on the lower half of each tree. On larger trees, branches may "flag" and eventually turn brown and die; when a younger tree is girdled, however, the entire tree often dies or is seriously stunted.

Life Cycle: Pales weevils spend the winter as adults in leaf litter beneath trees or as larvae in the roots. Adults become active from April to June and will feed on the tender bark of young trees and seedlings for a short period before moving to tree stumps or weakened trees. The Pales weevil is nocturnal, feeding at night and returning each day to the protection of litter on the ground. Most feeding damage will occur prior to July 1.

Mating and reproduction usually occurs around July 1. Females burrow their way to the roots of stumps, dead trees or weakened trees, where they lay eggs beneath the bark of roots. Larvae feed on the roots for the rest of the summer, with pupation occurring in late summer. Just beneath the bark, pupation occurs in chambers which contain excelsior-like fibers. The majority of adults emerge in late September and October, feed for awhile on twig bark or needles, then hibernate.

Control: Night-time scouting will help determine the exact time of adult emergence in the spring. Also look for feeding holes on twigs. Chemical applications sometime between mid-April and mid-May are usually effective, but warm weather can activate adults even earlier than —

An alternative time to apply pesticides is late September through October.

Since weevils use stumps and roots of weakened trees for reproduction, removal of these prior to July 1 will reduce the number of sites available for egg laying.

Control measures should be targeted at young trees. It is important to treat the roots of seedlings and liners that are being planted, if Pales weevil is a common problem

PINE BARK ADELGID

Pineus strobi

Host: Found primarily on white pine but will also attack Scotch pine.

Description and Injury: Adult adelgids are small, dark insects, covered with white, flocculent wax. Eggs are milky to amber-colored, and darken as they mature. Nymphs look much like a yellowish aphid when young, but as they mature, they darken and secrete their waxy covering. The trunks of heavily infested trees may appear to be nearly white from merging masses of adelgids. Cottony masses can also be seen around needle bases.

Adelgids feed by sucking sap from the tree. Injury shows as yellow needles that eventually die and fall off. Small trees are often severely stunted and may die when adelgid populations are large. Larger trees will exhibit low vitality and poor needle color, and will produce little new growth.

Life Cycle: Pine bark adelgids overwinter in all stages but primarily as immature females. In late winter development resumes, and eggs are laid in small, cottony masses at the bases of needles. These eggs produce both winged and wingless forms. Both immature adelgids, called crawlers, and winged adelgids can migrate to other trees. Stationary wingless forms reproduce parthenogenically and produce several generations per year. Some winged forms may fly to spruce trees where they lay eggs. Nymphs hatching from eggs that have been laid on spruce trees die.

Control: Overwintering females may be killed by dormant oils. Oils should be applied from mid- to late May.

PINE NEEDLE SCALE

Chionaspis pinifoliae

Hosts: Most common on Scotch and white pine, but also on Douglas fir, true firs and spruces.

Description and Injury: Pine needle scales are oystershell-shaped, hard scales. Males are white, about 1/12" long and have four parallel ridges on their bodies. Females are white to yellowish and 1/8" long. Eggs are pink or reddish-brown. Newly-hatched crawlers are reddish-brown with black eye spots.

Scales attach themselves to the surfaces of needles. Heavily infested plants take on a whitened appearance from the numerous insects covering them. Scales suck sap from the needles, causing them to yellow, turn brown and drop prematurely. Light infestations rarely produce economic damage, but heavy populations will cause a loss of vigor, sparse foliage and twig death.

Life Cycle: Pine needle scales overwinter as eggs under female scales. Eggs hatch in late spring when the tiny crawlers emerge and begin feeding on needles. Crawlers can move about until they settle down to feed and secrete their waxy shell covering. The scales mature in early July, mate, and females lay eggs. These eggs produce a second generation of crawlers by mid- to late July.

Control: Dormant oil sprays in April will control overwintering eggs. Foliar sprays in late May and, again 7 to 10 days later, will control first generation scales. Second generation scales will be controlled by foliar sprays in early August, with repeat spray as described above.

PINE ROOT COLLAR WEEVIL

Hylobius radicis

Host: Scotch and white pine.

Description and Injury: Adults are dark reddish-brown to black, and have light-colored, irregular patches on the back. This snouted weevil resembles the Pales weevil, but it is larger, measuring 3/8" to 1/2" long. Larvae are legless, white, brown-headed and often crescent-shaped.

Larvae feed on the bark and cambium of host trees around the root collar and its adjacent roots. Feeding is usually below the soil line. Feeding injury causes partial girdling of the tree, resulting in restricted water and nutrient flow. Trees become stunted and weakened, often tipping over in winds or snow loads. Badly girdled trees die standing. Evidence of heavy infestation is a swollen tree trunk at the soil line and dark pitch oozing from this area.

Life Cycle: The winter is spent as an adult in the soil, under litter or in the bark crevices of tree trunks. Nearly full-grown larvae also overwinter. Eggs are deposited from early May through late September in cavities in the inner bark near the soil line or, sometimes, directly into the soil. Peak egg laying occurs during late June and early July. Larvae hatch from eggs in about two weeks and begin feeding downward in the inner bark, at the base of the trunk and into large roots. As larvae grow, their galleries (i. e., tunnels in the bark) are enlarged to accommodate themselves. Galleries may even be expanded into the surrounding soil. Larvae feed on the bark during growing season until cold weather in the fall. Larvae then overwinter under the bark in their galleries and resume feeding the following spring. Pupation occurs from early June through September. New adults feed on branches for the duration of the summer and fall, then overwinter in litter beneath the tree. Adults emerge the following spring to feed again on branches and to lay eggs. Some adults may even overwinter a second time, thereby laying eggs for two consecutive seasons.

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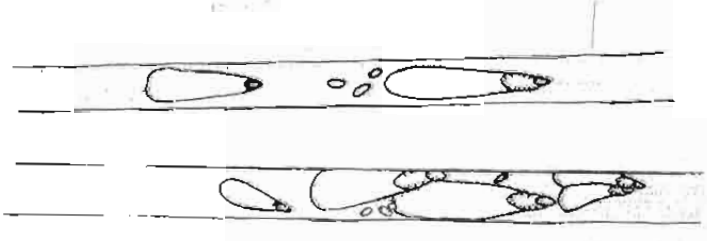
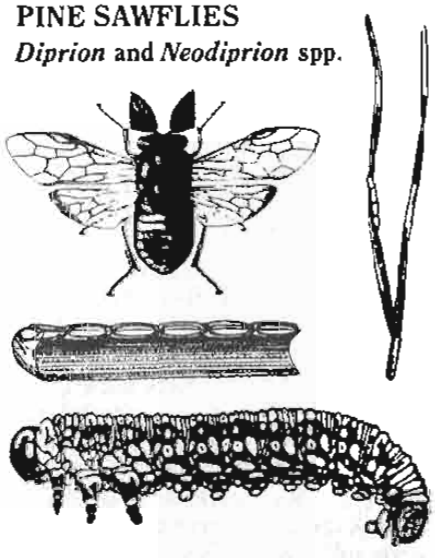


Initial sprays should be made from mid-May to mid-June to control overwintering adults. A second application in mid-August will control newly emerging adults. A third spray in early September may help control any adults that are emerging late. Spray efforts should be concentrated around the lower trunk, at the soil line and out several inches from the trunk on the soil.

PINE SAWFLIES

***Diprion* and *Neodiprion* spp.**



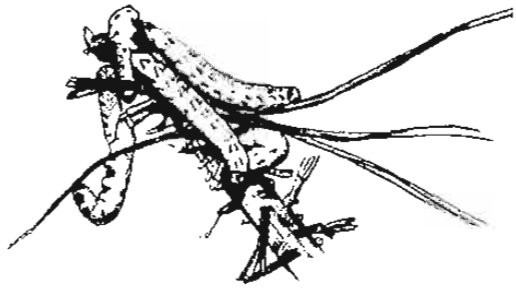
Hosts: White pine and Scotch pine.

Description and Injury: Sawfly larvae are caterpillar-like, but are not true caterpillars (i. e., lepidopterans). A sawfly larva can be distinguished from a true caterpillar by the number of prolegs on the posterior part of its body: a caterpillar will have two to five pairs of these fleshy legs, while a sawfly larva will have seven or more pairs. The larvae measure 3/4" to 1" in length when mature and vary in color from greenish to straw-colored, to gray. Most have prominent stripes or spots on their bodies. Cocoons are cylindrical, reddish-brown structures 1/4" to 3/8" long and less than 1/8" wide. They are constructed of tough, woven silks.

Adult sawflies are not moths or butterflies. They are small wasps, 5/16" long, that look like a cross between houseflies and wasps. The insect gets its common name from a saw-like structure on the end of the females's abdomen, which she uses to cut slits in needles for egg laying. Eggs are about 1/16" long, and are laid in rows on or embedded into needles.

Dried, skeletonized or ragged-looking clusters of needles are an early sign of sawfly infestation and the feeding of young sawfly larvae. These damaged needles die and drop from the tree. Older sawfly larvae eat entire needle clusters, leaving only stubs or the fascicle sheath. Large larvae can even damage young bark. Sawfly larvae have an interesting habit of rearing back their heads in a menacing posture, in unison, when an intruder approaches. This response can be a good ID feature for most sawflies.

Light sawfly feeding is usually not a significant problem, but heavy infestation can kill branches or entire trees. This is especially true if heavy defoliation occurs late in the growing season.



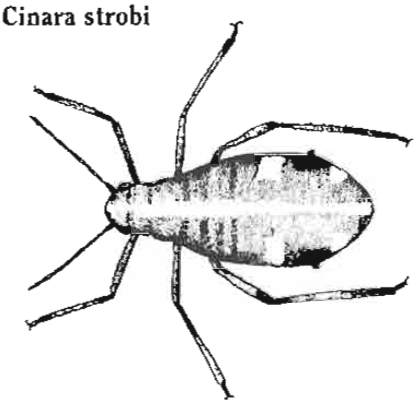
Life Cycle: Most species overwinter as prepupae inside cocoons, most often in the litter or topsoil beneath the tree. Pupation is completed in early spring, and adults emerge a few weeks later. Eggs are implanted in needles in rows. Eggs hatch in three to five weeks. Larvae feed in masses, defoliating trees from top to bottom. The larvae move to new food sources when old ones are exhausted. When fully-grown, larvae drop to the soil and form their cocoons. There may be one or two generations per year.

Pine sawflies are sometimes divided into spring-feeding and summer-feeding types. Spring-feeding species commonly attack only last season's needles, because they are feeding prior to the expansion of the current season's new growth. Summer feeders prefer current season's foliage, but, eventually, eat last year's needles as well.

Control: Foliar sprays when the larvae are seen (mid-May to mid-June) are effective.

WHITE PINE APHID

Cinara strobi



Hosts: White pine.

Description and Injury: The white pine aphid is a pear-shaped insect with a soft body. The species has both winged and wingless forms. The aphid's shiny, black body has a white stripe down the middle and white spots on the sides. Long, stiff hairs cover the body. Winged adults can be as large as 1/4" long, but nymphs of all sizes smaller than this will be seen as well. Eggs are black and are laid end to end, in rows, on the needles.

Life Cycle: This aphid overwinters as eggs in the Northeast. Eggs hatch in the spring into wingless females that give birth parthenogenically to live young. Aphids live in colonies which produce several parthenogenic generations of both winged and wingless females, during the summer. In the fall, both male and female winged forms are produced; these mate, and overwintering eggs are subsequently laid.

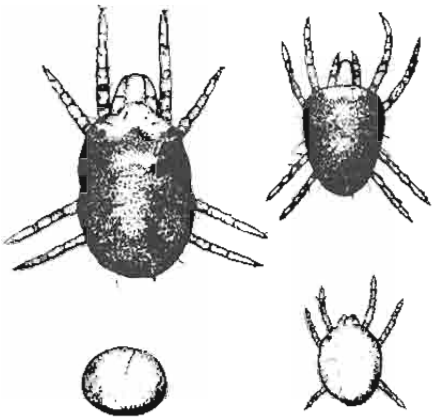
Control: Aphids are relatively easy to control with insecticides. Foliar sprays

, applied in May or June and again in mid-August, should control aphids. Isolated populations can be spot sprayed whenever they are seen.

Horticultural oils, applied in April, will often smother some eggs and will help to keep aphid populations low. Careful monitoring for this pest is needed, since populations can build up quickly at any time during the growing season.

SPRUCE SPIDER MITE

Oleogonychus ununguis



Hosts: Attacks all Christmas tree species but is especially troublesome on spruces.

Description and Injury: Mites are not insects, but are arachnids, and have eight legs rather than the insect's six. These mites are very small and are difficult to see without magnification. Shaking a branch over a piece of white paper often dislodges some mites onto the paper where they are easier to see. They appear as dark green to reddish-brown, spider-like flecks that move. Larvae are smaller than adults or nymphs and have only six legs. Eggs are very tiny, round and brown. Heavily infested branches may be covered with strands of webbing, mixed with dead mites and eggs.

The spruce spider mite is the most destructive mite of conifers. It injures foliage by sucking chlorophyll and sap from needles, causing them to become speckled, yellow and bleached. Injured needles often die and drop. Plant vigor is reduced by spruce mite feeding. Mite attacks sometimes follow control programs for gypsy moth, because repeated applications of carbaryl or methoxychlor kill mite predators, but not mites. Mite damage often progresses from the bottom of a plant, upward. Several years of repeated heavy mite feeding can kill trees.

Life Cycle: Eggs laid at the bases of needles are the principle means of overwintering for this pest. Eggs hatch in April and May, and the larval mites feed and pass through several nymphal stages before becoming adults in four to five weeks. There are multiple overlapping generations per year.

The spruce spider mite, contrary to popular belief, is a "cool weather mite," and seems to exhibit maximum feeding and reproduction in the spring and fall. During the hot, dry parts of the summer, the mites become inactive, and populations usually decline dramatically as a result of predation by natural mite enemies.

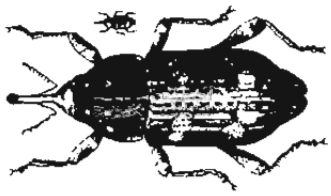
Control: Scout plantings regularly to catch mite buildup in the early stages. Thorough foliar sprays in May and September are recommended for control. Repeated sprays every ten to fourteen days, for all but the systemic miticides, may be required to get populations under control.

OLD INFORMATION DELETED

Horticultural oils, applied in April, will reduce early season mite population explosions. Remember that oils will discolor blue-needled (glaucous) conifers.

WHITE PINE WEEVIL

Pissodes strobi



Hosts: White pine and Norway spruce are most seriously attacked. Scotch pine, blue spruce, white spruce and Douglas fir are occasionally attacked.

Description and Injury: The adult weevil is a reddish-brown, snouted beetle about 1/5" to 1/4" long, which has irregular white patches on its back. The legless larvae are white and cylindrical.

Adult weevil feeding and egg laying damage are first evident as resin droplets oozing from tiny holes in terminal leaders. As the larvae grow inside the leader, their feeding girdles the leader, and the current season's growth wilts and flops over. It eventually turns brown and dies. This is usually noticeable about mid-June. Cut part of the dead shoot and the larvae, pupae or young adults should be visible beneath the bark and throughout the wood. Two-year growth is always killed, but up to five years of growth can be killed.

Lateral branches in a whorl below the killed leader assume the role of the leader. More than one lateral shoot may compete to become the leader, with the result being "cabbage pines", trees with crooked and multi-forked trunks. White pines grown as Christmas trees are targets for the white pine weevil because it prefers small trees, 3' to 15' tall, which are growing in full sun.

White pine weevil damage.

Life Cycle: Adults overwinter in litter on the ground and resume activity sometime in April. Eggs are laid in tiny chewed-out holes in terminals; these hatch in seven to ten days. Larvae feed on the inner bark of the leaders and pupate inside the pith of the leaders. Larvae move upward in the leader as they feed. Adults emerge from late June through early September and may fly to new locations. There is only one generation per year.

Control: Any leaders that begin to wilt should be removed and burned

before late June to kill the insects inside. The strongest lateral shoot from the highest remaining whorl of branches should be trained vertically so that it will develop into a decent new terminal leader. Leaving a stub of old central leader above the highest whorl of branches provides a good place to tie a lateral in a vertical orientation. After a growing season, the stub can be cut away; the lateral will remain vertical as the new leader.

The top of the tree should be sprayed from all sides in April before the candles begin to elongate. It is important to thoroughly coat the central terminal cluster of shoots.

SPRUCE TWIG MIDGE

Hosts: White spruce and, occasionally, Colorado spruce.

Description and Injury: The spruce twig midge is a tiny fly, native to Canada, that was seen initially in southwestern Connecticut in the early 1970s. Since then, it has been spreading to most parts of southern New England.

The tiny midge larvae bore into shoots, causing an elongated swelling or gall to form along the new shoot. Severe infestations cause the current year's growth to curl, drop needles and die within the year.

Life Cycle: Adults emerge from galls over a three-week period from late April to mid-May. They live only a few days, laying reddish-orange eggs under bud scales and at the bases of needles. The eggs hatch, and larvae bore into the shoots, creating the galls that they remain in until the following April, when the cycle begins again.

Control: Foliar sprays in late April through early May, when buds are swelling, are effective.

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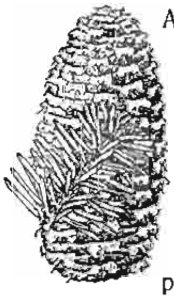
X. Disease Control



A 1989 survey of Christmas tree growers in southern New England, conducted by The University of Connecticut's Department of Plant Science, indicated that there were several potentially destructive diseases present in southern New England. During conditions conducive to disease development, these diseases can result in a reduction of tree quality and, occasionally, death of the tree.

Fungicides are available for use in controlling most diseases of Christmas trees, particularly foliar diseases. The use of cultural practices which create less favorable conditions for the causal fungus will help reduce disease severity. Twenty percent of southern New England Christmas tree growers felt that they had to take measures to control harmful Christmas tree diseases in their plantings. The following is a discussion of some of the diseases found on Christmas trees in southern New England.

NEEDLE DISEASES

The most common diseases observed on Christmas trees are foliar diseases, primarily needle cast diseases. Fifteen percent of growers indicate that needle cast diseases are a serious problem. These are caused by fungi which attack the needles, causing various symptoms, including necrosis, yellowing and defoliation. Heavily infected trees are weakened and susceptible to various secondary organisms. Also, most infected trees are unacceptable for sale as Christmas trees.

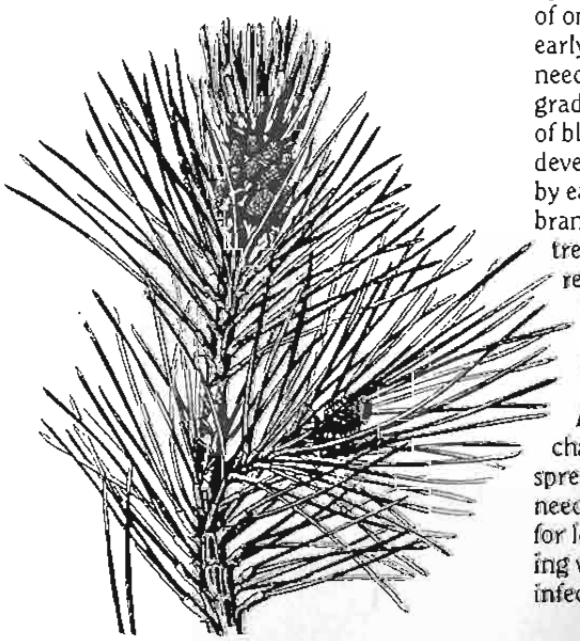
Rhabdocline Needle Cast

Hosts—Douglas fir. Based on observations in Pennsylvania and Germany, Douglas fir from the southwestern United States seem to be the most susceptible.

Symptoms— The first visible symptoms are yellow blotches that appear on last year's needles in late fall to mid-winter. These blotches turn reddish-brown and are conspicuous by February. In spring, as new growth begins, orange-brown fruiting structures appear in the blotches. The fruiting bodies are obvious as they protrude from the leaf surface following wet weather. Infected needles are cast from the tree in spring and early summer leaving only the current year's needles. The above symptoms are most obvious on the lower branches.

Disease Cycle— Spores which cause new infections are discharged from fruiting bodies on the needles during wet periods. They can be carried by wind to developing new needles on surrounding trees. If conditions are right (cool temperatures around 45-55^{0}F and several days of rain or drizzle) the spores can initiate infection. Infection can occur as soon as green tissue appears in the buds.

Control—In general, disease is most severe on trees in areas where moisture remains for long periods after rain or dew. Avoid planting susceptible trees on north facing slopes, near the edge of a hardwood forest or in low, damp areas. Planting at wider spacing (6' x 6') will help promote faster drying of foliage. Removal of weeds and brush around the base of the tree facilitates quicker drying of the foliage.



If severe disease develops, it may be necessary to rogue some trees and prune the lower branches of others. Culls in and around the planting should be eliminated, preferably by the first of April.

In some plantings, a fungicide may be necessary to reduce the severity of disease. Fungicide applied at bud-break, one week later and three weeks after the first spray, should provide adequate control. An additional spray application two to three weeks after the third application may be required if there is extreme variation in bud-break within the planting, and/or there is a long, cool spring.

Seedlings should be purchased from a reputable nurseryman. Only purchase seedlings grown from seed sources that are known to be less susceptible to Rhabdocline needle cast disease.

Swiss Needle Cast

Host—Douglas fir

Symptoms—Yellowing or mottling of one- or two-year-old needles in early spring is characteristic of Swiss needle cast. The infected needles gradually turn brown, and two rows of black, fuzzy fruiting bodies develop on the underside of needles by early summer. Heavily infected branches on the lower part of the tree will usually only retain the current year's needles. Several years of continuous infection severely weakens trees and may cause mortality of some branches.

Disease Cycle—Spores are discharged from the fruiting bodies and spread by splashing rain to emerging needles. Trees which remain moist for long periods of time after becoming wet are most likely to be severely infected.

Control —Follow the cultural recommendations given for Rhabdocline needle cast. Since the disease can be spread by infected nursery stock, inspect plants carefully. Do not shear infected trees during wet weather.

Applications of fungicide will reduce disease severity. The first application should be made when new growth is one-inch long, followed by a second application in three weeks. Regular rainfall during the early growing season may necessitate a third application.

Lophodermium Needle Cast

Hosts—Most species of two- or three-needle pines are susceptible. In southern New England, Scotch pines (particularly Spanish and French Green seed sources) are most susceptible.

Symptoms—Reddening of the previous year's needles in early spring followed by browning of the needles and defoliation in June and July. Symptoms are most common on the lower branches. By mid-July, black fruiting bodies become visible on dead needles.

Disease Cycle —Spores are wind disseminated from fruiting bodies on old needles during wet periods in mid-July to late September. Current year needles are infected, and the fungus persists in these needles until the following season.

Control—This disease is similar to Rhabdocline in that the causal fungus requires abundant moisture for dissemination and infection. Therefore, the best control strategy includes the measures outlined under Rhabdocline to assure rapid drying of foliage.

Fungicides can be used to protect trees during the period from early July to the first part of October.

Cyclaneusma (Naemacyclus) Needle Cast

Hosts—Scotch pine is the primary host in Christmas tree plantations.

Symptoms— This disease can be easily distinguished from Lophodermium needle cast because symptom development occurs primarily in the fall. The most conspicuous symptom is the yellow color of infected needles. Close examination will reveal brown bands that run across the needle. Fruiting bodies develop primarily in the brown bands. Unlike Lophodermium needle cast, where symptoms are most conspicuous on the lower part of the trees, symptoms develop throughout the tree.

Disease Cycle—Spore development occurs on infected needles, either on the tree or the ground. The spores can be wind disseminated any time of the year when the temperature is above freezing and it is wet. According to studies conducted at Pennsylvania State University, infection may occur from July through December. However, severe infection usually occurs from April to late May. The same studies also indicate that infected needles do not develop symptoms until the end of the second growing season or the beginning of the third growing season.

The fungus has the potential of causing infection during most of the year, so foliage must be protected from late spring to late fall. Sprays should be applied in late March, early May, mid-June, mid-August and early October. Since seedlings may be infected and not show symptoms, growers should be certain to plant stock from nurseries which have effective disease control programs.

OTHER PROBLEMS

Sweetfern Rust

Although this disease is relatively uncommon, losses can occur when the alternate host is in close proximity to the pines.

Hosts—Most two- and three-needle pines are susceptible. Scotch pine is the most commonly infected pine in southern New England. Alternate hosts are sweetfern (*Comptonia peregrina*) and sweetgale (*Myrica gale*).

Symptoms—The sweetfern rust fungus attacks the main stem of trees, usually near the base. Infected stems are slightly swollen and cankered, usually on one side. Orange-colored spore masses which form on the stem in the spring make the disease easy to recognize.

Control —Where practical, elimination of sweetfern or sweetgale in and around the planting will control the disease. It is not known how far the fungal spores travel, but it is apparently only a short distance.

Air Pollution Injury

Sulfur dioxide and ozone can cause damage on susceptible species in southern New England. The severity of damage is dependent upon many factors including age of needles, genetic susceptibility of the tree, exposure time, weather and pollutant concentration. Air pollution can reduce growth, discolor needles and predispose trees to attack from secondary agents.

Hosts—All species of conifers are susceptible.

Symptoms—Stunting of needles is a common symptom. Affected needles may have brown, red or yellow tips. A stippling or flecking of the needles is also characteristic of some air pollution damage. Exposure of Eastern white pine seedlings to ozone for long periods results in a condition known as chlorotic dwarfing. Affected trees are stunted and have very sparse, off-color foliage (usually only the current year's needles) and the overall appearance of the tree is scraggly.

Control—The major source of ozone results from sunlight acting on automobile exhaust, initiating a series of chemical reactions that result in smog comprised mainly of ozone. Injury can occur great distances from the source of the pollutant. Ideally, control consists of reducing the amount of ozone generated through automobile exhaust pollution control. Eastern white pine showing symptoms of chlorotic dwarf disease will not recover so they should be rogued.

Tip Blight

This is a common, but rarely serious, disease which causes death of new shoots.

Hosts—Fraser fir, white spruce, white fir, Douglas fir and Colorado spruce have shown symptoms of this disease in southern New England.

Symptoms—The new growth is invaded in the early spring causing it to wilt and eventually turn brown. By July, the affected shoot usually drops off.

Disease Cycle—The cause of this disease has not been clearly established. Circumstantial evidence indicates that a fungus, possibly *Diplodia* sp., is involved. The injury seems to be most prevalent following cool, moist weather in early spring as new growth is emerging.

Control—The disease is seldom serious enough to warrant chemical control. If necessary, an application of an appropriate fungicide with a spreader-sticker in early spring as new shoots are emerging, and again in 10 to 14 days, should provide control.

Shoestring Root Rot

Host—Most conifers

Symptoms—Rapid decline and death of a tree are characteristic of this disease. Foliage turns yellow then brown. Occasionally there is a resin at the base of the tree. When the bark in this area is removed, a white mycelial fan of the causal fungus may be evident.

Disease Cycle—Shoestring Root Rot is caused by a fungus that lives in the soil. It is common in hardwood forests and colonizes roots and stumps of many trees. It spreads through the soil by growth of a specialized type of fungal structure called a rhizomorph (shoestring). The fungus infects through the roots and eventually girdles the trunk of the tree.

Control—Stressed and weakened trees are most susceptible. Choosing the correct site and controlling pests will help avoid stress. Trees planted in recently cleared hardwood stands are most likely to be infected. These sites should be avoided if possible.

White Pine Root Decline

Hosts—Eastern white pine is the most susceptible of the conifers grown for Christmas trees in southern New England. Scotch pine is also susceptible.

Symptoms—Symptom development is somewhat variable, but the end result is death of the entire tree. In some cases buds fail to open in the spring, and the tree dies suddenly. In other cases the new growth wilts initially and is followed by the eventual death of the tree. Occasionally the tree will turn yellow during the growing season and die in the fall or the following spring. Some discoloration usually occurs in the wood at the base of the tree. Trees that wilt and die suddenly should be checked carefully to determine if mouse girdling might be responsible.

Control—There are no practical chemical means of controlling this disease in Christmas tree plantings. Sites where the disease is a problem should be planted to more resistant species such as Douglas fir and white spruce. Avoid planting Eastern white pine on poorly-drained soils.

XI. Animal Damage and Control

In southern New England, some wild animals might cause enough damage to plantation Christmas trees to warrant damage control treatment. Presently, there seems to be no widespread damage in the region, but growers should be able to recognize damage and be aware of treatment alternatives. Wildlife causes damage only if it is attracted by suitable habitat conditions or if it is driven to seek secondary foods when its natural foods are diminished. In any event, it is usually the local animals that are involved. Damage can include debarking, nipping of new growth or breaking of leaders on the trees.

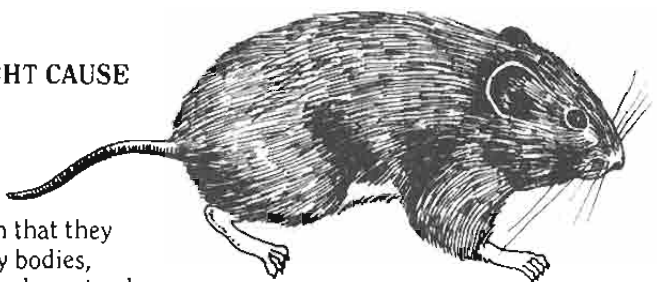
ANIMALS THAT MIGHT CAUSE DAMAGE

Voles

Voles differ from mice in that they have rather short, stocky bodies, short tails, short ears barely protruding above the body hair and small eyes. They are brown or gray overall and six to seven inches in length. Voles breed throughout the year, but mostly in spring and summer, having three or more litters per year with three to six young in each litter. Gestation is 24 days. Females become sexually mature in 25 to 30 days; males at around 45 days. Thus the biotic potential (the possible number of offspring per spring pair) is high. Since the life span is short (two to 16 months), populations of voles normally do not reach eruptive levels. However, large population fluctuations are characteristic, with peaks every two to five years. Occasionally extremely high densities are reached such as in western Massachusetts and neighboring areas several years ago. Voles are active day and night and do not hibernate. Their home range is 1/4 acre or less, and many individuals commonly live together in a community, in an extensive tunnel system.

Voles feed mostly on bark of tree stems, bark of roots, plant stems or shoots up to about 1/4 inch in diameter and on various other plant materials. When there is a deep snow cover and voles are abundant, all the stems and branches of small trees and shrubs below the snowline can be completely debarked. This becomes evident once the snow cover melts.

Two species of voles are found in southern New England, the more common meadow vole and the smaller pine vole. Both might have an impact on plantation Christmas trees, but the latter is often a particularly damaging animal in fruit orchards.



MEADOW VOLE

Meadow voles (*Microtus pennsylvanicus*), often called "meadow mice," occur in various types of habitat having sufficient ground cover. Because they live both underground and on the ground surface, they are said to be semifossorial. They construct many tunnels, surface runways and numerous burrow entrances. These animals live in all sorts of habitats where there is a full ground cover of grasses and other plants. Their primary foods are the tender parts of grasses, sedges and many succulent plants. When food is scarce, they will feed on the bark of trees and shrubs. Meadow voles are generally dark chestnut brown over the back and head, the sides are paler and the belly is tan or gray. The short tail is darker on top than the gray underside.

Pine voles (*Microtus pinetorum*), also known as woodland voles, are not likely to be as much a problem to Christmas tree growers as meadow voles because they spend more time underground and feed mainly on plant parts from below. They seek succulent roots, tubers, sprouts and the tender bark of tree roots. Pine voles can be distinguished from the meadow species by their smaller size (up to 6 inches), their dull reddish-brown color and the bicolored tail which is only slightly longer than the hind foot. The red color is the main characteristic.

Damage to Christmas trees by voles can best be prevented by frequent

PINE VOLE

mowing and clipping of the ground vegetation between tree rows and around trees. When ground cover is very dense and tall, the clippings should be removed to eliminate a mat buildup that would provide voles with an ideal habitat in which to live and breed. While mowing is the recommended method of damage prevention, poisoned baits

are effective in controlling vole numbers within the plantation. They are most effective when used in late fall before snow cover develops. Treatment of marginal areas is important, to intercept voles moving into the plantation. One problem with poisoned baits is that wildlife other than voles might be killed. Your local Cooperative Extension educator should be consulted in regards to what poisons are allowed in a particular state and as to proper application procedures.

White-footed Mouse

The white-footed mouse (*Peromyscus sp.*) is another small mammal which might be found in Christmas tree plantations. It is probably the most common mammal in North America. As the common name implies, it has white feet with the white extending along the underside of the tail, over the belly and on the lower face. The tail is much longer than that of voles, measuring nearly as long as the body. The eyes are large and black, the ears are large and protruding and the coarse whiskers are long. The back and sides of adults are grayish to reddish-brown.

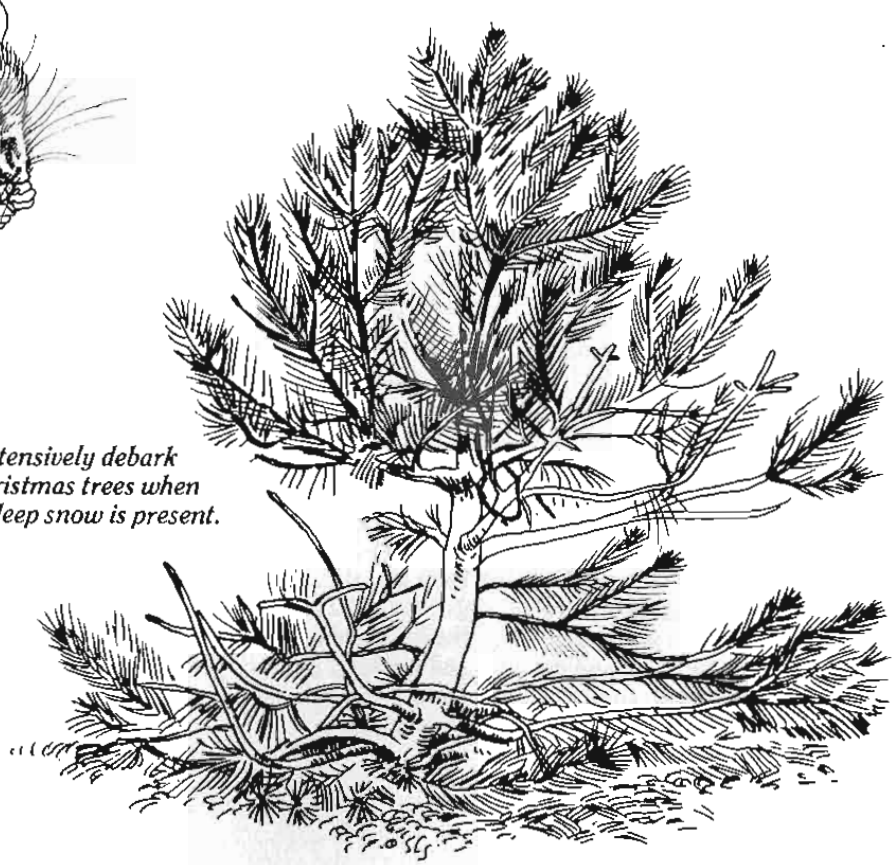
White-footed mice are prolific breeders, like voles, and inhabit a wide variety of vegetation, from overgrown fields to fully wooded areas. They readily climb trees and shrubs. The nests are in underground cavities, under boards or logs, in hollow trees, logs, fence posts and bird houses. They are nocturnal and remain active all year. Many can be found in abandoned buildings, as well as in basements and attics of occupied houses.

Insects, seeds, nuts and grains are the principal foods of white-footed mice which cache foods for winter use. During spring they sometimes become a nuisance by digging up planted seeds that they detect with their keen sense of smell. Because of their food habits, it is unlikely that white-footed mice will become a problem in Christmas tree plantations. Should population control be desired, baits carrying toxicants are sold in farm and hardware stores and are generally useful. In closed areas, various commercial repellents or naphthalene moth balls or flakes remain effective for several months.

Deer

Deer occasionally damage Christmas trees by nibbling the soft, succulent new growth during summer, but this is rare, because of the abundance of natural foods. Towards the end of summer, as the fall rut approaches, males begin to rub their new antlers on small sapling hardwoods or conifers to rid themselves of the dried velvet skin layer on the antlers and to mark their territory. Where deer are plentiful, a buck might choose to rub on the stems of a few trees in a plantation and thereby strip enough bark to injure the trees. During winter, particularly in the later months, deer sometimes enter tree farms to browse on the dormant buds if their preferred natural foods are in short supply. In a 1985 survey of Christmas tree growers in Ohio, nearly 45% reported damage from deer, mainly in fall and winter. White pine and firs were the most damaged species.

Deer are protected game species in all states, so damage control methods must be legally applied. When damage to plantation trees by deer is excessive, most states will allow the



Voles can extensively debark Christmas trees when deep snow is present.

landowner to shoot the encroaching individual deer at any time during the year, providing a permit is obtained from the state wildlife agency.

Short of killing deer, exclusion of the animals from plantations is the best form of control. Fencing has proven to be the most effective means where deer are abundant, but this alternative might be too costly in most situations in southern New England. Deer can be excluded from plantations by use of an eight-foot high, mesh fence, but such a barrier is very expensive to construct. Electric fences are more reasonably priced, but maintenance costs tend to be high and, to be effective, they must be continuously electrified during the periods when deer are apt to venture into tree plantings. An effective five-wire electric fence has been developed at Pennsylvania State University and a seven-wire type has been used with much success at Carey Arboretum in New York State. Either of these designs would be useful to protect Christmas trees.

Deer can be discouraged from entering tree plantations by treating trees with a commercial repellent. Spraying with a repellent may be restricted to the few trees where deer habitually enter the plot and then treating other trees randomly, but with special attention to the outer rows. Individual trees should be fully covered with the spray. If a planting is surrounded by woods and is less than 25 acres, every tree should be treated, as well as the low vegetation in plantation borders, to make the inner treatment more effective. Repellents are virtually ineffective when put on bare soil, as the ingredients readily deactivate. See Table 16 for some selected chemicals and suppliers.

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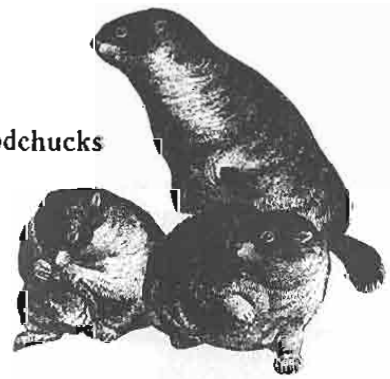
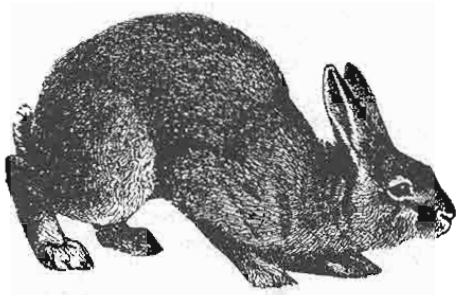


Woodchucks

Woodchucks are not known to feed on tree seedlings. Within a tree planting, they might become a rare nuisance, by creating a physical hazard with the digging of a burrow. These animals can best be controlled by fumigating their burrows with a commercially available cartridge that produces carbon monoxide gas when burned. After lighting the cartridge and placing it in the burrow, all entrances to the underground system should be blocked to allow the fumigant to spread but remain con-

tained. Specific directions for use of the cartridges should be followed closely. The devices can be purchased at local farm supply outlets. There are no poisons registered for woodchuck control, so the only other ways of disposing of nuisance individuals is by trapping or shooting. See state wildlife laws to review which methods are legal in your state.



Rabbits

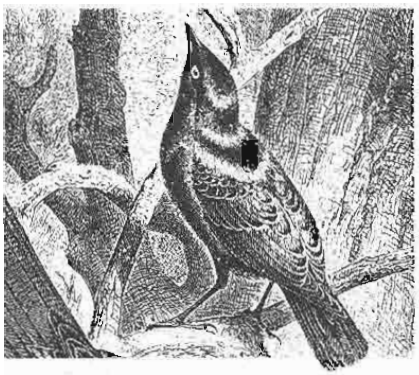
Rabbits are not apt to damage Christmas trees, because they feed primarily on succulent plants during the growing season and on slender twigs of woody plants at other times. When winter food is scarce, they might chew bark from small trees including some species of conifers. Rabbit damage can be easily recognized by the angular cuts made on twigs by their chisel-like front teeth, in contrast to damage done by deer, which tear twigs apart, leaving shredded, broken ends.

To keep rabbits from feeding in plantations, repellents used for deer work well, especially

If rabbit damage is severe and persistent, some sort of wire fence might be feasible. An electrically charged wire, placed low enough to the ground to prevent rabbits from sliding under it, is an effective control. A hardware wire or small mesh poultry wire fence along the periphery where rabbits habitually enter the plantation, or around the entire plot, might be the most effective way to protect valuable trees from these animals. The least costly way of reducing damage might be elimination of rabbits by shooting or trapping. Because rabbits are protected game species in all of southern New England, the state wildlife agency should be contacted for specific advice on elimination.

Birds

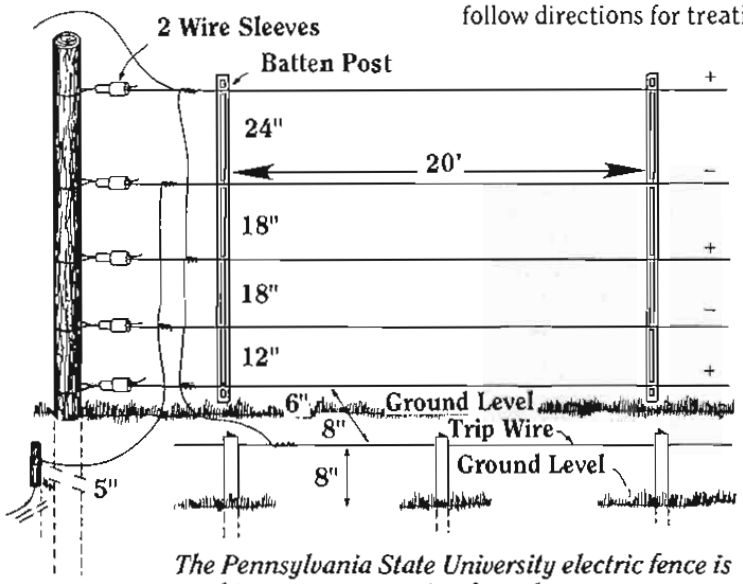
Birds might become an occasional minor problem when they perch on fragile tender leaders of plantation trees during the first few weeks of the growing season. There is little that can be done to prevent this or damage to terminal buds in other seasons, because virtually all birds are protected by federal and/or state laws. If damage from birds becomes severe, the federal animal damage control agent (listed under Animal and Plant Health Inspection Service, U.S. Department of Agriculture) for your area should be consulted.



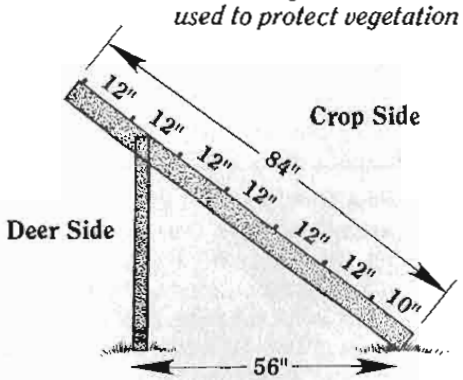
NOTE OF CAUTION

Before using any repellent or toxicant products to reduce or prevent animal damage, BE SURE TO READ THE LABELS ON THE CONTAINERS. Special precautions must be taken for certain preparations. Some commercial chemicals might damage some species of Christmas trees, so a test application should be made on one or two trees.

New growth is particularly sensitive to some products, and application should be made only before bud burst. Be safe. Use precautions and follow directions for treating trees.



The Pennsylvania State University electric fence is used to protect vegetation from deer.



The seven-wire electric fence was developed at Carey Arboretum in New York.

XII. Shearing and Shaping

Unsheared Christmas trees were the rule 25 and more years ago, then growers began to adopt shearing practices used by nurserymen. The result was often dense, heavy trees that took too long to reach salable size. The current prevailing practice is to shear just enough to produce a tree of medium density in as few years as possible.

In 1957, the U.S. Department of Agriculture established standard grades for Christmas trees. These standards, while voluntary, are used more and more commonly in wholesale transactions and outline the characteristics the shearer should strive to obtain. In general, a well-shaped tree will have the following characteristics:

Stem—It will have a single, straight stem.

Butt—The butt, or handle, should be trimmed to the first complete whorl of live branches. The trimmed handle should be six to ten inches in length. (Note, some customers prefer to trim the handle and have use of the branches for decorating.)

Taper—The percent of taper is determined by dividing the tree's branch width at the base by the height and multiplying by 100. Normal taper is between 40% and 90%; 66% is often considered the ideal (a tree with such a taper, if six feet tall, would be four feet across). Pines will generally have a wider taper (60-90%) than spruces and firs (40-70%).

Density—A "U.S. Premium" or "U.S. No. 1" grade tree will have at least medium density, which means that "whorls or branches are relatively close together, the branchlets or side branches are fairly numerous, and the needle population is adequate to cover the branches. The stem may be visible, but not distinctly visible throughout most of its length." The well-shaped tree will look essentially the same from all sides.

Table 17. Number of trees sheared per hour by Southern New England Christmas tree growers.

	Number of trees sheared per hour		
Tree Height	**Least**	**Mean**	**Maximum**
Less than 3 ft.	12	133	600
3 to 5 ft.	3	81	500
Greater than 5 ft.	2	56	400

Equipment

Hand pruning shears are the tool of choice to cut a branch or twig at its base, a procedure most often used in eliminating double leaders or butt pruning. A leather scaboard attached to a waist belt is convenient for carrying hand pruners. Long-handled shears extended several feet are available to cut leaders or touch-up the tops of tall trees.

Shearing is done with either hedge clippers, shearing knives or power shears. Thirty-seven percent of growers use hedge clippers, 22% use knives, 34% use both clippers and knives, and 7% use pruning shears to shape their trees. Shearing with a knife is faster than with hedge clippers, and the power shearer is much faster than the knife. Disadvantages of the knife are that it is very sharp and dangerous if mishandled; disadvantages of the power shearer have largely to do with the capital investment. The cost of power shearers may be too great for owners of small plantations. Shearing trees nearing market size with a knife takes an average time, per tree, of about one minute. Some figures on number of trees sheared per hour are given in Table 17.

No one of these tools does an inherently better or worse job. Quality is dependent largely on the operator, not the tool in his or her hand.

Sharp, clean tools are essential for good shearing, so a honing stone and some pitch cutting solvent, such as kerosene, or a good household cleaner, such as Fantastic, should be available. The latter is easier on the hands than kerosene and comes in an atomizing dispenser.

Chaps or leg guards and protective gloves are good ideas when using knives. Some sort of measuring stick for determining lengths of leaders is helpful. The blade length of the shearing knife may be an adequate measuring device. Twist ties, plastic tape, a hand-held stapling taper and bamboo sticks are items that can be used to tie errant leaders.

Shaping

Because of their different growth habits, shearing discussions usually break the tree species into two main groupings: (1) pines and (2) spruces and firs. Most growers (84%) shear their trees once a year, but some (11%) shear twice a year and 6% shear only every other year or even less frequently.

What follows are some general guidelines to be used in shaping Christmas trees. Please remember that these are only guidelines. Shaping, while not difficult, is a job which is really only mastered through observation and experience, and no two shearers do everything the same way. The state Christmas tree growers associations hold regular field meetings where proper shearing is often demonstrated. The Cooperative Extension Systems and the Agricultural Experiment Stations offer similar programs, from time to time.

A power shearer is especially useful on large trees (six to eight feet) and trees with lots of annual growth, such as white pine and Douglas fir.

PINES

Each growing season, the leader or tip of a pine tree forms a single cluster of buds consisting of a terminal bud, from which will grow next year's leader, and several lateral buds, from which will grow the lateral branches. This group of lateral branches, emanating from a single point on the stem, is called a **whorl.** The point from which they emanate is called a **node,** and the stem area between two nodes is called an internode. Under normal conditions, no limbs will form along the **internodes.**

There are, however, dormant buds, called **fasicle buds,** which exist at the base of healthy needle clusters growing along the new and one-year-old stems. Removal of the terminal bud cluster can stimulate these buds to develop into shoot buds that sprout the following season. *Timing, however, is critical.* Pines must be sheared during the growing season or healthy fasicle buds will not develop. The best time to shear is as soon as the terminal bud is evident and shoot extension has stopped, which means during the months of June and early July for southern New England.

In scheduling pine shearing, the rule to follow is young trees before old; white pine before Scotch. Young trees are sheared before old because trees which are sheared very early can sometimes produce secondary growth (lammas growth), a feature which may be a bonus on young trees but disfigure the conical shape of trees approaching market size. This late season growth may be off-color, as well. The following are some general guidelines for shearing pines, assuming you are aiming for six- to eight-foot trees.

Year of Planting—Do no shaping. Remove double stems, if that was not done before planting.

Trees Less Than Three Feet Tall—Prune double leaders. As a general rule, leaders should be kept no longer than 16", but remember that more mistakes are made from overshearing at this stage than vice versa. The stronger and more numerous the top whorl laterals are, the longer the leader can be. If the leader is cut back, the top whorl laterals should also be cut back to about two-thirds the length of the leader.

Do no other shaping unless a lower limb is growing through the limbs above it or protrudes well outside the general form of the tree. Meticulous shaping to produce a perfect cone shape at this state is fine if you are growing table trees, but a waste of time otherwise.

Trees Three Feet to Five Feet Tall—Annual shearing is now required to develop symmetrical trees with a taper in the normal range. Prune double leaders and, if necessary, cut back the leader (using 12" to 16" as the rule of thumb) and top whorl branches as above. If more than one top whorl branch is cut, it is often advisable to debud the rest of them, or uneven growth may result. A pruned shoot will produce more buds and, hence, more branches the next year than an unpruned shoot. Shear lower branches as necessary to maintain the conical shape.

Trees Five Feet to Market Year— Most pines hold their needles for only two full growing seasons. Pine shearing, therefore, necessarily culminates in the development of an outer layer of green foliage, with needleless branches in the interior. Shearing up to this point has concentrated simply on maintaining the normal cone shape. Now, however, thought must be given to filling any holes and creating a full and even foliage effect.

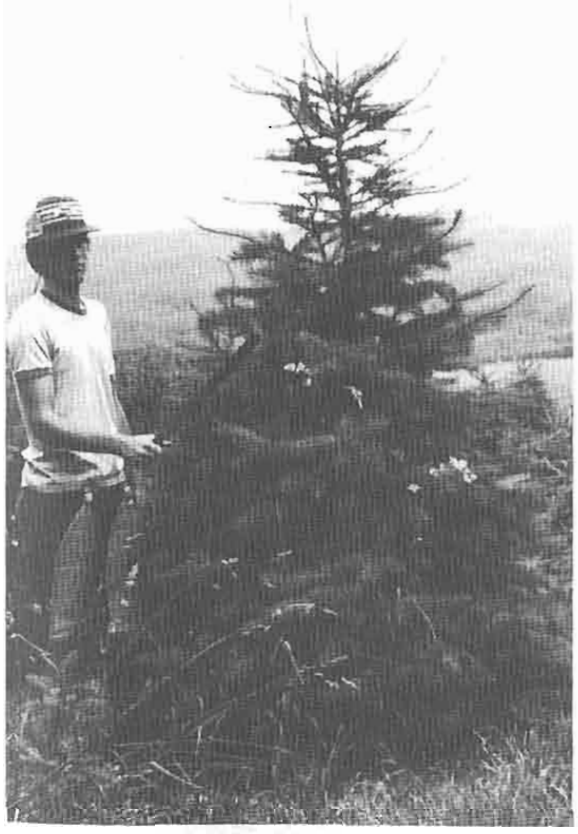
If the tree is well formed and tapered, this may mean doing nothing other than what was done in previous years. If not, it may mean shearing somewhat more heavily, so that larger numbers of branches are debudded and, thus, form new bud clusters and subsequent tufts of full foliage. Granted, one can overdo this and end up with a tree so dense that the buyer can do little more than wrap a garland around it. But the object during the last year or two before market should be to fill any large holes and create an even appearance, so that heavy shearing is not required during the year of sale. On trees that are thin, it may be advisable to remove the terminal bud even if the leader length is not too long so that branch density will be increased.

A common problem with pines, which may occur at any age, is leader die-back due to infestation by insects such as white pine weevil or the European pine shoot moth. When the leader dies back, a strong lateral branch from the top branch whorl should be trained to become the new leader. Select a strong lateral (preferably one with another strong limb beneath it to fill the gap) and tie it to a straight stick which extends below the top whorl and is tied to the main stem. String, rubber bands, twist ties or even long grass stems have been used successfully for this purpose. Early shearing (mid-June) often enables detection of white pine weevil damage before the entire leader is affected. Removal of the infected leader at this time will, in many cases, save a year's growth which would otherwise be lost.

There is a growth regulator, benzyl adenine, (Pro-Shear, Abbot Labs) which can be used to increase bud set and branching on white pine. A single yearly application has been shown to be effective, but whether it is practical for most growers to use is not clear.

SPRUCES AND FIRS

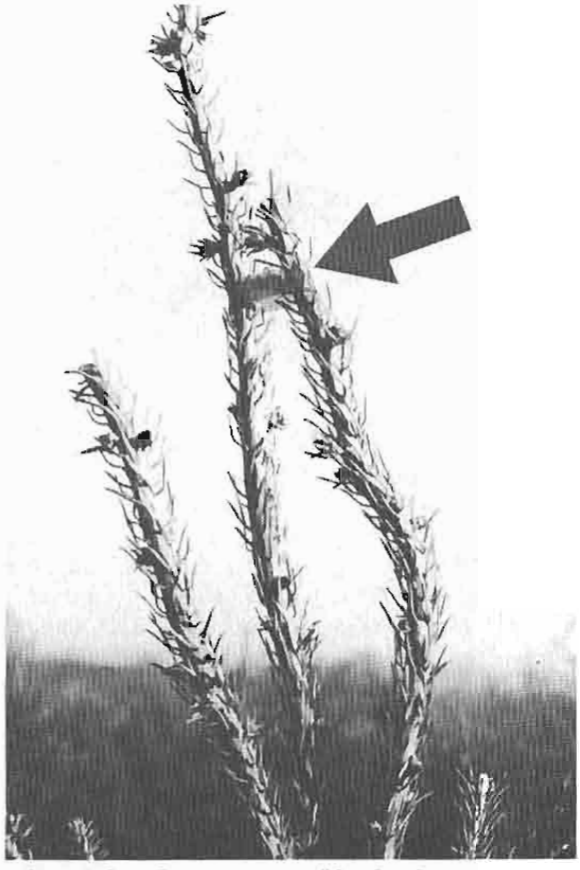
Like the pines, spruces and firs produce a terminal bud and a cluster of lateral buds which will make next year's main whorl of branches. However, the spruces and firs set additional side buds along the length of the leader. These buds produce small branches which add to the overall density of the tree.



Knife at high point of cutting stroke. Arm and knife are always brought down to the outside of the body, never across the front. Note leg guards. If shearing with a knife with other people, work on alternate rows to ensure safe working distance.

A stake and taping machine is used to tie a side branch into the terminal position.

When multiple leaders exist, it may be necessary to remove competing shoots so one shoot can take over as a central leader.



When a plant loses its central leader due to disease, insect attack or mechanical injury, it will be necessary to hold a new branch in a vertical orientation for a period of time so it can develop into a new central leader. Here (arrow) plastic tape is used to position a new leader by attaching it to another lateral branch.

Spruces and firs can be pruned any time of year except during extremely cold weather and during growth extension. However, best bud set appears to be obtained when spruces and firs are sheared once growth is completed and is just beginning to harden. Most experienced growers try to shear their spruces and firs right after they finish their pines, from late June to early August. Among the species grown in southern New England, Fraser fir is the last species to extend and harden new growth; thus, it should be the last species pruned.

Unlike pines, spruces and firs tend naturally to grow in a cone shape, so shearing can usually be done less often or, at least, less heavily. If the trees are perfectly shaped in the size range of three to five feet, then, most likely, they are being oversheared.

Some points to remember with spruces and firs:

If the tree has a single, straight stem of proper length and the branches are within the normal taper, walk right by. On average, those growers surveyed sheared 90% of their pines each year, but only 78% of their spruces and/or firs.

Keep leader lengths between 10" and 16", depending on tree development and taper as discussed in the section on pines. If the leader is cut, cut top whorl laterals back to about two-thirds of the length of the leader. Shear any lower limbs as necessary to maintain normal taper.

Some species, notably Fraser fir, have a tendency to grow tall and thin with a candlestick (less than 40%) taper. Height growth may have to be controlled to allow time for lower limbs to fill out.

Douglas fir from southern sources may keep growing into the fall, especially when on good soil with adequate moisture. Some growers prune such trees twice, once in July and again in September. Others prune heavily just once in late summer.

Basal Pruning

There are growers who advocate basal pruning on relatively young trees (three to four feet) to develop a good handle early and a strong bottom whorl. This is a reasonable practice on vigorously growing trees where a reduction of total growth is desired. In southern New England basal pruning on young trees has been noted to stunt total tree growth. Many wholesale growers do not basal prune until they harvest the tree. Some of the choose-and-cut operators basal prune in late fall the year before or the year of harvest, and the branches are used for

wreaths, garlands and bunches of greens. Basal pruning on Douglas firs when three to five feet tall, may be justified, to increase air circulation around the base of the trees and, thus, reduce infection by rhabdocline needle cast disease.

Tying Leaders

Most growers do some tying of leaders, especially on trees that are within three years of market. Any species may have a damaged or missing leader. Errant tops are common on blue spruce and Douglas fir. Terminal buds on blue spruce grown in areas with poor air drainage often fail to grow in the spring and a lateral branch from a tip whorl fails to attain dominance rapidly and without a serious crook. Such trees are more marketable and, thus, more valuable, if a promising lateral branch of the top whorl is tied or splinted to a vertical position. A wooden stick, twist ties or plastic tape are useful for doing this.

Conclusion

Approach an unpruned tree with an idea of what it should look like after it is pruned: height, taper, symmetry and density. Cut the leader and shear the tree. After you have pruned one or several trees, step back and ask if they look right for that species and size tree. Adjust your technique accordingly. If working with other growers, exchange ideas and advice with each other to improve the quality and speed of the shearing process. Remember, at a minute per tree, you can prune 480 trees in eight hours. At 30 seconds per tree, you double the rate to 960 trees. With a lot of trees to prune, seconds wasted or saved per tree can add days to or subtract days from the length of the job.

XIII. Marketing

Marketing is the key to a successful Christmas tree enterprise. Regardless of how well trees are produced, a profitable marketing outlet is the financial bottom line. Before a tree is planted, a plan to market the product must be determined.

The grower has several options in marketing the crop. The choices are wholesaling, retailing on the farm with either tag or choose-and-cut, retailing at a lot on or off the farm, or balling and burlapping. In southern New England, 79% of growers retail their trees, 5% wholesale their trees, and 15% combine wholesaling and retailing.

There is no substitute for **high quality** Christmas trees. All statistics show there is and will be a surplus of trees on the market for the foreseeable future. Only the very best trees are going to sell and demand a high price. Poor quality trees will be left on your plantation or on roadside lots after December 25. Focus on quality, quality, quality.

Grow into the business. If the plan is to have a 10-acre farm, don't plant the entire 10 acres in one year. Plan and plant it over a 10-year period. This offers an opportunity to improve management. The tree growing management and reputation will be important in developing customer relations.

Once a grower begins to sell trees, he or she must continue to have an abundance of trees for customers. If an operation must close for a year or two after opening, customers will find another source of trees and may not return. An even-aged stand may take two to five years to completely harvest, depending on species management, etc. All trees do not grow uniformly. One stand, eight years old, may take as long as 13 years to completely harvest.

The entire harvest and retail period is crammed into a few short weeks or weekends between Thanksgiving and Christmas. Reliable seasonal labor is needed in sufficient quantity. Plan to have that labor when it is needed. Experience indicates that one person can harvest between 50 to 75 trees per eight-hour day.

Consider these marketing vehicles:

1. Wholesaling;
2. Choose and Cut;
3. Choose, Tag and Cut;
4. The Retail Lot;
5. Balling and Burlapping;
6. Associated Products.

Wholesaling

There are several advantages to wholesaling Christmas trees. First, large quantities of trees are marketed at one time, saving time and expense. The average southern New England Christmas tree wholesaler sells around 650 trees per year. Second, wholesale selling may go on all year. Some established growers contract with buyers a year or more before harvesting. Third, the risks and costs of transportation and retail marketing are passed onto someone else. The primary disadvantage is the lower price received per tree.

To wholesale, the grower must know well in advance how many trees of what size and species are needed to sell in any given year so as not to under- or oversell. Becoming established in the wholesale market will take some advertising at first, but there are good outlets available.

The Connecticut, Massachusetts and Rhode Island Christmas tree growers associations have established marketing committees. Their responsibility is to connect the grower with the potential buyer for wholesaling. The associations are not responsible for the contract between grower and buyer, but simply supply information to both parties. The National Christmas Tree Association publishes an annual marketing issue of the *American Christmas Tree Journal* in May. Remember that most reliable wholesale buyers ship very early.

A large area for piling and loading is needed when wholesaling large numbers of trees. One thousand trees (about an acre's worth), stacked head high, can take up to one quarter acre of space. The piling area should be protected against theft, and a water source is desirable for keeping the cut trees moist.

Retailing

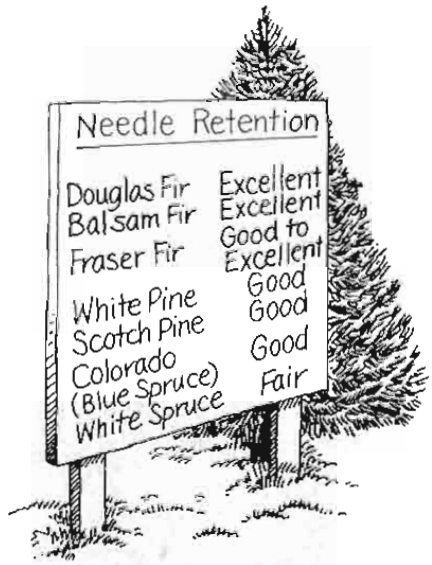
To retail Christmas trees, select tagging, choose and cut, or the retail lot. The average southern New England Christmas tree retailer sells around 450 trees per year.

TAGGING—To tag or not to tag has been discussed since Christmas tree farms have been in existence. In southern New England, 38% of growers allow customers to tag trees, then return later to cut the trees. Beginners should contact growers who have used tagging and choose and cut methods. Ask for advantages and disadvantages of both operations and make a decision.

Unless a tagging operation is foolproof, some tag switching and other problems can be expected. Some people may elect not to return to that tagged tree. With tagged trees a grower must deal with the customer twice—once for tagging and once for harvesting. Tagging usually starts in the fall, sometimes as early as Labor Day, making the marketing season long. The biggest disadvantage is the "tagged-out-syndrome". After the first two to three weeks, a farm can look like it is sold out. The customer sees a sea of tags waving in the breeze and is convinced that all the high quality trees are tagged and there are none left for him or her. In reality, many high-quality trees may be left.

Tags may be supplied to the customer, or an employee may actually put the tag on the tree. Field and row numbers must be printed on the tag, in addition to serial numbers.

The biggest advantage gained by allowing tagging is that the fall weather it is usually beautiful and can often contribute toward higher sales. Another bonus is that deposits, if taken, boost early season cash flow.



Informative signs make the customer's experience a better one.

The customer will usually pay 25 to 50 percent of the purchase price, as a down payment.

CHOOSE AND CUT—Because of the disadvantages discussed previously, many growers have elected to eliminate tagging. In southern New England, 87% percent of growers have settled on choose and cut marketing. There are good reasons for the popularity of choose and cut selling. The grower is selling not only a tree, but an outing to the country. For many families, this annual excursion to the local tree farm is as much a part of the holiday season as Christmas dinner, and, if a good experience is provided, repeat customers will be plentiful. Furthermore, if a tree is not sold, it is still growing and need not be thrown away, as do cut trees on retail lots.

For choose and cut, the selling usually begins around Thanksgiving, although the trend is toward even earlier dates. Both tagging and choose and cut allow the customer to browse over the tree plantation, seeking the tree of their choice. After the "best tree" is harvested, the next best tree becomes the best tree on the farm. The customer never sees the trees that were cut and taken off the plantation, so comparisons cannot be made, as with the tagging method. In tagging operations, many potential customers compare the trees they have to select from to trees that are already reserved with a tag, and they may feel that they are having to settle for second best. Once the customer has chosen a tree, he or she either cuts the tree, usually with a bowsaw provided by the grower, or has the tree cut by a sales attendant.

Whatever retailing method is chosen, certain conditions are required for success. Adequate parking is a must with a parking space for every 10-12 trees sold on the busiest day. Unless trees are being retailed at a shopping center or the tree farm is on a busy highway, advertising in the local newspapers will be necessary. Liability insurance for the sales period will be required, and an adequate, but not excessive, labor force will be necessary, to keep customers happy and costs low. Forty-one percent of retail growers find they have to hire extra

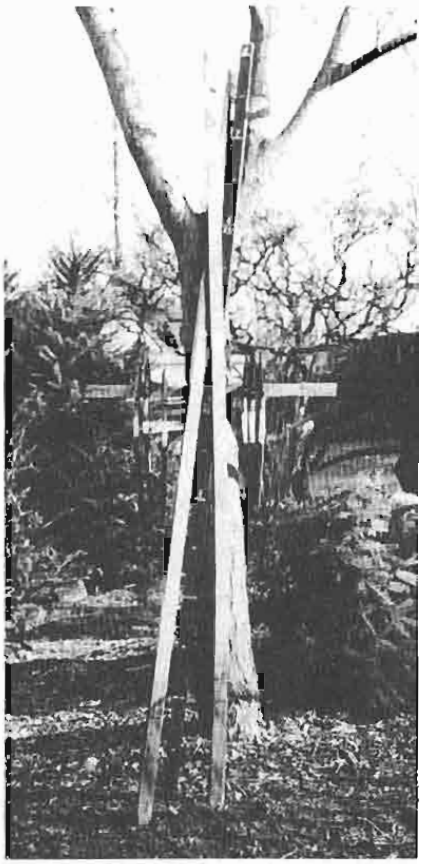
When laying out a Christmas tree operation, be sure to allocate sufficient space for off-road parking.

temporary help during the marketing and harvesting period.

Timing in retailing is crucial, perhaps even more so than in wholesaling. Depending on which day of the week Christmas falls, as much as 50% of the year's business can occur on a single weekend. A single day of bad weather or a day when a grower is not ready to sell trees can translate to a serious dent in profits. Well-kept annual records of weather, sales and trends can prove increasingly valuable with time.

To sell by the choose and cut method, it is necessary to plan plantings so that a continuous supply of marketable trees are available within dragging distance of the parking area. Tractor or horsedrawn rides to more remote fields can be provided, but this adds to operating expenses and slows the operation. Most growers plant in even-aged, single species blocks which are harvested over a two- or five-year period and then replanted. The alternative is to manage all-aged fields, which means that a tree is replanted the following year in each space where one is harvested. This method increases the chances that smaller trees will be damaged by customers trampling them, but some growers prefer it, nonetheless.

THE RETAIL LOT—We are all familiar with the retail lots in towns and cities. Overnight Christmas tree stands emerge on vacant lots, in garden centers, next to convenience stores and at gas stations. Many people have the misconception that there is easy money to be made selling Christmas trees in these lots. Competition to sell trees at retail lots is very real, and many retail lots go out of business each year, only to be replaced by other individuals ready to try their hand at this type of Christmas tree marketing.



Measurement sticks provided to customers will help them determine if a tree will fit beneath their ceiling. They are also useful for operations where trees are priced by the foot.

Theft of trees, high labor costs and customer price haggling are common difficulties encountered in operating a retail lot. Maintaining fresh, high-quality trees in retail lots is also a difficult task. The biggest disadvantage is competitor panic price cutting. If trees aren't sold by the middle of December, inexperienced lot owners panic and put signs up cutting tree prices in half or worse. Price cutting rarely makes an operation more profitable.

Retail lots can be used to one's advantage, if there are extra trees on the farm that can't be marketed at the farm. When looking for a lot, remember that a good location is the key to success. Be sure to plan for ample parking, customer traffic flow, a proper method of tree display, how and where extra trees will be stored, and dependable security. Permits, a vendors license, a sales tax license and insurance will probably be needed to sell trees at a retail lot. Keep in mind that, during the week, most sales are made in the evening, so lights will be needed. Consider where and how wreaths, roping, baskets and other associated materials should be displayed. Lots should not be overstocked; an unsold cut tree is a lost tree. Resupply the retail lot with freshly cut trees as they are needed. This minimizes the risk of great losses from unsold trees and the customer gets a fresher, higher quality tree.

Above all, a retail sales business must have a neat, attractive and safe sales area. The grower who displays some cut trees standing up and hangs 15 or 20 wreaths on an attractive wreath tree will always fare better than the grower who tosses some trees on the ground and nails two or three wreaths to the barn wall.

Having a well-organized, adequately staffed sales area facilitates the final sale of trees and hardgoods and keeps both the customer and sales personnel happy.

Finally, when the season is over, take stock of which trees did and did not sell and try to determine why. What species moved faster than others and what price ranges were people interested in? Were there problems with quality or were the trees simply displayed unattractively? Again, careful record keeping over time will indicate which changes in practices are needed to continually improve sales and profits.

Live Balled and Burlapped Christmas Trees

Over the past few years there has been a renewed interest in live balled and burlapped (B & B) evergreens as Christmas trees. Live trees are sold by 22% of southern New England Christmas tree growers. Live trees range from 2' potted trees to 8' B & B trees. Customers usually buy live trees to plant in their yard after Christmas. Common reasons stated for purchasing a live tree are:

1. A desire to plant a tree in their yard for landscaping purposes;

2. The economic value of spending the extra money for a live tree which can be planted, rather than buying a cut tree and throwing it away after Christmas;

3. The feeling (by some) that the idea of cutting down a living tree is unjust and unnecessary;

4. The planting of a live tree can serve as a first Christmas together celebration, a memorial to newborns and as an investment in the increased value of their property;

5. Those who do not have a place to plant a live tree can give it to relatives or donate it to a park or other organization.

Customers prefer blue spruce, white spruce, Fraser fir, white pine, Norway spruce, Douglas fir and concolor fir as live Christmas trees. The majority of sales are with 5' B & B trees because the rootball is a manageable size and weight, and because, when placed in a tub, the tree is actually close to 6' tall.

Live trees, either balled and burlapped or in containers, are in demand for those customers wanting to enjoy their tree for the holidays and also in their yard.

In the past few years, there has been a marked increase in demand for large B & B trees in the 6' to 8' size, particularly blue spruce, Norway spruce, and Fraser fir. This presents several serious problems for both the customer and seller, including the added work of delivery; the task of moving a 300-lb. rootball into the house; finding a tub large enough to hold the tree; removal of the tree after Christmas; the digging of a large hole; and the planting, staking and shielding of the tree to prevent winter damage. In addition to these concerns, the average price of a large tree can range well above $100. Nevertheless, many customers want a large live tree (many have cathedral ceilings) and are willing to deal with the added problems.

Without proper planting instructions and education concerning live trees, Christmas tree farms may experience a decline in the number of repeat live tree customers for several reasons.

1. Live tree customers, especially first-timers, may leave their tree inside for two to three weeks, although accepted recommendations are for five to seven days in the house. As a result, many trees will break dormancy, become deacclimated and die from subsequent exposure to severe winter conditions.

2. Some customers will find the extra effort of hauling the tree inside, watering the rootball, leaving the tree up only five to seven days, hauling the tree outside, digging and planting too much trouble and convert back to a cut tree.

3. The lower cost of a nice 7' cut tree is easier to justify than the much higher cost of a comparable B & B tree, which has no guarantee of survival.

The following policies will help ensure satisfied and repeat customers of a B & B operation. The main goal is for customers to have a successful addition to their landscape and become repeat customers during the next Christmas season.

1. Ask potential live tree customers how long they plan to keep their tree up. If they insist on two to three weeks, politely recommend they look at cut trees. If they can adjust to having a tree up no more than a week, then show them live B & B tree selections.

2. Make customers aware of the extra weight the rootball adds to a tree.

3. Explain that a live tree must be brought into and out of the house gradually to avoid temperature shocks.

4. Explain that a planting hole must be predug before the ground is frozen.

5. Explain that planted trees should be mulched, staked and protected from winds with burlap.

6. Every customer should receive a set of written instructions and should be encouraged to call the Christmas tree farm if questions arise.

There is a significant market for live B & B trees, but live trees as Christmas trees are not for everyone. Educating the customer on potential advantages and disadvantages and fully explaining the appropriate planting procedures is important. With the right customer and the correct care, a living Christmas tree can provide years of enjoyment in the homeowner's landscape as well as providing pleasure as a Christmas tree.

RENTING B & B TREES—Although the renting of B & B trees for use as Christmas trees is a new concept and not done on a wide scale, growers who have tried rentals have found business to be brisk. Trees used for rentals can be either container-grown or dug with a ball from the field. Containerized trees or B & B trees are stored in unheated overwintering hoop houses covered with white polyethylene plastic. Trees stored in overwintering houses can then be easily delivered to the customer on a specified date before Christmas. Rented trees are picked up after Christmas and returned to the tree farm where they are placed back in the protective overwintering structures. Rented trees can be grown for another season and can then be sold as a live tree, a cut tree or rented again. By renting trees, the grower can receive profit from the tree more than once.

Tree renting is popular with urban and apartment dwellers who want a live tree but cannot contend with the "hassles" of obtaining and discarding a tree. A rented tree is exactly what is needed by this group.

Rental fees are generally comparable to the cost of less expensive cut trees. Although Christmas tree renting is an evolving business, it appears to have considerable potential and should not be ingnored.

B & B LANDSCAPE TREES—Recently, Christmas tree growers have found an expanded market for their trees as B & B landscape trees sold in both the spring and fall. The potential for sales of quality evergreen trees, particularly blue spruce, white pine, Fraser fir, Austrian pine and white spruce, is expanding each year. The demand for good size B & B trees (5' to 8') is great. Owners of Christmas tree farms with good digging conditions can easily expand their selling season by digging trees themselves, hiring diggers or renting a tree spade to mechanically dig the trees.

The financial return on live B & B trees sold as landscape plants is often more than the return on trees sold as Christmas trees. The sale of needle evergreens as nursery plants provides cash flow in the early spring and fall when cash flow is typically low.

The several disadvantages of a live tree operation include the difficulty of digging trees in rocky soil, the added expense of labor and machinery and the need to provide a means for watering, digging and delivering a perishable commodity.

One must also deal with the fact that, once a B & B tree is removed, the grower is left with a hole in the field where a planting spot used to exist. On small farms in particular, the long-term value of the topsoil removed with a rootball may exceed the value of the tree itself.

Christmas Shops

Many choose and cut retail Christmas tree farms have found that a Christmas Shop as part of their operation adds significantly to the family Christmas experience and increases sales. From a simple display of ornaments on a shed wall to an elaborate two-story shop, many Christmas tree growers have entered the retail shop business.

Items featured in Christmas shops include tree ornaments, collectibles, imported German nutcrackers and incense burners, bulbs, garland, lights, handcrafts and many other gift lines. Many items can be handmade during the less busy months, or purchased from local craftspeople who enjoy making items but have no retail outlet.

The Christmas Shop can become a focal point where outside sales can be finalized, it can be an appropriate location for Santa Claus to make a visit and has the potential to produce income year-round (although most sales occur in November and December each season).

Related Products

In addition to Christmas trees, there are several related Christmas tree products which can lead to increased sales. Christmas wreaths, handmade or bought wholesale, will add significantly to sales. These can be custom decorated and delivered or shipped to friends and relatives in other states. The most popular wreath is traditional balsam, although boughs from Douglas fir, Fraser fir, white pine and Scotch pine will also make fine wreaths. Roping and cut greens are two other accessory products that many customers will want. Roping is made from a variety of species, including mountain-laurel, princess pine (a *Lycopodium*), white pine or mixed evergreen varieties. Greens can be cut from poor quality trees in the field or in lots and bundled for quick sales.

Another important sales product is a sturdy, high-quality tree stand. A tree stand can be easily sold by a knowledgeable salesperson, demonstrating the advantages and how it works. Some operators place the tree in the stand if the customer buys both the tree and the stand. The important points are to offer a top quality stand, provide clear instructions on how to use it and stand behind the product with service.

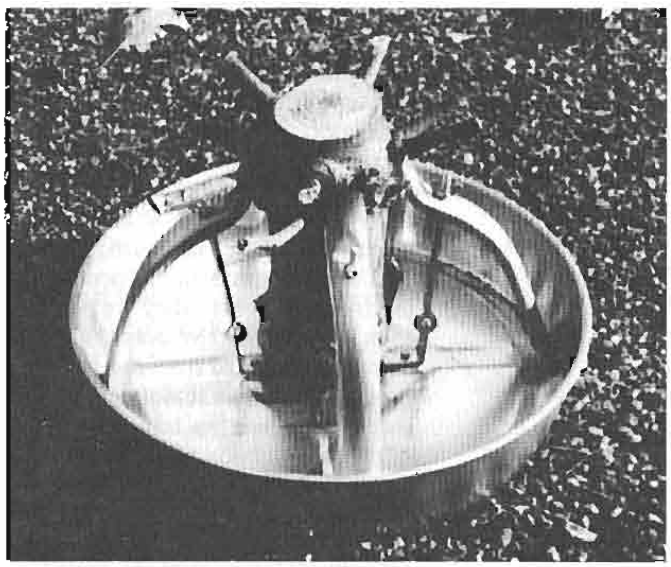
Additional services, such as tree shaking, baling trees and putting a fresh cut on the bottom of each tree will lead to increased customer satisfaction and increased repeat sales. Balers are used by 23% of southern New England retailers, and 2% use shakers. Allowing customers to return their trees after Christmas for chipping and composting is also becoming popular.

There are several marketing tips which can be useful to any Christmas tree retailer.

1. Keep a detailed list of all customers and their addresses, for future direct mailings.

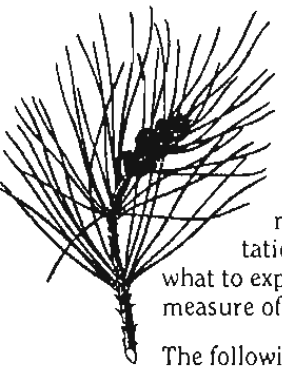
2. Identify your market and clientele and then develop a marketing plan to reach customers using a variety of media, including direct mail, radio, newspaper and even television. Offering special events and attractions can also help to draw customers to the tree farm.

3. Insist on a top-quality product and a well-trained and knowledgeable staff, and offer excellent customer service at all times.



Displays of items, such as stands, will help sell more hardgoods along with the trees.

XV. Christmas Tree Management Calendar



Planning is probably the single most important task to ensure that returns meet needs or expectations. Knowing what to expect is the best measure of success.

The following calendar is set up on a quarterly basis to allow some flexibility, but items are generally listed in their order of chronology and/or importance. The checklist format allows you to watch your progress, and the additional lines encourage you to add your own individual jobs or notes. This calendar is a beginning, so it is suggested that this list be incorporated into your own master plan. Perhaps a notebook with the list and the journal pages will help you, or perhaps you want to write the important jobs into your own production calendar. Either way, be sure to include time for planning and time for review into your schedule. Best of luck and good growing.

Note: Every attempt has been made to list activities in chronological order; nevertheless, you must check local conditions before doing any treatment.

Activities for JANUARY, FEBRUARY and MARCH

___ Conventions, meetings, education.

___ Remove culls, if necessary.

___ Bottom prune; check double tops.

___ Summarize all records from sales and cost of production.

___ File necessary quarterly taxes.

___ Pay sales tax, if not paid.

___ Review insurance.

___ Update customer records, analyze sales and marketing methods for possible changes.

___ Reevaluate and project sales activities, develop proposed changes for next year, file in appropriate place for later date.

___ Breathe deeply. Relax and enjoy winter.

___ Prepare tax records.

___ File chapter 61/61A early.

___ Limited shearing possible on spruce and fir, but pick warm days, to avoid shattering.

___ Have you reviewed your seedling order? Do you need to order additional trees?

___ Inventory all chemicals and fertilizers. Order only amount needed for one season.

___ Review pesticide license, attend update seminars and classes as needed.

___ Check, replace and replenish all safety equipment.

___ Check rodent damage, if snow cover permits.

___ Check all equipment to make sure it is ready for spring use.

ADDITIONAL NOTES:

Activities for APRIL, MAY and JUNE

___ Have you completed first quarter items?

___ Apply dormant oil spray, as soon as weather permits.

___ April is best month to plant in southern New England (rainy days are best).

___ Complete preemergence herbicide in early April or as soon as possible after planting.

___ Are you watching for insect activity, especially aphids and mites, on a weekly basis?

___ Treat Scotch pine stumps for weevil control.

___ File taxes, if not done already.

___ If disease is present, apply first fungicide at bud swell.

___ Is your mowing equipment ready?

___ **CAUTION: AVOID TRANSPLANTING, IF BUDS HAVE BROKEN.**

___ Apply second fungicide application at bud break. Follow label directions.

___ Apply white pine weevil control to tops of affected trees and those immediately surrounding.

___ Monitor sawflies and aphids. Apply controls as needed.

___ Apply postemergence herbicide as needed. Use care not to contact new tree growth.

___ Have you checked your shearing equipment?

___ Third fungicide application at 10- to 14- day interval, as label directs.

___ Mow as needed, especially just prior to shearing. Avoid exhaust burn on tender foliage.

___ Begin Scotch and white pine shearing toward end of June, or when "candles" are fully elongated and needles are 1/2 to 2/3 spread. Youngest trees first, oldest last.

___ Vegetation control (spot) as needed. Watch out for new, soft tree growth.

___ Review Christmas sales needs; order now, if possible.

___ Contact prospective buyers, if wholesaling

ADDITIONAL NOTES:

Activities for JULY, AUGUST and SEPTEMBER

___ Complete shearing of pines.

___ Order fall planting needs, after checking for spring mortality.

___ Is your equipment in good repair?

___ Mow only if needed for shearing or to reduce competition.

___ Begin shearing spruce, then fir.

___ Continue to monitor weekly for insects/disease. Apply controls only as needed.

___ Continue to spot treat herbicide, only as necessary.

___ Vacation? Conventions?

___ Prepare for sales season, check inventories and equipment, order supplies not previously ordered.

___ Tag/count saleable trees for this season.

___ Review sales procedures/traffic patterns/"glitches". Order signs if necessary.

___ Review insurance needs, if not already done.

___ Review and/or plan marketing strategy.

___ Visit other growers! Share information.

___ Late August apply insect control for pales weevil

___ Volunteer to staff fairs and booths.

___ Herbicide for brush control.

___ Late September control adult aphids.

___ Watch for late sawfly (second hatch).

___ Apply colorant to poor or off-colored saleable trees.

___ Fall planting/replacement, if not too dry.

___ Finalize advertising, if not done.

___ Enter trees in local fair/competition.

___ **Eastern States Exposition!**

___ Site prep next year plantings.

___ Plow fields due for renovation/soil test and apply fall lime and fertilizer if not done.

___ Avoid ground compaction. Mow only when necessary.

ADDITIONAL NOTES:

Activities for OCTOBER, NOVEMBER and DECEMBER

___ Have you finished planting?

___ Have you completed all herbicide treatments?

___ Have all insect controls been completed?

___ Review sales help; contact or recruit now.

___ Have you completed hazard removal and repair?

___ Order seedlings for next year's spring planting.

___ Clean and store equipment no longer needed.

___ Tag trees for sale if not done already.

___ Early choose-and-cut tagging?

___ Make sure all tax requirements and sales permits have been met.

___ Set up sales areas, Christmas shop, etc.

___ Rent or purchase cash registers and other equipment, if needed.

___ Send out customer notices and advertisements.

___ If wholesaling, check all harvest equipment and needs. Prepare to harvest.

___ Sell! Sell! Sell!

___ Clean up.

___ Inventory stock.

___ Bring your money to the bank.

___ Smile!

___ Take a deep breath, next year will be here before you know it!

ADDITIONAL NOTES:

Christmas Tree Terminology