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On the cover:

Christmas trees of several species are grown in North Carolina, from the Appalachian Mountains to the Atlantic Coast.

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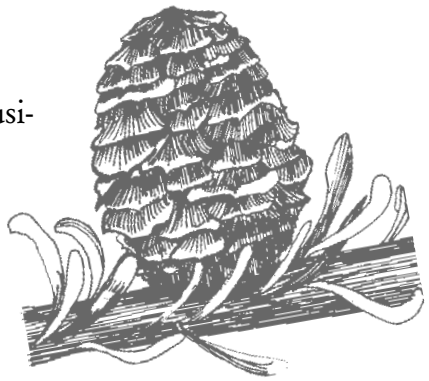
Contents

Growing **Christmas Trees** *in North Carolina*

This publication provides basic information to assist individuals in growing Christmas trees. It attempts to address the wide range of production, marketing, and business issues that may be encountered in such a venture. Please consult other references to obtain more information concerning a specific topic.



Fraser Fir

Commercial Christmas tree production requires a sufficient amount of suitable land. It also requires sizable amounts of labor and capital. Labor will be needed periodically, and special materials are almost certain to be needed seasonally for several years. Therefore, a potential grower should start with sufficient capital reserves to cover costs until income is realized from the sale of trees.

Eastern White Pine

Much of the normal cultural work, such as mowing, shearing, and pest control, must be done within the growing season, and frequently when the weather is hot or disagreeable. In contrast, harvesting is in late autumn or early winter, sometimes in bitter cold weather. In brief, the profitable production of Christmas trees requires intensive care with precise timing from planting to harvest. It is not an easy get-rich-quick scheme, but rather a long-term (5-10 years) business venture requiring a multitude of skills.

Virginia Pine

Unless professional advice is secured at the start, newcomers are advised to "grow into" rather than "buy into" the Christmas tree business. Efficient production of a few quality trees is more likely to prove successful than large-scale production of poor quality trees. At present there are no obvious limits on the number of quality trees North Carolina growers may sell. North Carolina growers are within 500 miles of approximately half the nation's population, so fresh trees can usually be delivered overnight to compete in a significant regional market.

Characteristics of Some Evergreen Trees

Before deciding which tree species to plant, a grower should consider several points. Characteristics of the different trees should be evaluated to determine which species will grow into high-quality trees on the available land and in the proposed climate. Consideration should also be given to the advantages and disadvantages of each potential Christmas tree species. For example, trees not native to the state may grow well in North Carolina, but such species may already be grown elsewhere in large numbers at low cost. On the other hand, the native Fraser fir is in great demand and can be successfully grown in limited areas, often giving western North Carolina growers a competitive advantage. The following species descriptions include trees that are commonly grown in North Carolina.

Fraser Fir

Fraser fir (*Abies fraseri*) is one of the more attractive species used for Christmas trees. This fir has a natural Christmas-tree shape, glossy dark-green foliage, strong branches that easily support ornaments, pleasing aroma, and excellent needle retention. Fraser fir has a highly restricted natural range in western North Carolina, eastern Tennessee, and southwestern Virginia. It occurs naturally at elevations above 5,000 feet. Fraser fir, however, is being grown successfully in plantations on fertile, moist, well-drained soils at lower elevations. At higher elevations, soil characteristics and aspect (direction which a slope faces) may not be critical. However, at lower elevations (below about 3,000 feet), soils and southern aspects are distinctly less favorable. Fraser fir is sensitive to drought and to poor soil aeration at any elevation. Poor soil aeration greatly increases the probability of the trees being killed by root disease. Locations with poor air drainage can form frost pockets, resulting in tree damage or death.

Even on good sites, Fraser fir plantings can be damaged or killed by balsam woolly adelgids. Mites are also frequently a serious problem. On well-drained sites, 8- to 12-inch transplants require about 8 years to grow into 7- to 8-foot trees. Fraser fir grows slower than several other species, but it also brings the highest price of any Christmas tree grown in North Carolina.

Eastern White Pine

Eastern white pine (*Pinus strobus*) is native to western North Carolina at elevations between 1,200 and 3,500 feet.

Figure 1. Christmas trees are an important part of North Carolina's agricultural production.

Figure 2. Fraser fir.

It has a soft blue-green foliage, pleasing fragrance, and good needle retention. Within its natural range, growth is seldom significantly hampered by variation in slope, aspect, or elevation. Outside the tree's natural range, however, a planting site must be chosen carefully. White pine is susceptible to root diseases, and it should not be planted in wet spots. Air drainage is also needed to avoid frost damage. White pine is occasionally infested by aphids and other insects.

On Piedmont sites, white pine plantings should be restricted to northern slopes with well-drained moist soils. Regardless of aspect, Piedmont soils underlain by a relatively impervious layer of clay within a foot of the surface should be avoided. White pine can be grown in the coastal plain, but there is abundant evidence that extending this species beyond its natural range is risky business. Typically it takes 7 to 10 years to grow a 2-year-old seedling to a 7- to 8-foot Christmas tree.

Figure 3. Eastern white pine.

Figure 4. Eastern Redcedar.

Virginia Pine

Native Virginia pine (*Pinus virginiana*) is generally considered to be of poor form and color, thus detracting from its use as a Christmas tree. It can be grown on a variety of soils from the coastal plain into the lower mountains. Growth is rapid, so rotations of 4 to 6 years are possible. At present, quality is only moderate. Virginia pine is much less sensitive to soil fertility than Fraser fir or white pine, but fertile, well-drained soil is best for vigorous growth and dark green foliage. The tree is subject to rust canker, but the most common problem is caused by tip moths. Poor color can generally be corrected by artificial coloring before marketing.

Redcedar

Redcedar (*Juniperus virginiana*) has been a traditional native Christmas tree in the Piedmont and coastal plain of North Carolina. Its chief disadvantages include prickly foliage, poor form and color, and weak branches. Redcedar dries out quickly after cutting unless the stem base is kept in water. This species should be marketed locally, because it is not suitable for shipping. Redcedar grows best on loamy soils of limestone origin, but it can be grown as a Christmas tree, with little shearing, on almost any site in North Carolina. *Phomopsis,* or cedar blight, is the major disease problem.

There is wide variation in color, shape, disease resistance, and needle characteristics among redcedar. Many redcedar trees in the wild represent escapes from ornamental selections.

Leyland Cypress

Leyland cypress (*x Cupressocyparis leylandii*) is a cultivated hybrid of Monterey cypress and Alaska-cedar. It is grown in all southern states as an ornamental and now is becoming popular as a Christmas tree. It can retain moisture after being cut, if kept well-watered, and has an attractive natural shape.

Based on trials in the southern United States, "Leighton Green" is the most desirable variety for Christmas trees. Leyland cypress grows well on a variety of soil types, with best growth on well-drained upland sites with pH of 6.0 to 6.5. Christmas trees are usually harvested within 3 to 6 years after planting. Significant pests include bagworms and cypress canker, although this species is generally considered fairly pest-free.

Because of its tendency to dry after being cut, Leyland cypress is only recommended for production on choose-and-cut farms.

Other Species

White spruce (*Picea glauca*), blue spruce (*Picea pungens*), and Norway spruce (*Picea abies*) are all grown in North Carolina. All of these spruces grow slowly and, except for Norway spruce, require from 10 to 15 years to grow to Christmas tree size. In addition to the slow growth, susceptibility to several pests may increase the cost of production. Norway spruce is plagued by white pine weevil, mites, and aphids. Needle cast diseases hinder blue and white spruce.

Introduced in limited quantity to the North Carolina mountains, white fir (*Abies concolor*) has been grown with

varying degrees of success. This fir has long needles of excellent blue-green color. Both needle retention and shipping qualities are good, although growth rates are slow. White fir's site requirements are similar to those of other fir species, but takes 10 to 15 years to grow to salable size. White fir is also somewhat susceptible to freeze damage and may be injured on sites where Fraser fir and white pine are not.

Establishing a Christmas Tree Plantation

Establishing a Christmas tree plantation begins with selection of species and site and includes site preparation and planting. Successful harvest of Christmas trees from any plantation is largely determined by the decisions made during this establishment phase. Suitability of the site for the species to be grown is of critical importance. Selection of an optimum site can minimize the risk of a number of production problems. Careful planning and layout of fields and farm roads can reduce pest management and harvesting costs. Proper site preparation can cut a year or two from the production cycle by providing an optimum environment for young trees. By planting only the highest quality planting stock, the health and quality of a plantation can be enhanced. A grower should proceed with establishment thoughtfully — mistakes made at this point have a tendency to grow and multiply.

Species Selection

The choice of Christmas tree species to be grown is largely governed by geographic region and climate. Some species require the mountain climate. Other species have traditionally been grown and marketed only in the coastal plain and Piedmont of North Carolina.

While species such as Fraser fir are primarily marketed through national or regional wholesale markets, other species, such as Virginia pine, are primarily marketed through local choose-and-cut markets. A potential Christmas tree grower must carefully weigh the growing requirements and business aspects of each species. Some of the questions to be answered before deciding which species to grow are:

❑ Will there be a market for these trees when they are ready to harvest?

❑ Can this species be grown on the land available, or am I willing to relocate to a more appropriate area to grow the species I want to grow?

❑ What special problems are involved growing this species?

The final choice of species depends on the availability of suitable land. Planting in areas not recommended usually leads to poor survival and growth, and subsequent reduced financial income.

Site Selection

Determination of site suitability for the selected species is one of the most important decisions. A potential Christmas tree producer should focus on finding land with the best possible characteristics. A landowner cannot simply choose a species based on local selling price for that crop. It would be better to succeed in a less profitable enterprise than to fail at Christmas tree production because the site was unsuitable.

Site suitability is governed largely by soil characteristics. A grower should inspect the soil conditions on potential sites. Is the topsoil more than 6 inches deep? Is the subsoil a heavy clay or a clay loam? Is there a hardpan? How deep do weed or existing tree roots grow? Is the soil compacted? Is there ever standing water on the site after a rain? Are there weeds on the site that indicate periodic water saturation, such as swamp grass or rushes? Any of these factors could indicate a problem. County soil survey maps can help determine soil type and suitability. A preliminary soil sample is also needed to evaluate the fertility of the soil.

The elevation and aspect of a site should be considered. Both of these factors influence microclimate and, to a large extent, the characteristics of the soil at a given location. Sites that face south and southwest and sites at lower elevations typically have warmer, drier soils in contrast to north and east aspects or higher elevations, which are cooler and more moist. In the mountains, elevations above 3,000 feet and north-facing slopes usually have more soil organic matter, while clay content tends to increase at lower elevations or on south-facing slopes.

The microclimate of a site determines the risk of freeze damage to buds or new growth. Trees may tend to break bud as much as 2 weeks earlier in the spring on warmer south- or southwest-facing slopes, as compared to cooler north-facing slopes. When there are risks of late hard freezes in an area, early budbreak is a liability that can cost a year's growth. The extent of frost damage can be compounded by other site factors that create a frost pocket. Any factor that reduces air drainage can keep cold air on site. Cold air drains poorly from flat land. Hills or

ridges above the planted area can trap cold air, as can a wall of trees along a property line.
The pattern of water flow and drainage in a site should be considered in site evaluation. Obviously, creeks and intermittent streams should be noted, as well as drainage ditches or culverts above the area. Surface evaluation not only indicates potential flood areas but also where soil may be saturated for extended periods. Flat or concave areas are particularly subject to slow water drainage. Moisture retention can also be evaluated in terms of aspect. Soils on south-facing slopes will be drier than those on adjacent north- or east-facing slopes. Such conditions can effect survival after planting, or tree growth during seasons in which a drought or flood occurs.

There are several other factors that might reduce the effective production area without eliminating the site altogether. Are there areas that are too rocky, wet, or steep to plant? Such areas might serve as staging areas for harvesting or road turn-arounds, even if they are lost to production. The prevailing slope may be severe enough to impede cultural management. Trees generally cost less to manage, and achieve market size faster on gentler slopes. Topography may restrict the use of mechanization. Are there "edge effects" from a tree line along a property border? Unless shade can be removed, such areas are almost certain to produce inferior-quality trees.

Site access should also be evaluated during the selection process. Harvesting must be accomplished in a variety of weather conditions. Good access becomes critical, both to the site on state-maintained roads and on the site with well-planned farm roads. With the short market distribution period, trees must be removed on schedule. However, easy access can also encourage theft. Plantations along public roads and those with multiple access points invite these kinds of problems. For security, the best location is at the end of a dead-end road with no other access. Occupied dwellings with a good view of the plantation can reduce the potential for theft. However, security can be augmented at easy-access sites and generally should not be a primary factor in rejecting a site.

Plantation Layout

Careful layout of tree fields, roads, and work areas before the plantation is established can result in cost savings in both management and harvesting. Roads through and around the field should be marked off, necessary drainage culverts installed, and grading accomplished prior to planting. Professional advice is recommended for road construction. Poorly constructed roads require extra maintenance, and still can fail. Improperly constructed roads can also create drainage problems that can lead to root diseases and erosion problems in tree fields.

As a general rule, no place in a plantation should be more than 100 feet from a road. Some growers space roads as close as 65 feet apart or about every 12 to 13 rows. Placement of field roads every 16 to 20 rows apart is quite common. This spacing facilitates spray applications from the road. It also minimizes the distance trees have to be carried during harvest. "Edge-effect" areas make excellent roads and equipment turn-arounds. Fifteen feet between rows should be left for secondary roads, with more width for main roads. As tree crowns develop, the usable width will be reduced to 10 feet or less (about the minimum to accommodate operation of trucks, tractors, and other machines without damage to the trees).

All-weather roads to a plantation should be graveled. Roads within the plantation that are used less frequently should be seeded to grass to produce heavy sod. Steep or wet roads may require installation of filter cloth and gravel to hold up to normal usage. Regular road maintenance and sod renewal pay off when roads must be used during unfavorable weather.

Some growers like to leave wider areas in the roads at strategic locations for work centers and collection points in harvesting. Designation of work areas, however, is not critical, and many growers operate without them.

Site Preparation

Once a suitable site is selected, it must be prepared for planting. The degree of site preparation will depend on the current condition of the land and the requirements of the intended planting technique. Forests, abandoned fields, and pastures each need different operations to be readied for planting. Machine planting requires a more prepared surface than does planting by hand. Site preparation might involve pushing stumps and rocks, raking roots, and smoothing the ground with a bulldozer. It might also involve disking, chisel plowing, strip-tilling, or subsoiling to provide favorable soil conditions for tree establishment.

Where soil erosion or compaction is probable or when capital is limited, growers may choose less intensive site preparation practices. However, cost savings during site preparation are often countered by increased costs during planting and early production. Regardless of the economics, potential impacts of site preparation, especially on marginal soils, must be carefully considered before heavy equipment is used.

Initial land clearing must be both cost effective and favorable to future production. Little or no clearing is necessary for existing croplands or pasture, while forest-

Figure 5. Using large equipment for site preparation is efficient but is not suitable for all areas.

land or abandoned land may require extensive work. Extreme care should be taken to not work on the land when the soil is too wet. Heavy equipment, including skidders, bulldozers, and farm tractors, can compact wet soils to depths in excess of 16 inches. Compaction becomes worse with each additional pass of heavy equipment, particularly under the wrong soil conditions.

Traditional intensive land clearing involves bulldozing debris into windrows. Intermediate techniques involve the use of dynamite or a backhoe to lift stumps from the ground without scraping topsoil away. The slash can then be piled with minimal soil disturbance. Many growers are choosing to leave the largest tree stumps and sacrifice space for a handful of trees per acre to avoid soil disturbance and compaction caused by moving stumps. The lowest intensity land clearing techniques involve cutting and piling the debris by hand with the help of available farm equipment. Farm size frequently dictates the techniques that a grower selects, but with any land clearing, preservation of topsoil must be a primary goal.

Future management must be considered in relation to the degree of land-smoothing conducted. Where growers plan to rely on manual fertilization and herbicide application, the field can be much rougher with occasional rocks or stumps. If a grower plans to mow regularly with a tractor or walk-behind mower, smooth land is a necessity. Achieving a perfectly smooth field can have a cost in soil compaction. Mowing is also more expensive than most herbicide applications. Thus, many growers are settling for less manicured fields.

Often, initial land clearing is completed the year before planting to allow time for site preparation. Herbicide control of re-sprouted or emerged woody and perennial weeds in late summer or early fall of the same year can control weed problems. Hardwood sprouts, vines, and briars are easier to control without the complication of newly planted trees.

If the soil was not tested during site selection, samples should be collected before site preparation is completed. This could be the only good opportunity to work certain nutrients into the soil as the presence of trees limits some fertilization practices. Phosphorus and lime do not move readily in the soil and may not be available in the root-zone for a considerable time following application to the soil surface. These same chemicals also do not readily leach, so once incorporated into the soil, they remain available to the trees. One of the important functions of phosphorus fertilization is to lessen transplant shock. This can occur only if the phosphorus is immediately available to the newly-planted tree. If these materials are needed, they should be applied before tilling in the amount that will meet requirements for at least the beginning of the production cycle. Other nutrients can be applied before planting, but may be more likely to leach over time.

Depending on the condition of the land, several techniques may be used between clearing and planting to improve the tilth, drainage of the soil, or both. Generally, tillage techniques are only used when there are fertility, drainage, compaction, or some combination of these problems on site. On former pasture land, which is often severely compacted, use of these techniques can be especially important. To minimize erosion problems, tillage should be done along contours.

Where true hardpans exist in coarse-textured, sandy soils, subsoiling is an approved practice to improve internal drainage. Growers have used chisel plows, large disks, and various types of cultivators to till the soil. Subsoilers may be used in both directions on a planting grid to provide four channels for root growth. However, in silt or clay soils, subsoiling has little long-term benefit to drainage because the channels quickly fill up with fine soil particles. On finely-textured soils, tillage can be of great benefit, particularly where surface compaction exists. Although long-term drainage may not be enhanced, tilth is improved for the tree establishment period. Tillage should be completed in the fall or early enough in the spring to allow soil to settle prior to planting.

On sloping land, some growers are reluctant to tear up established weeds or sod for fear of accelerated erosion. If heavy rains occur before new groundcover becomes established, severe site damage and loss of valuable topsoil may result. When tilling is done in the fall, rye or some other cover crop is sown over the area to minimize

surface runoff. Some growers establish sown groundcovers between their trees, because it can be managed more uniformly and easily with less herbicide than the native weed growth.

Finally, it is not enough to know that the site selected is suitable in elevation, soil type, and location for the species to be grown. There must be adequate expenditure of time, labor, and materials in developing the layout of the area and preparing the site. Proper attention to these items can spell the difference between the success or failure of the entire venture.

Selecting the Planting Stock

Regardless of species, choosing the right size, age, and quality of planting stock is very important. If healthy, vigorous nursery stock is used, harvesting in a field may begin a year or two earlier. A buyer should examine the seedlings closely. Signs of seedling health include light-colored roots (tan, red, or light brown) with no stripped root tips, and uniformly green foliage. A number of private nurseries grow and sell seedlings or transplants (also called liners) suitable for Christmas trees. Conifer seedlings are also available from the North Carolina Division of Forest Resources and other state nurseries on an as-available basis.

Growing Your Own Planting Stock

It is possible to grow your own seedlings and transplants or even to develop seedling transplant production into a full-scale enterprise. Production of these initially small and tender seedlings is not suited to the management goals of every Christmas tree grower. Some species of Christmas tree take only 1 year to achieve a seedling large enough to plant in the field. For others, 4 to 5 years are necessary. In purchasing seed for seedling production, be sure to deal with a reputable firm that guarantees seed source origin. An alternative is to personally collect the seed from native stands. In either event, the seed should be tested for germination and treated with a fungicide before sowing.

The site for a nursery bed should be level, fertile, well-drained and stone-free, with a deep, sandy loam topsoil. The site should be free of perennial vegetation, controlled either by herbicides or tillage. The soil should be tested for nutrient deficiencies before seed sowing. If soil analysis shows a need for phosphorus or lime, the material(s) should be applied and tilled into the soil before planting. Soil fumigation will control both weed seeds and many soil-borne diseases and should be done either the fall or spring before the beds are sown. Seedbeds can be prepared in the fall or spring. Many producers till, fertilize, and fumigate their fields in the fall but wait until spring to build raised beds. Soils are often dryer and easier to work in the fall and there is more time to allow for potential delays.

Most seedbeds are built 4 feet wide with 2-foot aisles between the beds. Beds should be designed to fit the wheel width of the tractor to be used. Beds are usually elevated 6 to 8 inches above the aisles. The surface of the bed is finely tilled and then smoothed prior to sowing seeds. The equation below can be used to calculate sowing rate.

$$\text{Pounds of seed required} = \frac{\text{Area in sq. ft.} \times \text{Seedling density per sq. ft.}}{\text{Germination \% of seed} \times \text{number of seed per pound}}$$

More seed should be sown than indicated by the calculated sowing rate to cover losses by insects, diseases, birds, and rodents. Seedling density varies with the species. Firs and spruces should not exceed 40 to 50 plants per square foot. Pines and redcedar should have a density of not more than 35 plants per square foot. Immediately after sowing the seed, the surface of the bed should be rolled or pressed to ensure firm contact of the seed with the soil.

Seedbeds should be covered with ¼ to 1 inch of pine straw, composted sawdust, hardwood bark, peat moss, or other organic material. Fresh sawdust should not be used. Mulch conserves moisture and protects tender plants during germination and early establishment.

Seedbeds should be fertilized according to the specific needs of the species grown and recommendations from the soil test. Nitrogen and potash fertilizer should be used sparingly the first year. In the second year, seedbeds should be top-dressed with nitrogen usually split into three applications in April, May, and June. A late summer application of potassium, not exceeding soil test recommendations, will speed the process of seedling dormancy in some species. If seedlings lack vigor, good color, or both, additional soil samples should be analyzed.

Irrigation water of suitable quality should be available with a full irrigation system installed. Water must be applied to the beds as needed each day following sowing. When seedlings are emerging, more than one application per day may be necessary. During rainless periods, water should be applied at the rate of approximately 1 inch per week after germination and throughout the first growing season.

Figure 6. Quality seedlings and transplants are important aspects of plantation establishment.

Figure 7. Machine planting of trees is often preferred to planting by hand.

Fraser fir and spruce seedlings develop better if grown under partial shade during the growing season. Above elevations of 3,000 feet, the seedlings do best under 30 percent shade the first year and no shade the second year. At lower elevations, Fraser fir may need 50 percent shade the first year and 30 percent the second year.

Pines and redcedar usually grow enough for field planting directly from the seedbed. However, after 2 or 3 years in a seedbed, firs and spruces need to be transplanted to a line-out bed for 2 years. This disturbance stimulates the root system and produces a more balanced plant. Transplant beds require well-drained soils and raised-bed construction similar to seedbeds. Transplant beds should have irrigation water available and, as with seedbeds, should be fumigated in the spring for fall prior to planting. Seedlings are spaced 6 to 8 inches apart in the transplant beds. If transplanting by hand, a transplant board and a trenching tool will speed the effort. For large quantities of seedlings, the cost of renting or purchasing a mechanical transplanter may be justified. Seedlings should be transplanted with the roots fully extended downward and the stems upright. Properly handled transplants will be straighter and easier to outplant.

Outplanting the Trees

Success of outplanting largely depends on the care given plants before and during planting. Planting should be done during the dormant season, with planting dates varying with geographic area. While fall planting can be successful, most Christmas trees are planted in early spring (Table 1). Soils are cooler and retain more water and there is usually more rainfall in the spring to support young trees.

Table 1. Suggested times for planting Christmas trees in the spring

Location	Time of Planting
Coastal Plains	January through March
Piedmont	February through April
Mountains	March through mid-May

Planting should be delayed if adverse conditions are likely to reduce either the quality of planting or later survival. No planting should be attempted when surface soils are too dry, too wet, or frozen. Unless the soil is in tillable condition, seedling roots can not be properly packed. Roots die if exposed to air in poorly packed planting holes. Under wet soil conditions, soil is likely to be compacted during planting, aggravating soil drainage problems.

If dormant seedlings are to be field-planted within 4 weeks after they are received, they can generally be stored in the shipping package. From the time trees arrive until they are set out, they should be stored in a cool, dark place, preferably under 50 degrees F. Roots must not be allowed to dry out. Failure to keep the roots moist has contributed to many unsuccessful plantings.

Planting time is an excellent opportunity to remove cull trees. Many growers grade their planting stock before going to the field. They evaluate stem diameter (or caliper), height, vigor of the root system, and presence of a dominant terminal bud or single top. Cull trees are likely to remain a poor investment, but some growers reset them in a transplant bed in an attempt to grow them up to grade.

For a majority of low-grade trees, however, a cull remains a cull. They can cost years in reduced efficiency and increased costs.

While grading seedlings, many growers root-prune their planting stock. Root-pruning can reduce the incidence of "J-rooting" or "U-rooting" that occurs when planting too large a seedling into too small a hole. Root-pruning should target only the excessively long roots, as severe root-pruning can reduce plant survival. Ideally, planting stock should have as much volume in the roots as in the top and never exceed a two-to-one ratio of top to roots. It would be better to dig a deeper hole than to cut off too many roots. Root-pruning can also spread root diseases. Periodic sterilization of the knife or hatchet with a disinfectant is recommended to minimize this risk.

Even during planting, care should be taken to keep the roots moist. Many growers root-dip their transplants in a water-retaining planting gel. Trees should be protected from direct sunlight at all times. Loosely stored trees or seedling packages should be kept in the shade, tarps, which can trap heat, should not be used. Trees should be carried from package to planting site in a bucket, planting bag, or tray with damp moss covering the roots. When hand planting, trees should be removed from the container one at a time as each hole is dug.

Several planting methods have been used successfully, depending on the planting site. Across North Carolina, tractor-pulled tree-planting machines are used on open land where larger numbers of trees are being set. Most hand planting is done with planting bars or spades. Some growers use hand-held power post hole diggers to provide a tilled planting hole for transplants. However, using post hole diggers in clay soils can be difficult, and can result in a sealed hole, which results in trees becoming "pot-bound." For very rough, steep, or erodible land, hand planting may be the only practical choice. If the planting site is suitable and properly prepared, machine planting is more efficient. Machine-planted trees may require some hand straightening and packing in, but survival often exceeds that of hand planting.

Precise spacing is advantageous for Christmas tree production, because each tree has more uniform growing conditions, and cultural practices become easier to complete. Christmas trees must be planted "in-line" in either straight rows or in rows on the contour. "Off-set" trees may be damaged or destroyed by machinery used for cultural practices, especially mowing. To keep trees in-line and uniformly spaced, many growers stretch a string to mark off each row as it is being planted. The string may have the in-row intervals marked on it as well. Other growers carry a measuring stick to mark off tree spacing both within and across rows. Some tree planting equipment is designed to precisely space trees, resulting in equal distances between trees within rows.

Spacing trees the proper distance is very important to growing quality trees. Correct spacing varies by species, intended tree size, and amount of mechanization. As can be seen in Table 2, even a small change in spacing can make a large change in the number of trees per acre. It is important to note that as the trees grow together in a tight spacing, they shade bottom branches of adjacent trees, reducing quality.

Table 2. Common tree spacings and the corre-sponding number of trees per acre

In-row x Across-row (feet)	Number of trees / acre
4 x 4	2,720
4 x 4½	2,420
5 x 5	1,740
5 x 6	1,450
6 x 6	1,210
7 x 7	890

Depending on the existing groundcover, the marked rows may need to be banded with a pre-emergent herbicide several weeks before planting. In other situations, trees and emerged weeds can be oversprayed with a post-emergent herbicide after planting. Generally, tall weed growth is allowed in row middles during the first year to provide partial shade as long as there is no immediate competition around the tree. The fields should be periodically scouted to check for problem weeds, such as vines, that can quickly escape control.

Even with ideal conditions, most growers expect to lose 1 or 2 percent of their trees the first year. If establishment stress is compounded by insects, disease, poor weather conditions, or by poor planting technique, much higher losses can occur. Planting success should be evaluated during the first year. Unless losses can be attributed to a soil-borne disease, any gaps may be reset

the following planting season, depending on species. If a root rot disease is the cause of death, replants of the same species are as likely to die as the initial planting.

Pest Management in Christmas Trees

Integrated Pest Management

Integrated pest management is a system of pest control methods that uses appropriate cultural practices and pesticide selection to reduce pest problems. The following are important considerations when trying to reduce pest problems.

Site Selection. Most conifers are very sensitive to the type of site on which they are grown. Several insect and diseases become a worse problem when Christmas trees are grown on poor sites. *Phytophthora* root rot only occurs on wet sites or in areas of the field where water tends to flow. The spruce spider mite is often worse in Fraser fir on south facing slopes because of the warmer or dryer conditions.

Scouting. Most pests of Christmas trees can cause considerable damage if left untreated. However, applying pesticides without prior knowledge of pest numbers in a field wastes pesticides, is harmful to the environment, and can actually cause outbreaks of secondary pest problems. Therefore, scouting fields on a regular basis to estimate pest numbers is imperative.

Groundcover Management. The choice of groundcover affects every other management practice including fertilizing, insect control, shearing, and harvesting. By maintaining appropriate groundcovers around Christmas trees, natural insect and mite predators have a habitat in which to thrive so they will be present to control pest problems. See the "Weed Control" section of this publication for groundcover management suggestions.

Interplanting. After a block of trees is partially harvested, some growers interplant among remaining trees. However this practice can be a poor management strategy. Pests that are more common on older trees will attack the younger trees sooner than if young trees were set in a separate block. Control of these pests will be made more difficult and will be ongoing. Clearcutting a block before re-planting is generally the best practice.

Selective Harvesting. With some pests, pesticide controls can be reduced or even eliminated if the trees showing the worst damage are harvested as soon as possible. Tagging problem trees for harvest while scouting is a cheap and environmentally friendly way to control these pests.

Pesticide Selection. There are often several pesticides labeled for the control of certain pests. However, some pesticides create problems with non-targeted pests even while they control the target. Always use the least toxic pesticide at the appropriate time and at the lowest rate consistent with the control needed.

Spray Equipment and Coverage. Several insect pests of Christmas trees are particularly difficult to control. Some require thorough coverage of the entire surface of the tree, which can only be achieved with a high-pressure sprayer and a hand-held spray gun. Other insect pests require less thorough coverage and can be controlled when pesticides are applied with a mist blower. Most herbicides are applied with backpack sprayers.

Many pesticides labeled for use on pests of Christmas trees are classified as restricted use pesticides and require a grower to have a private pesticide applicators license. Growers who employ workers must follow the Worker Protection Standards. When using any pesticide, be sure to follow all personal safety guidelines including personal protective equipment and restricted entry intervals.

For growers interested in growing Christmas trees organically, certain products like horticultural oil and insecticidal soap can give good control of pests if spray coverage and timing are excellent.

Treatment of Common Christmas Tree Pests in North Carolina

The following summary (Table 3, page 11) shows the conifer species grown in North Carolina, the pests common to those species, and the likelihood that the particular pest can be a significant problem needing treatment during a rotation. Additional information can be found in the Christmas Tree Note series from North Carolina State University.

Insects

Balsam Twig Aphids (*Mindarus abietinus*). Balsam twig aphids (BTA) are small, pale green aphids that feed on fir and spruce trees in the spring. Feeding on the new growth of Fraser fir often results in permanently curled needles. Heavy infestations can also stunt growth.

This aphid is common in western North Carolina and can cause severe damage. Fraser fir Christmas trees should

Table 3. Summary of pests and common treatments for North Carolina Christmas tree species

Tree Species	Pest or Disease	Notes on Common Treatments
Firs		
Fraser fir, balsam fir,	Balsam twig aphid	Treat last 2 years before sale
white fir, Canaan fir, and	Balsam woolly adelgid	Treat 1 to 2 times in rotation
Douglas-fir (not a true fir)	Spruce spider mite	Problem during dry years
	White grubs	Scout before setting trees in pastures
	Cinara aphids	Seldom a pest
	Rust mites	Seldom a pest, but becoming more prevalent
	Rosette bud mites	Only in some areas; treat 3- to 5-foot trees
	Phytophthora root rot	Only a problem in poor planting sites
White pine	Pine bark adelgid	Treat 1 to 2 times in a rotation
	Cinara aphids	Seldom a pest
	Rust mites	More common in warm springs
	Pales and other weevils	Usually found near harvested pine stands
	Pine sawflies	Seldom a problem
	Pine leaf adelgid	Found periodically in some mountain counties
	White pine blister rust	Seldom a problem
Virginia pine	Pine tip moth	Treat 3 to 4 times per year
Leyland cypress	Bagworms	Treat as required
Eastern redcedar	Cedar blight	Treat as required by infection
Spruces		
Blue spruce,	Eastern spruce gall adelgid	Common problem
Norway spruce, and	Cinara aphids	Not common
White spruce	Spruce spider mite	Problem during dry years
	Needle cast	Not common

be treated the last two years before sale. Younger trees may also need treatment if damage is severe. Trees must be treated in the spring before bud break. Once the aphids have gotten into the newly broken buds, it is difficult for insecticides to reach them.

Balsam Woolly Adelgids (*Adelges piceae*). The balsam woolly adelgids (BWA) are tiny, soft-bodied insects that appear as white, woolly spots on Fraser fir. This adelgid is native to silver fir of central Europe, and was introduced to this continent before 1900.

These adelgids are very small and difficult to see. It takes several months for trees to develop symptoms of insect damage. Because of this, the number of adelgids can increase unnoticed and cause serious losses for unsuspecting growers. Luckily, adelgids take a year or more to spread to many trees, so through careful scouting and conscientious control, serious losses can be avoided. Infested trees should be sprayed as soon as adelgids are observed with a high-pressure sprayer.

The primary symptom of balsam woolly adelgid attack is a flat top or weak leader. Other symptoms include dead shoots or branches, swelling around the shoot nodes (gouting), reduced shoot growth, a stiff trunk, and growth rings with red, hard wood instead of the healthy, creamy white wood (observed when trees are cut).

Pine Bark Adelgids (*Pineus strobi*). The pine bark adelgids are tiny, soft-bodied insects that suck sap from the bark of both the trunk and branches of white pines. These adelgids appear as white, cottony spots. Large numbers cause yellow and stunted needles and reduced shoot growth. Damage is seen primarily on seedlings and young trees.

Immature adelgids move to new growth during shoot elongation. Each year, check trees for the presence of pine bark adelgids when pruning top growth. Spray infested trees as soon as possible with a high-pressure sprayer.

Pine Leaf Adelgids (*Pineus pinifoliae*). Pine leaf adelgids alternate between white pine and red spruce. It is only a problem on pines during odd-numbered years in western North Carolina. Adult female adelgids fly onto pines in June, produce eggs, and immediately die. The crawlers, which hatch from the eggs, move onto the new growth. At low numbers, pine leaf adelgids are beneficial, stimulating bud development. At high numbers, the adelgids cause "flagging" and distorted growth. Trees should be scouted in June to determine if adelgids are present. Damage can be prevented by prompt treatment with an insecticide. The pest is only a problem near native stands of red spruce.

Cinara Aphids (*Cinara* spp.). Cinara aphids are a group of several species of large, brown or black aphids that feed on many conifers including white pines, Virginia pine, Fraser fir, and spruces. They are much larger than balsam twig aphids, and are usually found in the early spring in dense clusters or colonies of up to several hundred aphids on the terminal, trunk, and first whorl of branches. They feed (suck the sap) on the bark between needles. Several dozen to several hundred trees on an acre may be affected and the rest remain clean.

In most instances, Cinara aphids have no affect on tree growth. They are easy prey to predators such as ladybugs, and usually disappear after several weeks. However, Cinara aphids can promote the growth of sooty mold and can create problems if they hatch out on Christmas trees in people's homes. In rare instances, extremely high numbers of Cinara aphids feeding on trees before bud break can reduce terminal growth during years of drought.

Because Cinara aphids can damage trees or become a problem on harvested trees, it may be necessary to control them in trees going to market. Usually, control is only necessary if there are high numbers on many trees in a field.

Spruce Spider Mites (*Oligonychus ununguis*). These mites are tiny, soft-bodied pests that suck sap from the needles of conifers. Spider mite-infested needles first appear off-color from a distance, and speckled or stippled when viewed closely. As the number of mites increases, the damaged needles can become rusty, bronze, or brown in color by late summer or early fall. In addition, webbing produced by the mites is visible on the needles of heavily infested trees. Heavily damaged needles drop prematurely. Damage is permanent.

In the spring, mite eggs hatch and mite feeding, development, and reproduction occur almost continuously throughout the spring, summer, and early fall. In the fall, overwintering eggs are laid among bud scales and at the base of needles.

A number of effective miticides are approved for spider mite control. To minimize the presence of spruce spider mites in a Christmas tree plantation, inspect trees frequently during the spring, summer, and early fall for spider mites or any signs of their presence. Treatment should be applied only when economic damage threatens to be significant. Pesticides that kill the mites' natural predators should be avoided.

Rust Mites (*Nalepella* spp.). Rust mites are eriophyid mites, a group of tiny, elongated mites with four legs instead of eight, that require a hand lens or microscope to see. They feed on the needles of several conifers including white pine and Fraser fir. On white pine, they cause the needles to turn brown and die. Damage is usually confined to an area on the upper southeast portion of the tree. On Fraser fir, damaged needles appear bronze or rust colored, and may be on one side of the tree or throughout the tree. Damaged needles often shed prematurely. Rust mites are more common during long, warm springs and often disappear in the summer. Trees should be scouted to determine if treatment is necessary.

White Grubs (*Phyllophaga* and *Polyphylla* spp.). White grubs are the immature stage of beetles. Depending on the species, grubs can live in the soil for up to 3 years before maturing into adult beetles.

White grubs damage trees by eating the roots. The needles of damaged trees will yellow, and the trees will eventually die. These symptoms can have many causes besides white grubs, especially on trees set 1 or 2 years in the field. *Phytophthora* root rot, drought damage, and

Figure 8. Scouting for insects is an important part of Integrated Pest Management.

improper planting can produce identical above-ground symptoms.

To distinguish white grub problems from other problems, a sample of affected plants should be pulled up and the roots examined. Grubs will eat the feeder roots and bark from primary roots, leaving little of the root system, though what is left will appear healthy. The grubs can also be found in the adjacent soil.

The grubs that eat conifer roots are the brown May and June beetle grubs. These grubs prefer the roots of grasses or wild strawberries. However, when they are present in pastures where herbicides have completely killed grass sod, they may be forced to eat the only remaining fresh food — the recently planted conifer roots. Though grubs are primarily a pest of young trees, older trees can also be damaged if grass growing between rows is suddenly killed because of herbicide applications or drought.

Fields should be scouted for white grubs before trees are planted. Grubs are difficult to kill, because insecticides may be bound to the clay and organic matter in the soil and will not move deeply enough into the soil to effect the grubs. Grub control is improved if the pesticide can be incorporated into the soil, which can only be done before trees are planted. It is especially important to scout old pastures that are to be planted, since grubs are extremely common at such locations.

Rosette Bud Mites (*Tricetacus* spp.). Rosette buds are deformed buds on Fraser fir. They are larger than normal buds and are rounded instead of pointed. Rosette buds usually do not break in the spring. If they do break and develop, they form multiple, weakened shoots. If many rosette buds are found on a tree, the tree develops holes in the canopy, especially if the tree is young when first affected. This decreases the quality and marketability of the tree.

Rosette buds are more common at higher elevations and in specific counties of western North Carolina. Rosette buds are caused by an eriophyid mite similar to rust mites except that it produces a gall, in which it lives throughout the year, where the bud should be.

Eastern Spruce Gall Adelgids (*Adelges abietis*). The eastern spruce gall adelgids produce a cone-like gall on the shoots of spruces. The immature adelgids feed and mature inside the gall. An appropriate insecticide can be applied in the spring prior to budbreak.

Bagworms (*Thyridopteryx ephemeraeformis*). Bagworms are caterpillars that live in bags made of foliage and silken threads. These insects prefer to eat the needles of redcedar and Leyland cypress. However, they will also cut the foliage of other conifers.

Young bagworms can be controlled in June with an approved insecticidal spray. In the fall and winter, the eggs are present in the bags attached to trees. The bags should then be removed and burned. In many cases, natural enemies keep bagworms from becoming numerous.

Deodar Weevils (*Pissodes nemorensis*). These weevils are small, tan, snout-beetles, which look similar to white pine weevils. However, the annual life cycle and breeding habits of these two weevils are quite different. Deodar weevils chew on the branches and shoots of various conifers. If a large number of weevils are present, shoots and branches could be pitted or scarred and killed as a result of weevil feeding.

Deodar weevil infestation can be reduced by following both the white pine weevil and the pales and pitch-eating weevil control procedures. Generally, removing and destroy-ing high stumps, discarded limbs, and dead trees will elim-inate most of the potential deodar weevil breeding sites.

Pales Weevils (*Hylobius pales*) and **Pitch-Eating Weevils** (*Pachylobius picivorus*). These weevils are dark brown or black, robust, hard-shelled snout-beetles. They chew on the bark of conifer shoots, branches, and seedlings, particularly of pine. Both of these weevil species are found throughout the eastern United States and, in some cases, into Canada. However, they are more common in the South. Depending on location, their biology varies to some degree, but the nature of damage and the mode of control remain the same.

Dead or dying new pine seedlings, older tree branches, and shoots are usually the first noticeable indication that

these weevils are present. The bark at the base of young seedlings fed on by these weevils will appear to be either completely or partly removed. On older pines, small resin-filled holes or pits in the bark of stems, shoots, and (living or dead) branches are signs of weevil feeding.

Insecticides can be used to protect newly planted pine seedlings. However, these insecticides can be time-consuming to apply, and if proper safety precautions are not strictly followed they can be very toxic to humans.

Nantucket Pine Tip Moths (*Rhyacionia frustrana*) and **Pitch Pine Tip Moths** (*Rhyacionia rigidana*). These moths are small insects that have a small, orange colored caterpillar stage that bores into pine shoots (tips) and buds. White and longleaf pines are seldom attacked. The appearance, biology, damage, and control of these two insects are similar.

The brown or rusty-red, dead pine tips is the most noticeable indication that tip moths are present. Dead needles on a tip moth-killed shoot are usually not as long as the living needles on the undamaged part of the shoot.

Several insecticides are approved for controlling pine tip moths. Systemic insecticides, either sprays or granular, can sometimes provide better control than non-systemic insecticides. Proper timing of spray applications is critical to successful control of tip moths.

Pine Sawflies, such as the **Redheaded Pine Sawfly** (*Neodiprion lecontei*) and the **Virginia Pine Sawfly** (*Neodiprion pratti pratti*)**.** These insects eat pine needles. The redheaded pine sawfly has a caterpillar-like larvae with a reddish head and rows of black spots on a yellow body and commonly feeds on Scotch, Virginia, and white pines.

Virginia pine sawfly larvae have black heads and pale green bodies with black stripes. They commonly feed on Virginia pine. The biology, damage, and control of these and other pine sawflies are similar.

Groups of sawflies are often observed feeding on pine needles. Other indications that sawflies are probably present are the reddish-brown, straw-like remains of incompletely consumed needles or the bare twigs stripped of needles.

Pine sawflies can be controlled with an approved insecticidal spray. Multiple applications may be needed if more than one generation occurs.

White Pine Weevils (*Pissodes strobi*). These insects are small, tan, snout-beetles with two white spots on the rear of their bodies. They chew on, and develop under, the bark of white pine leaders. They also attack Norway spruce and Scotch pine.

Although white pine weevil attacks usually occur during April, they frequently go unnoticed until later in the spring when pitch begins to flow from feeding punctures. These punctures are left by adult weevils in the bark of the preceding year's leader. By late spring or early summer, the new growth appears stunted, needles wilt, and the new leader assumes the shape of a shepherd's crook.

White pine weevils can be controlled by spraying white pine leaders in the spring with an approved insecticide when either the first sign of attack (pitch flow) occurs or when needles wilt, but no later than immediately after leaders crook. Weevils can also be controlled by pruning-out and burning all infested leaders before the new adults emerge.

Diseases

Figure 9. Phytophthora *root disease is more prevalent in areas of water flow and accumulation.*

Phytophthora Root Rot (*Phytophthora cinnamomi*). *Phytophthora* root rot is the most serious disease of Fraser fir Christmas trees in western North Carolina. It is caused by a fungus that inhabits the soil and infects woody plants through the roots. It can lie dormant in the soil for several years waiting for a susceptible host and suitable environmental conditions, including warm soil temperatures (above 54 degrees F.) and soils saturated with water.

The above-ground symptoms of *Phytophthora* root rot on Fraser fir progress from yellow-green needles, wilting, and dead branches to death. The needles remain on dead branches and turn cinnamon brown. Roots of affected trees are cinnamon-red or black and lack white growing tips. Feeder roots are absent. Many of these symptoms

may initially be present on only one side of the tree or on lower branches since the fungus first infects a root and grows toward the trunk on that side. Eventually, the entire tree will die. Infected trees are usually found grouped together in a field or nursery bed. A tree may be infected with the fungus for months or even years before above-ground symptoms are seen.

Phytophthora root rot is common in seed beds and transplant beds, because the fungus moves from one seedling to another through root to root contact. As a preventive measure all beds should be fumigated before planting and treated twice a year with fungicide. Diseased seedlings should be destroyed. To avoid *Phytophthora* in Christmas tree plantations, plant only on well-drained sites.

Needle Cast. Needle cast is the name applied to a disease caused by one of several fungi that cause a dieback of older needles, often followed by early shedding or "casting." These fungi usually do not kill trees but reduce their value as Christmas trees. From a distance, affected trees have a scorched appearance. The symptoms are most evident in the spring, at which time infected trees should be removed from the stand.

White Pine Blister Rust (*Cronartium ribicola*). White pine blister rust is caused by a fungus that has some of its spore stages on currant or gooseberry (*Ribes* spp.) plants. These spores enter the pine needles and then grow into the inner bark of branches, where the blister rust causes spindle-shaped swellings to form. Three to 4 years following infection, yellowish blisters form in the bark and produce numerous spores. These spores then infect currant or gooseberry bushes. The spore stage that infects the white pine is produced on the alternate host (*Ribes*) in the fall. These are delicate spores that do not survive very far from the point of origin. Thus, it is possible to prevent spread of this fungus by eliminating currant bushes within 400 feet of the pines. The early stage of this disease is so difficult to detect that an infection may have been developing for at least 2 years before it is discovered. Prune out infected limbs as far in advance of tree harvest as possible. If the infection has reached the main stem, the tree should be destroyed. This disease is not common in North Carolina.

Cedar Blight (*Phomopsis juniperovora*). Cedar blight is caused by a fungus that initially attacks foliage, then spreads to stem tissues. Spores produced from tissue infected the previous year are an important source of inoculum early in the growing season. Although the disease can be quite serious from the standpoint of numerous tips being killed, older trees are seldom killed. Control consists of treating with a registered fungicide at regular intervals when infection is severe.

Needle Rusts are caused by several species of fungi that attack the needles of Virginia pine (and other pines) in the spring. The fungus produces bright orange blisters, which break and release orange-colored spores. Needle rusts rarely cause severe damage to the trees, but the rust may lower the trees' value. Infection of pines originates from spores that form on alternate hosts, such as goldenrod, aster, and certain other weeds. Fortunately, these fungi require specific weather conditions to develop, and those conditions do not occur every year.

Pine Stem Rust (*Cronartium* spp.) is characterized by round swellings or galls on the limbs or trunks. In the early spring, orange blisters are produced on these swellings. Branches bearing galls should be pruned before the disease extends to the trunk, or the tree may die. The best time to prune branches that have galls is when the stand is between 3 and 5 years old so that the trees may recover their form before harvest. Oak trees are the main alternate hosts for stem rust fungi.

Protection From Animals

Domestic livestock and wild animals can damage or kill trees of all kinds. Livestock and Christmas trees should generally be in separate areas.

In many areas deer, rabbits, and mice have damaged young trees extensively. Rodent damage usually occurs in areas of heavy grass cover, which favors growth of an over-population of these pests. Grass control is usually enough to discourage a rodent population buildup. In some instances, rodent control by poisoned bait may be recommended.

Christmas Tree Fertility

Optimum fertilization promotes quality growth and gives trees luxuriant foliage with a deep, rich color. Trees with balanced nutrients are more resistant to pest problems and environmental stresses. The amount of fertilizer or lime needed to achieve optimum nutrient levels in the tree will vary with different soils and sites or even different land use history. Too much of a nutrient is often as harmful to Christmas trees as too little. The only way to optimize tree growth is to follow through with site-specific fertilizer applications based on the results of timely soil and tissue analysis. Effective fertilizer management is an ongoing

process that succeeds best when carefully planned and maintained throughout the crop rotation.

Soil samples should be taken regularly throughout the course of growing Christmas trees. The first soil samples should be taken during initial site evaluation. If the pH or nutrients such as phosphorus or calcium are low, materials can be tilled into the soil before tree planting with greater success than later top dressing of fertilizers or lime. Subsequent soil samples should be collected at least every other year, and many growers choose to take annual samples. Time invested in careful collection of soil samples will increase effectiveness of any following fertilizer applications. In North Carolina, soil sample boxes can be obtained and samples sent from any North Carolina Cooperative Extension Service County Center. The North Carolina Department of Agriculture provides soil and plant tissue analysis as well as other diagnostic services to in-state residents.

Once the trees in a field are well established, plant tissue samples should periodically be collected along with regular soil samples. Tissue analysis provides the status of 11 nutrients inside the plant (four more than reported in soil analysis). Tissue sampling also reflects what a plant is actually able to obtain from the soil, not just what is available. Under normal growing conditions, tissue samples should accompany the soil samples at about the middle of the rotation and then again the year before harvest. Usually about two shoots are collected from the same five to 10 trees from which soil is sampled. Tissue sampling is a necessary tool for evaluating and fine-tuning fertility management.

When fertility problems occur in a field, additional sampling can be useful. Problem areas should be sampled (and managed) separately from normal areas of a field. The contrast between normal and problem samples can often pinpoint the cause of a fertility problem. Often multiple-depth soil sampling can provide greater insight than a single topsoil sample. When nutritional problems occur, matching tissue samples should accompany any special soil sampling. It may take several seasons to correct a fertility problem.

Fertilizer materials should be targeted to the recommendations and deficiencies identified by soil and tissue analysis for each field, without applying a single blended material across the board. Annual applications of nitrogen per acre are recommended based on the requirements of the crop and the age and size of the trees. Different amounts of a nitrogen fertilizer will be needed depending on the percentage of actual nitrogen contained in it. Different nitrogen sources have varying effect on pH, soluble salt index, and leaching and should be selected accordingly. Different blends can also satisfy the need for certain amounts of phosphorous, potassium, or other nutrients and should be selected to fulfill the ratio of requirements for each nutrient. See Table 4 for a list of commonly used fertilizers and their characteristics.

Both the timing and method of fertilizer application are critical to successful nutrient management. Different nutrients have their own requirements for timing. Materials with a high soluble salt content containing nitrogen or potassium should not be applied during the heat of summer or during a drought. Large applications should be split between two timings. Phosphorus should be built up early in a crop rotation rather than adding an incremental amount each season. Early in a rotation, many growers band fertilizer outside the dripline of small trees to maximize availability, but after trees are about 2 years old, broadcast applications are most effective. Where growers mechanize their fertilization, they are often able to achieve a more uniform broadcast application. While ground-applied fertilization is the primary method of nutrient delivery, it occasionally must be supplemented with foliar-applied liquid sprays particularly where micronutrients are deficient or tied up in the soil.

For a fertility program to succeed, a variety of tools and methods must be used, usually in different combinations from season to season.

Best Management Practices to Protect Water Quality and the Environment

Although of primary importance, tree quality and net farm profit are not the only objectives that a Christmas tree grower should pursue. A farmer should manage the crop in such a way that production can be sustained well into the future. To achieve this, the quality of life must be protected on all levels. Soil must be protected from erosion. Surface and groundwater must be protected from sedimentation and contamination by fertilizers or pesticides. Wildlife should not be harmed by any farming practices. The health of farm workers should not be endangered by improper handling, storage, or use of pesticides.

Christmas tree farmers who invest in practices and inputs that accomplish these goals usually show a greater long-term profit because the land is maintained at highly productive levels. Collectively, the added or alternative production practices that protect the quality of life are called *best management practices*. For production to be

Table 4. Common fertilizer choices for Christmas trees

Name	Percent N-P-K	Lb Lime Neutralized by 100 Lb of N	Additional Comments
Ammonium Nitrate	33-0-0	180	High soluble salt content, can leach
Ammonium Sulfate	21-0-0	38	Used to lower pH
Calcium Nitrate	16-0-0	0	Source of soluble calcium
Urea	46-0-0	180	Concentrated form of N, leaches slowly
Diammonium Phosphate	18-46-0	180	Most available source of P
Potassium Nitrate	13-0-44	0	
Balanced Blends	10-10-10 17-17-17 19-19-19	variable	Can be high insoluble salts and leach readily
Concentrated Super Phosphate	0-46-0	0	Best when incorporated
Murate of Potash	0-0-60	0	High soluble salts, best used in dormant season
Potassium Sulfate	0-0-50	0	Lower soluble salts, best used in growing season
Potassium Magnesium Sulfate	0-0-22	0	Good where Mg and K both needed

Figure 10. Proper road and drainage construction prevents erosion and reduces potential for root diseases.

sustained, a combination of the following best management practices should be in place on every Christmas tree farm.

Farm Road Construction

The roads on many farms are too steep, are constructed of easily erodible material, and/or are poorly designed to manage flood water. Roads constructed at no more than a 9 percent grade will not generally wash out. Adequate drainage ditches with large gravel or riprap will eliminate erosion of the roadbed and water drainage problems in fields below the road. Installing an adequate surface to handle traffic is also critical. With increasing grade, slope length, and traffic, fescue grass will fail before a gravel surface will. Professional advice from soil conservationists should be utilized to develop plans for long-lasting roads (and fields) or to solve problems with existing roads.

Field Borders and Stream Buffers

Field borders and stream buffers are perhaps the cheapest

way to contain sediments and any nutrients or pesticides that are present in the sediments. A 10- to 25-foot-wide grassy strip will trap sedimentation from all but the most severe rain storms. These strips can usually double as field roads.

Low-Impact Site Preparation

Some land currently in Christmas tree production is too steep and erodible to bear extensive mechanical site preparation. Soils also may be too shallow or easily compacted to withstand the heavy traffic. Less disruptive site preparation practices have been developed for these situations. Any timber and brush is cut close to the ground without disturbing the mat of roots that hold the soil in place. All or a majority of stumps are left undisturbed. No tillage is attempted. If seedlings are planted mechanically, any areas near stumps are planted by hand or left empty. Hardwood sprouts from stumps are a greater problem with this approach, but labeled herbicides can control them. Achieving optimum fertility may also be more difficult without tillage, but by preserving the topsoil, Christmas tree production can be sustained on these difficult sites.

Pest Scouting

By scouting for pests, growers can reduce the frequency of pesticide applications and the cost of pest management program while increasing the effectiveness of their efforts. Pest thresholds and scouting methods have been developed for most of the major Christmas tree pests. Information generated by scouting indicates the need for pesticide applications and assures that such applications are targeted to potentially damaging pest populations.

Pesticide Alternatives

Where several pesticides are labeled for a specific Christmas tree pest, growers have the choice of selecting the material that is least toxic to beneficial insects, the environment, and wildlife. Toxicity of certain pesticides to specific groups of animals, such as fish or aquatic insects, can vary significantly. Safe pesticide choices will change depending on proximity to critical habitats or even the season and life cycle of vulnerable wildlife species. Some less-toxic materials may require different equipment, handling, or timing from traditional pesticide choices. Be sure to evaluate all factors when considering pesticide selection. For some pests, growers can apply pesticides at alternative times, such as fall or winter, when beneficial insects or at-risk wildlife are not present.

Figure 11. Groundcover suppression rather than elimination is a part of good management.

Groundcover Management

Production of quality Christmas trees depends largely on the balanced management of weed competition. Unchecked weed competition hurts tree growth, but repeated exposure of the soil surface with resulting erosion will shorten the productive life of a field. Out of necessity, growers have moved away from predominant use of long-lasting pre-emergent herbicides and bare-ground weed control. Groundcovers are the primary tool for stabilizing the soil within a field of trees. Best management practices involve suppression of native vegetation and/or establishment of cover crops. This reduces competition for nutrients, water, and space while maintaining almost total coverage of the soil. An alternative practice is to sow cover crops, such as clover or rye, that reduce germination of native weed seeds and that can be managed more uniformly. Regardless of the approach, groundcovers are a second crop that must be consciously managed in any Christmas tree field.

Nutrient Management

In North Carolina regions having sandy soils and shallow water tables, nutrient management is a critical factor in the availability of clean and healthy drinking water. Large applications of fertilizer can possibly leach into the groundwater. Smaller applications spread out over a season can increase uptake by the crop and reduce the probability of leaching. Leaching of fertilizer into the groundwater is not generally a major problem, but some precautions are still necessary. Best management practices depend on regular use of soil and tissue analysis as the basis for all fertilizer and lime applications. Applications should be specific to the needs of each field. Where

practical, annual nitrogen requirements should be split into two applications to reduce leaching potential and risk of salt injury to tree roots.

Pesticide Handling, Storage, and Disposal

Pesticides are most hazardous when they are in concentrated form during mixing, storage, and disposal. Pesticides should always be mixed and loaded far away from wells, springs, or streams. Progressive farmers are installing covered and contained concrete mixing pads, which capture any spills or rinse water. Secure pesticide storage areas are built on the same pads. PVC field mixing pads eliminate risky pouring from pesticide containers and cost less than permanent facilities. When empty, all liquid pesticide containers should be triple-rinsed and punctured before disposal in landfills. Other methods of disposing of containers are illegal and risk groundwater contamination. For liability and safety considerations, farm managers and foremen should all be knowledgeable about the handling, storage, and legal disposal of pesticides and their containers. Pesticide handlers must complete the appropriate licensing and pesticide training.

Wellhead Protection

Poorly-constructed wellheads are a major source of groundwater contamination from fertilizers or pesticides. Good wells are grouted and sealed with concrete and, ideally, enclosed in a concrete cover with a concrete floor. Several management practices can reduce the risk of groundwater contamination regardless of well construction. No agricultural materials should be mixed at the wellhead. Hoses or faucets should provide water at a mixing area away from and preferably downhill from the wellhead. A grassy buffer at least 10 feet wide should protect the well from high traffic areas or any pesticide application areas. The well cover should be above the surrounding landscape and the immediate land should slope away from the well. If production areas are above a well, consideration should be given to the leachability of fertilizers or pesticides used.

Summary

Christmas trees are a renewable and sustainable agricultural crop. With appropriate consideration of water quality, environmental considerations, and worker safety, problems need not occur.

Shaping of Christmas Trees

Shaping is necessary for high-quality Christmas trees. The term "shaping" is applied to any cutting done to shape the plant to its desired appearance. This may done by either shearing or pruning.

The term "shearing" refers to cutting back the current year's growth of the leader and lateral limbs. Shearing reduces deformities and improves the shape of the tree. Pruning is the removal of injured, dead, or diseased parts or wood older than the current growth.

Since any one set of guidelines is not suitable for all trees, several species will be considered separately. Ideally a tree should resemble a cone, wide at the base and tapering uniformly to the tip. The base should be about two-thirds as wide as the tree is tall. Taper is defined as the tree width at the base divided by the tree height. Acceptable standards for a taper will range from a minimum width of 40 percent of the height to a maximum of 90 percent.

Some growers prefer to shear using knives with a 14-inch blade, although strong hedge shears and specially-designed machines can be used with success. If knives are

Figure 12. Shaping and shearing require knowledge of tree biology as well as market preferences.

used, they should have high-quality blades that retain a very sharp edge with minimum sharpening. Regardless of the type of tool used, personal safety is a primary concern.

Firs and Spruces

Firs and spruces require substantially different treatments than pines. In these species, lateral buds develop along the current leader and branch growth and are not initiated from fascicles (bundles of needles found on pines). New growth may be cut any time after branch elongation is 80

percent complete until the following spring before new growth starts.

It is best to use a minimum amount of shearing and pruning so that the trees will have a natural appearance. The main thing to strive for is compactness by controlling height and lateral growth. Most growers cut the leaders in summer, although the same process may be used until late spring just before dormancy is broken. To maintain the desired cone shape, the terminal portion of lateral branches are also removed. Correct summer shearing allows for development of a denser, higher-quality tree, through growth of vegetative buds on the stem and branches.

When the trees reach 3 to 4 feet in height, bottom branches may be cut to provide a "handle," depending on what buyers expect.

White Pine

It is important to start shearing white pine at the proper year and season. When the tree is about 12 to 24 inches in height, the terminal bud should be removed to provide more limbs for what will be the base of the tree. This height should be adjusted upward for a tree growing on a steep slope. Shearing will stimulate production of buds and make the tree more dense and compact. The season to shear white pine is between the time the new leader completes its growth and before it "hardens." These dates vary with the growing conditions, the elevation, and the season, but is generally during the period of June to early-July.

Start shearing by cutting the leader to desired length (10 to 14 inches is usually best) at a 45-degree angle, with the face of the cut in a northerly direction to reduce drying. The side branches of the top whorl should be cut so that they are 3 to 5 inches shorter than the terminal. The side branches are then clipped to shape the tree into a cone. Overshearing should be avoided, as close- shaved trees are not the most desirable.

Shearing should be restricted to the current year's growth because older growth does not usually set buds. When the tree is about 3 feet to 4 feet high, bottom branches should be cut off so that a handle will be available when the tree is harvested.

Virginia Pine

Guidelines for shaping Virginia pine are generally similar to those for white pine. However, because of its growth habit, Virginia pine needs to be sheared at least twice and sometimes more frequently each year.

Time of shearing can be better judged from needle growth than the calendar. A good rule is to begin shearing when new needles are one-half as long as needles from the previous flush.

Corrective shaping can usually be done at any time of the year. It is extremely important that multiple leaders be removed early in the life of the tree. Additionally "handles" should be pruned at least 2 years before harvest.

Redcedar and Leyland Cypress

Redcedar can be sheared lightly at any time during the growing season with hedge clippers or knives. Leyland cypress should also be sheared lightly, with the best time late in the growing season.

Groundcover Management

Groundcover or vegetation management is essential in producing high-quality Christmas trees. Many growers have produced Christmas trees with bare ground because they were worried about groundcover competition for water, nutrients, and light. However, maintaining bare soil can lead to soil deterioration resulting in increased soil erosion, poor root growth, and poor tree quality. There are many groundcovers ranging from native plants to introduced plant species which, if managed properly, can be used as a groundcover without impacting tree growth and quality.

Scouting weed species in the plantation is the first step in a groundcover management program. Information on weed identification can be obtained from various agencies, and there are many good weed identification references (see Appendix). Identifying the type, density, and location of the vegetation in the plantation is an important part of the management process.

Vegetation may be grouped into five major categories: perennial grasses, perennial broadleafs, annual grasses, annual broadleafs, and woody perennial vegetation (trees, shrubs, and vines).

Whether the vegetation occurs between the rows or within rows is also important. Competition is greatest from vegetation in the area immediately around the tree or within a row. Vegetation growing between the rows is less of a competitive threat simply because it is further from the tree.

Since perennial grasses are very competitive, growers should minimize them within rows. In addition, perennial grasses found between rows should be mechanically or chemically mowed (suppressed via low rates of post-emergence herbicides) to control competition.

While woody vegetation is not particularly competitive, it does interfere with tree work, and is easiest to control prior to planting. Since most woody vegetation is perennial with well established deep root systems, it can be particularly difficult to control. Choice of control measures and timing is critical.

Vegetation desirable for use as groundcover generally exhibits one of two useful characteristics: it is naturally less competitive, or it is reliably controlled either through mechanical or chemical mowing. Less competitive groundcovers include broadleaf annuals or perennials that seldom grow tall enough to interfere with tree growth. Such species include strawberries, violets, dandelions, plantains, groundsels, and common trailing cinquefoil. Groundcovers that can and must be suppressed because they are otherwise too competitive or interfere with shearing or harvest include clover, smartweed, wild carrot, yarrow, red sorrel, nimblewill grass, chickweed, annual grasses, and some perennial grasses.

The two principal methods for maintaining groundcover at an acceptable height between the rows are mechanical mowing and chemical application, either separately or in combination.

Mechanical Mowing

Mowing is an effective way to keep competing plants under control between rows. Properly timed mowing reduces competition, rodent damage, and fire hazard. Rotary-type mowers are usually preferred for grass control, as sickle bars are particularly apt to damage or cut trees. However, mechanical mowing will favor grass species that are most competitive to trees.

Mowing alone must be repeated several times during the growing season. It should be done often enough to prevent the grasses from forming seeds that could germinate within the row. Weather greatly determines timing of the first and subsequent mowing operations. A cool, dry spring can delay the first mowing. Subsequent mowing during the growing season depends largely on the frequency and amount of rainfall and fertility of the site.

Chemical Application

Herbicides are an effective substitute to mechanical mowing for controlling competition by weeds and grasses. Herbicides are generally classified as either pre-emergent or post-emergent, depending on the stage of the weeds the herbicide is designed to control.

The effectiveness of a chemical can vary from no response to a complete kill, depending on application conditions and procedures. To be effective, herbicides should be carefully selected. Several different uses of chemicals are in new plantings in a cleanly cultivated field, new plantings in a sod, or on established plantations. Response to chemicals will depend on several factors, such as size, kind and growing condition of target plants, time of application, soil composition, rainfall, temperature, rate of deterioration before being incorporated into the soil, and persistence of the chemical. Most properly-formulated herbicides are short-lived in the environment, but still they must be carefully used to prevent long-lasting effects by changing the composition of the plant community.

"Chemical mowing" is a term used to describe the practice of applying post-emergent herbicides at low rates to stunt or suppress weeds and grasses. This practice was developed to provide growers with a cost-effective, soil conserving alternative to broadcast application of pre-emergence herbicides or mechanical mowing. Chemical mowing can be used as a broadcast application or as a between-row treatment where trees were previously banded in the row with pre-emergence herbicides.

Chemical mowing is generally more economical than traditional mechanical mowing. The application of low rates of herbicides two or three times during the growing season is usually less expensive than maintaining mowers and paying for the labor to mow several times a season. Chemical mowing typically provides control for 6 to 8 weeks, compared to 3 to 4 weeks for mechanical mowing.

Chemical mowing also fits well with many of the strategies used in Integrated Pest Management (IPM). It is especially important to the management of white grubs. By leaving a ragged height of suppressed vegetation, May and June beetles (the adults of white grubs) are less likely to lay their eggs than they are in mechanically mowed vegetation.

It should be noted that the need for pre-emergence herbicide applications cannot be totally eliminated by chemical mowing.

Harvesting

Trees grow at different rates, so harvesting an entire plantation may take from 1 to 3 years depending on the site variation and harvest management strategy.
Some growers prefer to cut and market an entire crop in one year. This technique requires an extra year or two to allow a greater number of trees to reach marketable size. Trees still too small for market are either cut into boughs or destroyed. An advantage of this method is the lower cost of harvesting and clearing the area for replanting.

Figure 13. Harvesting Fraser fir in the mountains of North Carolina.

Figure 14. Choose and cut farms are an important part of the Christmas tree industry throughout the state.

The predominant strategy is to harvest for several years on an area as the trees reach saleable size. This method produces a greater yield of trees per acre, but increases harvesting costs and possible delays in replanting that may offset the increased profits.

In harvesting for a wholesale market, trees should be cut with a sharp saw at right angles to the stem to leave a flat base. The person responsible for designating the trees to be cut should be familiar with market specifications, such as height, straightness of stem, length of handle, symmetry, and fullness of foliage.

Trees should be carried (not dragged) to a specified packaging and loading area. Twine or a plastic netting may be used to bundle or "bale" trees. Trees can be packaged by a baling machine or by using a simple cone through which trees can be pulled to constrict them for tying. Packaging trees in this manner can reduce damage during handling and shipping. Trees should then be hauled to the nearest truck-loading point and sorted according to species, height, and quality as they are unloaded. Preliminary sorting reduces "wear and tear" of the trees when buyers want to inspect their trees at the loading point.

When trees are cut in advance of shipping date, loss of moisture may result in a lower quality product. Trees should be protected from direct sun and drying winds during the waiting period. Growers may find it profitable to hire additional labor at harvest time for simultaneous cutting and loading operations. While this practice increases handling costs, it avoids delaying truckers waiting for the trees.

Marketing

The marketplace is where the grower learns whether the money and effort expended to produce quality trees is enough to allow profitable competition against artificial trees and trees grown in other areas.

Figure 15. Modern Christmas tree marketing involves more than advertising in traditional outlets.

Marketing methods vary according to the size of operations and the buyers' demands for quality and other services. While the majority of North Carolina growers sell trees on a wholesale basis, a number of choose-and-cut farms are also in operation. Many of the same principles of marketing apply regardless of selling method.

A grower's reputation for selling quality trees year after year can reduce the buyers need to inspect the trees at the plantation. A good reputation can thereby facilitate marketing and help retain satisfied customers.

Growers should label trees accurately according to species, height, and general quality in terms of color, density, and shape. This procedure helps to build a good seller-buyer relationship. A brochure listing salable trees

sent to all prospective buyers can help to increase sales. Such a brochure should include the species, size, quality, selling method (on the stump, at roadside, or delivered) and expected price. Growers may help sales by including pictures of their plantations and individual trees.

Many wholesale growers cut and harvest their own trees, but in some instances they may tag their trees and let the buyers do the cutting. It is usually better for the grower to harvest in order to retain control and prevent high-grading and physical damage to the plantation.

When cutting many trees for specific buyers, it would be advisable to have a performance contract signed by

Figure 16. Retail lot management is important if the consumers are to be satisfied with their purchase.

both the buyer and seller. Usual terms call for a one-third payment when the contract is signed and the balance paid when the trees are picked up.

Growers with large acreage are obliged to move thousands of trees. With efficient management, their production costs per tree may be less than growers producing smaller numbers of trees. However, growers with fewer trees may have more flexibility, and can take advantage of customer service requirements, such as selling either at the plantation or delivering trees directly to specific retailers.

To realize a fair return, growers with small areas may compete with those having larger acreage by improving efficiency of operations, offering a better quality product, and reliably supplying specific retail markets. They may also compete with those offering larger volumes by combining sales of trees with other growers.

Many growers operate their own retail lot and market their own trees. Those selling fewer trees may offer additional services, such as letting a buyer select and cut his own trees and making sales on consignment. By accepting part of the marketing risk and offering additional services, growers can expect a better net price per tree.

Some growers who live near population centers sell trees directly to consumers from the plantation as choose and cut. This method requires adequate all-weather parking in an accessible area within close driving distance of the city. Signs should be strategically located so that customers can find the plantation without difficulty. Thieves can also follow these directions, so there may be an increased need for security. Sales are frequently increased by advertising the location of a plantation and hours of operation. Customers should be provided with tools or assistance to cut their choice from among several species of trees on several acres. Growers should carry liability insurance.

There is considerable risk in retailing Christmas trees. The retailer's margin need not be as high if the grower assumes part of the risk. For example a grower could absorb all or a part of the loss on unsold Christmas trees, or deliver trees as the retailer needs them. This decreases the possibility of having large numbers of cut trees on hand after Christmas.

United States Department of Agriculture standard grades for Christmas trees may be used as a guide in grading trees for sale. If both grower and buyer know these standard grades and accept them, tree sales can be made by phone or letter without an "on the ground" inspection.

Growers and buyers often find it beneficial to join Christmas tree associations. Many production and sales techniques can be obtained at regular association meetings. Helpful information can also be found in the associations' periodic newsletters and publications.

Record Keeping

Complete, documented records are essential to any business, including Christmas tree production. Records should include a map of the farm layout, with fields, roads, topography, drainage systems, species and number of trees per field, and planting dates clearly designated.

Other records should include soil test data, weather conditions at the time of planting, pest and weed control efforts, and detailed cost and return figures. Data should also be maintained concerning trees survival of transplant shock, mowing machine injury, and pest infestations. A continuous inventory of salable trees permits calculation of cost per tree, or fertilizer and pest control chemicals needed, and depletion allowance. Records should contain information detailed enough to permit determination of the weak points of the total operation. The records also

enable growers to compare their costs with published estimates.

Records are also useful in determining a cash basis needed to arrive at capital gains for use in casualty loss, damage claims, sale of property, or a fair market value for estate tax purposes. Accurate cost records can prevent payment of unnecessary taxes.

Investment Planning

Before investing in a long-term crop like Christmas trees, the cost of production must be carefully weighed against the intended level of investment. Additionally, once a grower is in full production with trees at all stages of growth, there is a common progression of practices that add up to the total cost of production for any year. Table 5 indicates the labor required, total expenses, and proceeds to be anticipated for one acre of Fraser fir Christmas trees over an 8-year rotation. Table 6 provides an example of common operations conducted during the year and their cost.

Table 5. Labor, total expenses, and income generated by 1 acre of Fraser fir Christmas trees

Year	Labor (Hours)	Total Expenses	Gross Income
Year 0	6.1	$ 1,087.07	—
Year 1	68.2	$ 1,939.70	—
Year 2	34.8	$ 885.96	—
Year 3	34.0	$ 896.41	—
Year 4	41.2	$ 986.16	—
Year 5	44.2	$ 1,178.23	—
Year 6	112.2	$ 2,043.71	$ 7,400.00
Year 7	151.2	$ 2,695.06	$16,900.00
Year 8	75.8	$ 1,640.82	$ 9,150.00
TOTALS	567.7	$13,353.12	$33,450.00

Net Income	$20,096.88
Net Annual Income (Net/8 yr)	$ 2,512.11
Total Establishment and Growing Costs after Year 5	$ 6,973.53

Table 6. Common Christmas tree production operations and their cost range by acre.

Operation	Cost /Acre	Operation	Cost /Acre
Purchase land	$ 500-5000	Liquid insecticide application	$ 100-300
Site preparation	$ 200-1000	Mowing between trees	$ 20-40
Tractor applied lime	$ 25-50	Mowing farm roads	$ 10-20
Tractor applied fertilizer	$ 50-100	Manual shearing	$ 200-450
Mechanical tree planting	$1,500-2,000	Tagging market trees	$ 25-50
Hand setting replants	$ 100-500	Cutting trees (500)	$ 50-100
Manual lime or gypsum application	$ 30-60	Baling trees (500)	$ 250-500
Manual herbicide application	$ 15-40	Storing trees (500)	$ 40-100
Manual fertilizer application	$ 40-80	Loading trees (500)	$ 40-80
Granular insecticide application	$ 40-50		

Table 7. Cash flow chart for a 9-acre Fraser fir Christmas tree farm (1 acre planted annually)

	Year 1	Year2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
1 acre	$1,087	$1,940	$ 886	$ 896	$ 986	$1,178	$2,044	$2,695	$1,641
1 acre		$1,087	$1,940	$ 886	$ 896	$ 986	$1,178	$2,044	$2,695
1 acre			$1,087	$1,940	$ 886	$ 896	$ 986	$1,178	$2,044
1 acre				$1,087	$1,940	$ 886	$ 896	$ 986	$1,178
1 acre					$1,087	$1,940	$ 886	$ 896	$ 986
1 acre						$1,087	$1,940	$ 886	$ 896
1 acre							$1,087	$1,940	$ 886
1 acre								$1,087	$1,940
1 acre									$1,087
Cost	$1,087	$3,027	$3,913	$4,809	$5,795	$6,973	$9,017	$11,712	$13,353
Income							$7,400	$24,300	$33,450
Net (*cumulative over rotation*)	–$1,087	–$4,114	–$8,027	–$12,836	–$18,631	–$25,604	–$27,221	–$14,633	+$5,464

Break-even Point for a 9- Acre Farm: Year 9

Total Cost of Production for 9 Acres (over 17 years): $120,177

Total Income for 9 Acres (over 17 years): $301,050

Net Income for 9 Acres (with no 2nd rotation): $180,873

Costs will vary with location, weather, tree species, availability of labor, and variations, in supplies and equipment.

Most budgets are for one acre over the course of a rotation. This approach can be potentially misleading. Most growers plant annually and eventually harvest annually. However, others increase the acreage planted each year as their expertise and goals for future income increase. Table 7 expands the single-acre values from Tables 5 and 6 into an example of a 9-acre farm with 1 acre planted annually. As total production acreage and the number of older trees accumulate, annual costs will increase. Income from initial plantings usually is rolled back into the business to sustain a higher future level of production. Frequently, the break-even point may not occur until well into the second production cycle.

Taxes

It is beyond the scope of this publication to get into a detailed analysis of record keeping or tax treatment of timber sale income and expenses. However, there are some basics of this topic that should be considered.

Establishment costs include any costs associated with site preparation and practices necessary to ensure tree survival. Included are land preparation, lime, fertilizer, herbicide, interest, hired labor, tools, seedlings, and depreciation deductions on equipment used for any of these activities. Establishment costs are recorded in a capital account, and these costs are recovered on a per tree harvested basis (depletion) when the trees are sold.

Growing period costs begin after trees are established. Included are hired labor, fertilization, weed control, shearing and shaping, insect and disease control, rental payments, interest on production loans, road and fireline maintenance, and depreciation deductions on equipment used for any of these activities. Growing period costs would normally be deducted each year. To be eligible to deduct these expenses, a grower must be considered a material participant in a trade or business. The Internal

Revenue Service publishes a series of criteria that must be met in order to be considered a material participant.

Most growers would benefit by deducting growing period expenses annually. If a grower does not qualify as a material participant in a trade or business, the operation is defined as a passive activity. Deductions from passive activities are allowed only to the extent of total passive income from all passive activities for the tax year. Growing period costs not deducted annually may be carried forward and recovered through depletion at the time of sale or until there is passive income from some source in the case of passive activities. A growing period cost account should be maintained and adjusted as costs are incurred or deducted.

Sales costs can be deducted from the sale proceeds. Examples are tree marking, harvesting, bagging or baling, hauling, advertising, and hired labor.

Gains and losses from the sale of Christmas trees can qualify for special tax treatment as capital gain or capital losses. An evergreen tree that is more than 6 years of age when it is severed from its roots and sold is considered by the Internal Revenue Service Code to be timber with sales treated as capital gains income (loss). Age is calculated from the time of seed germination. If trees are not 6 years old or are dug and sold as live trees, then they are considered to be horticultural products and the sales are treated as ordinary income (loss). The advantage of selling Christmas trees as timber is that the highest marginal tax rate on long-term capital gains is historically less than the highest marginal tax rate on ordinary income. Also, capital gains income is not subject to self-employment taxes as is ordinary income.

Selling method is also important if the sale is to qualify as the sale of a capital asset (timber). Methods are: 1) cutting of standing timber with an election to treat as a sale; or 2) disposal of timber with an economic interest retained.

For questions regarding tax laws, growers are advised to enlist the services of a certified public accountant.

Assistance Available

The North Carolina Cooperative Extension Service is a cooperative effort among the United States Department of Agriculture, North Carolina State University, North Carolina A&T State University and county governments. Through the Extension Service, state and area specialists and county personnel can provide educational assistance, information, and guidance to the grower of Christmas trees.

The North Carolina Division of Forest Resources is a service organization that provides planting stock and seedlings which may be grown as Christmas trees. Their foresters may assist with management advice about the culture of Christmas trees and pest control. The Division also assists landowners with fire control.

The North Carolina Department of Agriculture (NCDA) provides assistance to growers through the registration of appropriate pesticides and the providing of applicators licenses for those individuals using restricted-use pesticides. The NCDA Agronomic Division provides both soil and tissue analysis with fertilization recommendations based on the results.

The Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture is responsible for developing and implementing conservation programs. The NRCS can advise on site characteristics relative to soil and water, as well as suitability of tree species. The agency offers a varied amount of engineering assistance to growers in the management of water and soil resources.

Other government agencies, private companies, grower associations, etc., also provide beneficial information and services to Christmas tree growers.

Summary

In growing Christmas trees as a business venture, the following points need to be given careful consideration.

❑ Christmas tree crops require intensive management to produce a quality product. Unless a prospective grower is prepared to invest capital and many hours of labor in necessary management, it would be better to not start.

❑ Selection and preparation of planting sites are of critical importance. The topography, surface condition, elevation, exposure, internal drainage, and accessibility to roads should be carefully considered.

❑ ~~Selection of tree~~ species adapted to site conditions and those that have strong market appeal are important aspects to beginning a Christmas tree farm.

❑ Implementation of Integrated Pest Management and Best Management Practices will provide for efficient Christmas tree production while minimizing environmental impact.

❑ A grower must select good planting stock, take care of the trees, and plant properly to ensure maximum survival.

❑ Among the necessary cultural practices is a good pest control program, to include control of insects, diseases and unwanted vegetation.

❑ Trees must be shaped and sheared at the right time and

at proper intervals to assure quality.

❑ Harvesting techniques must be adapted to a given situation to minimize damage and costs.

Note

This publication does not give specific information or suggestions concerning the use of pesticides for the control of insect, disease, or mite problems. The North Carolina Agricultural Chemicals Manual, which is revised annually, should be referred to for up-to-date pesticide information.

Caution

Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife, if they are not handled or applied properly. Use all pesticides selectively and carefully and follow label instruction. Dispose of surplus pesticides and pesticide containers following recommended practices.

Appendix

A Federal Income Tax Primer for North Carolina Christmas Tree Growers. North Carolina Cooperative Extension Service. North Carolina State University. Raleigh, NC.

American Christmas Tree Journal. Quarterly magazine of the National Christmas Tree Association, Inc., Milwaukee, WI.

Christmas Trees. Quarterly magazine published by Tree Publishers, Inc., Lecompton, KS.

Christmas Tree Notes. North Carolina Cooperative Extension Service. North Carolina State University. Raleigh, NC.

Christmas Tree Pest Manual. North Central Forest Experiment Station. USDA Forest Service. NE Area State and Private Forestry.

Christmas Tree Production Manual. Virginia Cooperative Extension Service. Virginia Polytechnic Institute & State University, Blacksburg, VA.

Identifying Seedling and Mature Weeds (AG-208). North Carolina Cooperative Extension Service. North Carolina State University. Raleigh, NC.

Limbs and Needles. Quarterly publication of the North Carolina Christmas Tree Association. Boone, NC

North Carolina Agricultural Chemicals Manual. College of Agriculture and Life Sciences. North Carolina State University. Raleigh, NC.

U. S. Department of Agriculture, Natural Resources Conservation Service, *County Soil Survey Reports*.

U. S. Department of Agriculture. *United States Standards for Grades of Christmas Trees*. USDA Agriculture Marketing Service. Revised 1989.

Resources on the World Wide Web

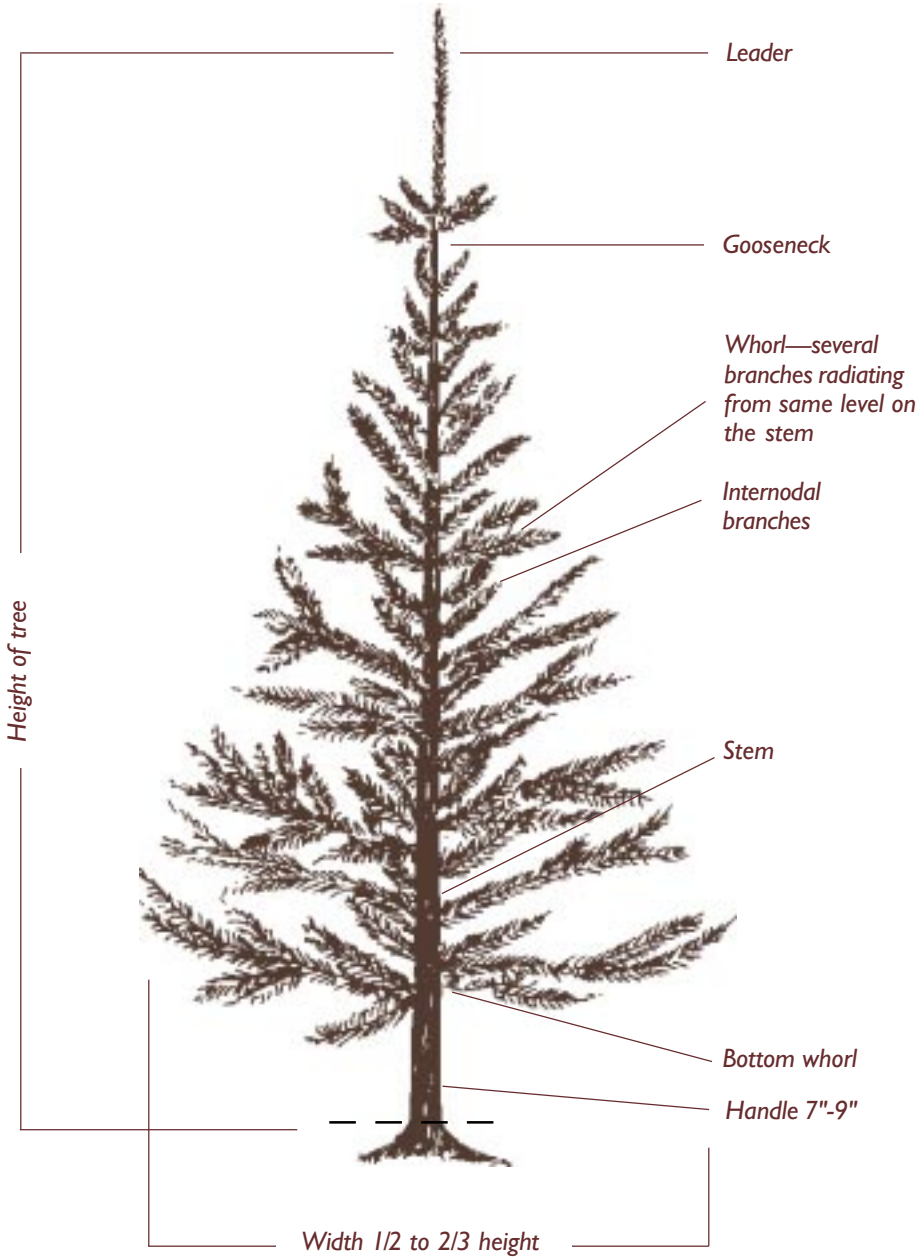
Extension Forestry has a number of online publications. You may access *Christmas Tree Notes* from:

http://www.ces.ncsu.edu/nreos/forest/xmas/catalog3.html

You may access the Mountain Horticulture Crops Research and Extension Center at:

http://www.ces.ncsu.edu/nreos/forest/resources.html

Christmas Tree
Terminology



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