Christmas Tree Production and Marketing: 32nd Annual Forestry Symposium, 1983

School of Forestry, Louisiana State University, Baton Rouge, Louisiana, USA

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FOREWORD

The growth of the southern Christmas tree industry has been phenomenal during the past few years. This industry, long established in northern states, has truly "arrived" in the South. Along with rapid increases in the number of trees planted and the number of growers, there has been a concurrent increase in the number of problems facing growers and sellers. Research efforts have been stepped up, and solutions to many of these problems have been worked out.

The aim of the 32nd Annual Louisiana State University Forestry Symposium was to bring Christmas tree growers in the South up to date on the latest research results and practical experience on the subject of the growing and marketing of Christmas trees in plantations. The meeting was held at the Baton Rouge Hilton April 5 and 6, 1983, and consisted of 14 papers delivered in three half-day sessions. Moderators for these sessions were: Dr. Conrad W. Brewer, Auburn University; Mr. A. Daylon Rogers, Limbs & Needles editor; and Dr. Alden C. Main, Louisiana Cooperative Extension Service.

We would like to acknowledge the contributions and expertise of the speaker-authors and moderators who participated in the Symposium. Appreciation is also expressed for planning assistance to Dr. Main, and for publicity to Dr. Brewer and Dr. Robert C. Parker. Personnel of the Baton Rouge Hilton cooperated in Symposium arrangements. Forestry graduate students Rob Lilieholm and James Mamit are commended for their work in operating the slide and overhead projectors at the meeting and in recording the discussion on tape. Special thanks go to Julie Marotz for typing the manuscript.

S.C. Hu

Paul Y. Burns
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CHOICE OF SPECIES FOR CHRISTMAS TREE PRODUCTION

R. E. Schoenike
Professor, Department of Forestry
Clemson University
Clemson, South Carolina

The choice of a species or several species to plant and grow as Christmas trees is of the greatest importance to the grower. A great deal of the financial success of a Christmas tree enterprise depends on this selection. A mistake made at this point will be felt increasingly throughout the life of the trees and will be financially costly in terms of time and money.

The choice of species is often best determined by what experienced growers in the region where the Christmas tree plantation is to be located have found to be most successful. By joining a local or statewide Christmas tree grower's association, successful growers and can gain much useful information on tree species. Then, too, growers' associations are usually in touch with state forestry and extension personnel and the latest research findings on Christmas trees are made immediately available at association meetings or at Christmas tree workshops.

Until about 20 years ago, plantation-grown trees were in the minority. The bulk of Christmas trees offered for sale came from wild stands, usually of spruce and fir in the West and North and of redcedar in the South. This has now changed. The majority of Christmas trees now offered for sale are grown in cultured Christmas tree plantations, tended and nurtured by growers who not only reap financial success from their operations, but who gain a great deal of personal satisfaction by growing a crop that is so aesthetically pleasing to many people at the most joyous time of the year.

Factors Determining the Choice of Species

Bell and White (1966) have identified six factors as most important in determining the species to grow as Christmas trees. They are:

1. Salability or consumer preference.
2. Distance from market and shipping qualities.
3. Adaptability to the site.
4. Low incidence or freedom from diseases and insect attack.
5. Genetically proven seed sources of stock.
6. Growth rates or length of rotation.
Salability or Consumer Preference

The best way to determine consumer preference is to go to a large Christmas tree lot during the sales season and watch the trees being picked out by the buyers. You will soon recognize two things: (1) people do like different species — some will select a bushy long-needled pine, others a stiff-branched short-needled fir, still others a limber-branched scale-leaved cedar; (2) most persons are discriminating in the tree's quality — Is the color dark enough? Will the tree hold its needles? Does it have a nice fresh smell? Is it big enough for the front room, den, or children's room? Is it the right shape and full of foliage on all sides? etc. The important features can be summarized as follows (Bell and White, op. cit. and others).

1. **Color**: Deep greens and bluish shades are preferred over gray green, yellowish, or bronze tints. Because of the common use of colorants, the natural green is no longer as strong a factor as previously.

2. **Foliation**: Vigorous fresh-looking growth is one of the two main criteria; the other is good needle retention. This is particularly important in spruces and some of the cedars and cypresses.

3. **Stem**: The preferred stem is straight with well-developed and even numbers of branch whorls, and has a convenient handle (base of stem without branches).

4. **Shape and taper**: Preferences vary; some persons like "fat" trees (to reflect their personality?), others prefer narrow types—towards a candlestick shape. An ideal tree has been described as having a 66 2/3% taper (2/3 as wide at the base as it is high). Spruces, firs, cedars, and cypresses are usually sold with a narrow taper; on the other hand, pines seem to develop better with a wide taper.

5. **Density**: In pines, people prefer a good compact crown with at least three good faces. Spruces and firs are often sold with more open branching, but even so, higher density foliage produces a better tree.

6. **Height**: To fit all markets a variety of tree heights should be offered from the short 2½ ft table tree to the 12-14 ft tree suitable for churches and buildings with tall ceilings. For most households, the 5½ to 7 ft tree is most suitable.

7. **Aroma**: Some people prefer the fresh aroma of a fir or cedar. In fact, this is a major selling point for these species. For others, this is not necessary. Generally, pines have little aroma.
Distance from Market and Shipping Qualities

The type of Christmas tree operation a grower contemplates will determine to some extent the tree species he plants and offers for sale. Our southern Christmas tree enterprises vary from relatively small choose-cut operations, where all sales are conducted at the plantation site, to large wholesaling operations where trees are contracted for, cut en masse and shipped to distant points to be sold on retail lots. For the first type of operation, a larger selection of species can be offered. Species that ship poorly, such as many pines, cypresses, and some spruces, would not be suitable for large wholesale operations. On the other hand, if the distance to market is relatively short (less than 30 miles), then shipping quality is of little significance. The shipping quality of the various species is indicated in Table 1.

Adaptability to the Site

Site refers to the specific environment in which the trees will be growing. The most important of these for any given area are soil, moisture, and topography. Each species has a set of site conditions under which it will grow best, but some species have greater amplitude than others in this respect and are suitable for a range of sites. Generally, the following site conditions should be avoided:

1. Excessively hilly land,
2. Droughty sands,
3. Swampy land or other tracts having poor drainage, and
4. Highly acid or alkaline soils.

Christmas trees do not require rich soil for good survival and growth. In fact, there may be greater problems in growing trees on such land because of increased weed problems and the necessity of extra shearing. However, it is a good idea to have the soil tested at your state experiment station to see if any minerals or elements are lacking. Species' site requirements are given in Table 1. Note that some, like redcedars, do best on dry, heavy soils with a high pH (toward alkaline conditions); however, most pines do best on moderately acid soils that are well-drained; and spruces and firs can tolerate wetter conditions and heavier soils than most others.

Certain weather factors should also be taken into account. Many species (spruces, firs, Deodar cedar) are severely damaged if planted in frost pockets, and areas subject to ice and snow damage should be avoided if long-needled pines and cypresses are to be grown.
Table 1. Major characteristics of species grown for Christmas trees in the South (after Touliatos et al. and others).

<table>
<thead>
<tr>
<th>Christmas Tree Type and Common Name</th>
<th>Scientific Name</th>
<th>General Suitability</th>
<th>Shearing Requirement</th>
<th>USDA Hardiness Zone and Range</th>
<th>Tolerance</th>
<th>Rainfall and Humidity Regime</th>
<th>Soil Moisture Class</th>
<th>Soil Texture Class</th>
<th>Soil pH Class</th>
<th>Stem Form</th>
<th>Natural Taper</th>
<th>Foliage Density</th>
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<td>Eastern White Pine (Pinus strobus)</td>
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<td>Scots Pine (Pinus sylvestris)</td>
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### Table 1. (continued)

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<tr>
<th>Christmas Tree Type and Common Name</th>
<th>Scientific Name</th>
<th>Foliage Color</th>
<th>Amount of Artificial Green Required to Stay Green</th>
<th>Foliage Retention</th>
<th>Aroma</th>
<th>Injury from Diseases</th>
<th>Injury from Insects</th>
<th>Injury from Birds, Mammals</th>
<th>Injury from Weather</th>
<th>Shipping Quality</th>
<th>Availability of Planting Stock</th>
<th>Method of Propagation</th>
<th>Are Improved Genetic Strains Available?</th>
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**Legends:**

- **F = Poor**
- **L = Light**
- **M = Medium**
- **N = Narrow**
- **B = Broad**
- **BG = Blue Green to Blue**
- **S = Seed**
- **V = Vegetative**
- **X = Christmas trees**
- **G = Good**
- **H = Heavy**
- **? = Unknown**
- **YG = Yellow to Yellow Green**
- **N = None**
Diseases and Insects

All species of Christmas trees are subject to certain diseases and the attack of some insects; however, the susceptibility to damage varies greatly both according to species and to site. Certain species like Leyland cypress have very few enemies and only minimal control measures are needed. Most pines have several insect enemies (tipmoth, bark beetles, aphids) and diseases (various rusts, needle casts, stem cankers) but they are often very specific. Thus, tipmoth may be a problem for some species (Virginia pine) and not for others (white pine) and cedar-apple rust is only serious on redcedar and other junipers and not on other species. (See Table 1 for general susceptibility to disease and insect pests.) Regardless, however, of the tree species grown, most growers of Christmas trees will have to carry out some sort of insect and disease control program.

Genetically Proven Seed Sources of Stock

This consideration is of the highest importance for some species of trees, particularly those, like Scots pine (known popularly as Scotch pine) and Douglas-fir, that have large natural ranges. Just because a tree is a Scots pine does not mean it will do well wherever it is possible to grow Scots pines. There is a vast difference between Scots pine whose seed origin is in Scandinavia and the same species whose seed origin is in Spain. Each seed source, referred to as provenance, is genetically adapted to a specific area or region, and may not do well at all in another area. The only way to find out is to test a large number of seed sources in a large number of areas to find out their suitability for specific climatic zones and soils. This is a task for researchers, not the average grower, unless the latter is inclined to experiment or to try out different seed sources as a hobby.

Tree traits that vary by seed source include the following: frost resistance, winter hardiness, drought resistance, disease and insect resistance, growth rate, foliage color, length of needles, number and size of buds, size of twigs, and straightness of stem. For some species, the best seed sources to plant are known. Inquiries should be directed to the extension forestry specialists in your state. For other species, research is presently being carried out, and for still others no work has been done. A Virginia pine seed-source test is now being carried out in several southern states, and most states growing Scots pine can recommend seed sources best for their particular areas.

Growth Rate or Length of Rotation

It is surprising the large variability that various Christmas tree species display in the time from which they are planted until they are large enough for sale. For rapidly growing species, like Virginia pine and Arizona
 Cypress, saleable trees can be obtained in four years. Others, like many firs and spruces, are so slow growing that 10 to 12 years may be required. There are three main reasons for this difference in growth rate: (1) inherent growth rate of the species, (2) quality of the site, and (3) age and quality of planting stock. Nothing can be done about the first of these unless it is known that some seed sources are faster growing than others. The grower must decide if the increased sale value of some slow-growing species (like Fraser fir) compensates for the longer rotations required to reach saleable size.

With respect to quality of site, rotations can vary by as much as two to five years with various species. Good, well-drained sites having high soil moisture retention will reduce rotation age for most species over sites that are droughty, poorly drained, or have less desirable soil features. Fertilization may in some cases also reduce rotation age, but this needs to be determined for each species.

It pays to get high-quality planting stock. This is especially important in such inherently slow-growing species as Fraser fir and Norway spruce. Planting well-rooted, bushy, transplants, four or five years of age, can reduce rotation ages by two to five years, far more than enough to offset the greater initial cost of such planting stock.

**Recommended Species for Commercial Christmas Tree Production in the South**

The Christmas tree literature (Southern Cooperative Technical Committee 1982) reveals that about 13 species are being grown in the southern states for Christmas tree production, although only four or five are being grown widely. The reasons for these are, first, consumers prefer some species of trees over all others. This is particularly true of the pines—Scots, white and Virginia; and for Fraser fir. Secondly, some species are more easily grown and have a shorter rotation age than others. Finally, there is the matter of the supply of planting stock. Many desirable species, such as Leyland cypress or Deodar cedar, are not available in quantity at affordable prices from conveniently located nurseries at the present time. This may be due to a shortage of seed or a lack of knowledge about their value and saleability.

A summary of species with Christmas tree possibilities in the 13 southern states is shown in Table 1. A few of the species included are seldom grown for Christmas trees at this time.

**Three Basic Growth Forms of Christmas Trees**

There are three basic growth forms of the type of Christmas tree offered on southern markets. They are the pine type, the fir type, and the cedar type. The pine type includes only pine species. Their major characteristics
are long needles (1½ to 5 inches or more) grouped in bundles (or fascicles) of 2 to 5 per cluster. They are intermediate to fast in growth rate, respond to shearing by producing large numbers of buds on short branches, and result in very dense foliage. Pines are of two main kinds: uninodeal, producing only one shoot of growth per season and characteristic of Scots and white pine; and multinodal, producing two or more shoots per year and characteristic of Virginia and other types. Except for Scots pine, which ships well, the other species are brittle-branched, bulky, and do not pack satisfactorily. On the other hand, pines hold their needles well, the best of any Christmas tree type.

The fir type includes all species of fir including Douglas fir, all species of spruce and hemlock, and certain others like Deodar cedar. The species in this group are multinodal, put out short single-needle branches and characteristically are more open-branched than pines, the trunk often being visible from the outside. Branches tend to be limber, the stiffest occurring on spruces and the most flexible on hemlock; but all species with the exception of blue spruce and Deodar cedar pack well and can be shipped long distances without injury. Trees in this group tend to be narrow-crowned with low taper. Their shape, aroma, and texture have always placed them at the forefront of Christmas tree favorites by the public, and even today they usually command the highest prices. Except for the firs, which have rather good needle retention, their main drawback is shedding needles, particularly in long-distance shipping and when standing in open places. This applies particularly to the spruces, but is also a drawback with hemlocks and Deodar cedar. Except for the latter, they tend to be slow growing.

The third type, here called the cedar type after its most typical representative, eastern redcedar, includes a variety of plants we call cedars but are actually junipers, arborvitaes, cypresses, cryptomeria, and some others. The species in this group are characterized by having tiny needlelike or scalelike leaves closely attached to slender branchlets which may be held horizontally or vertically. This combination results in a dense-foliaged tree in which the trunk is not usually visible. Trees of this type tend to be narrow-crowned, even columnar, and so have a very narrow taper. This type tree does not keep well because the foliage tends to dry out, causing loss of leaves. They also do not pack well and are not suitable for long shipping distances. Many of them have aromatic foliage and are desired for this trait. They are not suitable for use with large or heavy ornaments. They are inclined to rapid growth. Response to shearing is generally good, and they can be sheared any time of the year in contrast to other types.

Table of Characteristics of Species Grown for Christmas Trees in the Southern Region

Table 1 is complex but in compact form lists the traits that a grower needs to know to find out the suitability of any species for his conditions,
land location, soil, and climate. To aid in interpretation, three species will be chosen from the table and explained in detail.

**Eastern White Pine (Pinus strobus)**

The species is rated good as a desirable Christmas tree and is in high use among growers. It requires considerable shearing. The rotation age (planting to sale) averages 6-8 years. It is adaptable to USDA temperature hardiness zones 6 through 8 (see Figure 1). It must be grown where rainfall and humidity are high and it is quite heat sensitive. It does best under a medium soil moisture condition and a medium soil texture class (loam). It has a medium (low acid to neutral) soil pH class. Its foliage color is blue green and needs a relatively low amount of colorant for greening. The foliage density in sheared trees is medium to high. Stem form is generally good and it has a medium taper. It has very little aroma. It ships rather poorly and is subject to ice damage but only slightly to snow damage. Disease problems are moderate and include needle casts and rusts. It suffers from insects, especially aphids. Injury to terminal shoots due to birds is moderate. It is readily available as nursery stock and it is propagated from seed. Needle retention is good. Some improved genetic strains are available, mostly in the northern states.

**Fraser Fir (Abies fraseri)**

Fraser fir is rated highly desirable as a Christmas tree and is widely planted and sold by growers. It requires little shaping. Rotation age is long, 8-12 years, but this depends on the size and quality of stock when set out. It is adaptable mainly to elevations above 3000 ft. It has low heat tolerance and prefers high humidity, rainfall, and soil moisture. Its pH range is average for conifers. Stem form is good and it has a natural narrow taper. Foliage density ranges from medium to high. It has green foliage color in winter so that little artificial colorant is needed. Foliage retention after cutting is excellent and it has a moderately strong yet pleasant aroma. It is subject to considerable injury from insects (balsam woolly aphid, especially) and diseases (crown gall), sustains moderate damage from birds and mammals, but is rarely affected by storms or other weather-related injury. It ships well and is widely available from both private and state nurseries. It is raised exclusively from seed. Superior genetic strains are being made available in seed orchards.

**Arizona Cypress (Cupressus arizonica)**

The species is rated poor to fair as a suitable Christmas tree and is in moderate use among growers. It requires heavy shearing. The rotation age is short, only 4-6 years. It is adaptable to USDA temperature hardiness zones 7
Figure 1. USDA Plant Hardiness Zone Map.
through 9. It can be grown where rainfall is low to moderate and under a low humidity regime. It is very heat tolerant. It does well under low to medium soil moisture conditions, and light to heavy soil texture classes (sands to clays). Its soil pH requirements are moderately acid to neutral. Color varies from gray green to bluish gray but requires a medium to high amount of colorant for proper greening. It has high foliage density. Stem form ranges from poor to fair. It has a narrow taper. Trees generally have a moderate to strong aroma. It is subject to considerable ice and snow damage. It is troubled with diseases (phomopsis, monochaetia), is moderately susceptible to insect damage (bagworms, webworms), and suffers moderate to high damage from birds resting on the leader. It is usually readily available as nursery stock and can be raised from seed or from rooted cuttings. Needle retention is poor to fair. Some improved genetic strains (e.g. Clemson Greenspire) are available.

**Improved Genetic Material**

Improved genetic strains of Christmas trees are available now for only a few species. More are available for forest trees, and some of this may be useful for Christmas trees as well. Improved material consists of the following:

- a. Selected provenances (seed origin),
- b. Seed orchard progenies,
- c. Vegetatively propagated clones.

Provenance studies have been conducted with Scots pine, eastern white pine, shortleaf pine, Virginia pine, sand pine, Arizona cypress, Norway spruce, and perhaps some others. However, results are hard to interpret in terms of Christmas trees because most of these studies have emphasized timber values. In some cases (white pine and Norway spruce), the only information comes from outside the South and is virtually useless in terms of the region. In other cases, provenance tests have been carried out in only one or two places, hence results are limited to those areas which have climate and soils similar to the testing place. Hence, many more experiments coordinated over many states, climatic regions, and soil types must be carried out before any general recommendations can be made. A summary of some tests is given here.

1. **Scots pine**: Long-needled, yellowish green sources come from central Europe; short blue-needled sources from southern Europe, especially Spain and France; other short-needled sources are found in northern Europe, southeast Europe, and the USSR. Where they have been tested in the South, the central European strains which are the fastest growing seem to make the best Christmas trees.
2. Eastern white pine: The fastest growing and most blue-colored strains come from the southern Appalachians. All other strains are slower growing and have lighter-colored foliage.

3. Shortleaf pine: Faster growing sources but also less frost-hardy are those originating in the Gulf Coast states. Western sources leaf out earlier than eastern sources. No information is available on the relative suitability of the various sources for Christmas trees.

4. Virginia pine: Several provenance studies have just been established in the past three years in a coordinated test pattern across the South. In three to five years, these studies should provide Christmas tree growers with answers as to which is the best source to plant for their particular area. At present, there does not seem to be much difference in growth rate among different sources. The Alabama sources, however, seems to have straighter stems and a finer branching habit than those from further east.

5. Sand pine: Two distinct strains or races are known. The west Florida sources are faster growing, have longer needles, and open their cones at maturity. East Florida sources are slower growing, have shorter needles, and closed cones at maturity. At this writing, the west Florida sources appear to make the best Christmas trees.

6. Arizona cypress: In this species, two distinct races, sometimes regarded as separate species, are known. Central Arizona trees have smooth bark, strongly ascending branches, bluish foliage that is resin-dotted, and a strong aroma. Southern Arizona trees have scaly or furrowed bark, broader crowns, greenish foliage that has few resin blisters, and a mild aroma. It cannot be said with certainty, however, which make the best Christmas trees. Good and poor trees are found in both sources.

7. Norway spruce: No seed source tests have been conducted in the region, but in Europe and in the Northeast, differences are noted in tree form, foliage length and color, sensitivity to late frosts and other traits. The usefulness of these findings for Christmas tree production is not known.

In the South, seed orchards have been established for timber trees with the following species: shortleaf pine, eastern white pine, Virginia pine, and sand pine. Christmas tree seed orchards have been established with Fraser fir, Virginia pine, and Arizona cypress. Christmas tree growers are making use of Virginia pine seed orchards on a fairly large scale and on a lesser scale for Fraser fir and Arizona cypress. Although definitive answers as to the degree of improvement made by seed orchard stock have yet to be made, it
appears likely that they will be more extensively used in the future. The seed orchard tree improvement approach should be useful for giving us superior material in all pine species, Deodar cedar, and perhaps Norway spruce. It is absolutely essential for Fraser fir, a species whose entire range is threatened by an introduced insect pest, the balsam woolly aphid.

Vegetatively propagated clones, chiefly by rooted cuttings, have been successful in giving us one new species that shows great promise as a Christmas tree for many parts of the South, Leyland cypress. This tree is a sterile hybrid of two West Coast trees, Monterey cypress and Alaska cedar. It is highly attractive, exceptionally free of pests and rapid growing. It must be propagated vegetatively, which is usually considerably costlier than seed propagation. However, nurseries and independent growers are learning to propagate the tree and with the proper equipment and some operator care, several thousand cuttings can be rooted in a single growing season. Equipment needed includes a mist bed, rooting media, rooting hormones, water supply with timer and solenoid valve, and a supply of cuttings. In the future, it may be possible to clone this plant with bioengineering techniques such as tissue culture.

Vegetative propagation is useful for any tree species that roots readily. That includes many members of the cypress and redwood families. It has been successfully used to propagate a superior clone of Arizona cypress, given the name "Clemson Greenspire." Because of the great variability in crown form and foliage characters in these species, it should be possible to propagate other desirable clones as well.

A feature about a clone that deserves emphasis is its genetic purity. Every member of a clone that is vegetatively propagated looks the same because it has an identical genetic constitution. This has both good and bad features. If it means that identical copies of a "perfect" tree could be produced indefinitely and all that that could mean to sales and consumer satisfaction, it also means that a disease or insect pest could come along and destroy an entire plantation, because not just one or a few trees, but all would be equally susceptible. To mitigate this risk, geneticists advise using a mixture of clones, all of good quality but of differing genetic constitution.

Need for New Species

Because the South is in strong competition with other regions of the country in developing and holding markets for Christmas trees, there must be continued research into finding and propagating better trees. One aspect that is important is the testing of new species and, perhaps, hybrid combinations of species already in production. This research can best be carried out by state experiment stations and other public agencies but can also be encouraged on the part of the adventuresome grower as a hobby. The number of species
that have been tried in the South as potential Christmas trees is possibly over 50 (Toullatos et al. 1971, Schoenike and Wright 1973, and others). Few of those tried have been successful, but some have shown promise for specific areas and site conditions. One of these is Deodar cedar, a commonly grown ornamental in all southern states. Once shearing schedules and foliage retention problems had been solved, these trees were found to move well in one South Carolina locality (Wright and Wicker 1979). Genetic differences between seed sources have also been shown (Schoenike 1976). I believe the same can be done for Cryptomeria, a beautiful Japanese species also very successful as an ornamental tree in most southern states. This suggests that the horticultural literature should be explored and that Christmas tree researchers and growers should seek the advice of nurserymen and horticulturists for successful species that might have utility as Christmas trees.

Two hybrid pines, one in the Northeast and the other in California, have been advocated as promising Christmas tree species. The northern hybrid is a cross between Austrian pine (Pinus nigra) and Japanese red pine (Pinus densiflora) and results in a better Christmas tree type than either parent (Wright et al. 1969). Austrian pine has dark green, long-needled foliage but is slow growing; Japanese red pine has shorter needles of a lighter color but is faster growing. To my knowledge, this hybrid has not been tried in the South, but the parent species can both be grown in parts of the region. The western hybrid is a cross between lodgepole pine of the Rocky Mountains and shore pine of the Pacific Coast (Anonymous 1964) and develops a better branch structure, stem form, and foliage characters than its parents. (This hybrid, however, may not grow well in the South because neither of its parents can grow here.) Both illustrations are examples of what can be accomplished by interspecific hybridization and indicate the possibilities of doing the same with other tree species. Wright (1976) discusses some of these possibilities in his textbook on forest genetics.

Certain areas of the southern states are more in need of new and improved species than others. These include the subtropical parts of south Florida and Texas, the lower coastal plains of the Carolinas, and the semi-dry to dry regions of central and western Texas. Researchers should actively establish species trials in these and other difficult regions to determine the most suitable species.

A word about broadleaf evergreens. In this country, based on its north European tradition, the only trees generally found acceptable for Christmas trees have been the needleleaf evergreens. From time to time, voices have been heard to promote other kinds of trees, notably small-leaved evergreen angiosperms. Hollies and some other kinds (Osmanthus?, Photinia?) have been used as outdoor Christmas trees successfully, a practice suited to the milder climate of the deep South. There needs to be some trials with fast growing broadleaf species as cut trees to determine leaf retention, shaping techniques, and growth rates and to ascertain whether it would be feasible to develop these as saleable Christmas trees. Again, horticultural success with
ornamentals can be explored. Certain cultivars of holly (*Ilex* spp.), especially the narrow-leaved Foster Holly, and of tea-olive (*Osmanthus* spp.), such as the holly-leaved Osmanthus, show promise in this respect. Entire new markets could be opened up should such species prove successful.

**Summary and Conclusions**

1. Choice of species for Christmas trees is determined by six important market and biological factors, i.e., consumer preference, distance from markets, adaptability to site, freedom from injurious agencies, availability of genetically improved planting stock, and growth rate.

2. There are three basic growth forms of Christmas trees. They are the pine type, the fir type, and the cedar type. Over much of the South, the pines are preferred because they are easily grown, have relatively high growth rates, and are popular among consumers.

3. The suitability of 24 species for Christmas trees is explored. Of these, only about six are widely grown. Specific requirements for each species and its suitability for a wide variety of biological and economic conditions are given. The information for three species—eastern white pine, Fraser fir, and Arizona cypress—is given in detail.

4. Improved genetic strains are available for a few species grown as Christmas trees and more will be forthcoming as more research information becomes available. Improved genetic material consists of superior seed provenances, seed orchard progenies, and vegetatively propagated clones. The first two of these are most applicable to pines and some firs and spruces; the last of these to cedars, cypresses, and related species.

5. New species are needed for certain problem areas in the South if the region is to realize its full Christmas tree production potential. This is especially true of south Florida, dry areas of Texas, and portions of the Gulf and Atlantic coastal plains. In addition to new species, the possibility exists of developing hybrids among existing species. At least two of them have been found suitable as Christmas trees in other parts of the country.

6. Investigation with the use of small-leaved broadleaved evergreens including various species and cultivars of hollies and tea-olives should be explored for their Christmas tree potential, particularly in the deep South.
Literature Cited


Discussion

Question: My question concerns Leyland cypress. Some of you folks who haven't traveled over into South Carolina are not familiar with this tree. You can't believe how pretty it is; the only problem is getting it planted properly. Were you able to produce commercial quantities in South Carolina?

Answer: This past year we grew about 3,500 to 4,000 cuttings. We sold them at the cost of producing them. You get about 78% success on Leyland cypress—78% is considered success. I might say also that two or three growers are growing their own cuttings in their back yard.

Question: What about Japanese red pine and Deodar cedar--their availability?

Answer: They are not readily available. Deodar cedar is grown commercially in some southern commercial nurseries but not as far as I know in
any state nursery. The growers association would have to request it. You can collect seed from Deodar cedar trees that are planted as ornamentals. That is what we have done in South Carolina, and we have had good success. Japanese red pine is not grown much except in a few places in the Northeast. Contact your state nursery people and see if they can deliver seed for you. In South Carolina in a number of cases like this, the growers association has contracted for growing these seedlings. On that basis, growers are the only ones who get the trees.

**Question:** What time of the year is best to take your cuttings and to do grafting?

**Answer:** Leyland cypress can be rooted if you have the proper equipment almost any time; however, the best success we have had was in taking the cuttings in the winter time. You have to have an indoor system. I think you will have the best success that way. They will be rooted by July or August. You won't have any planted out that fall. Grafting is done in early spring; in South Carolina it's done in April, in parts of the deeper South, in March, just as the new growth is beginning to flush.

**Question:** If white pine is less susceptible to tip moth, why is Virginia pine recommended over it for Louisiana?

**Answer:** You may have to ask one of the local growers about that.

**Comment:** The problem with white pine is that it does not grow well in Louisiana—we are too far south.

**Question:** What are the ingredients for rooting Leyland cypress?

**Answer:** The ingredients are peat moss 50%, vermiculite 25%, and perlite 25%. Perlite is available at most horticultural supply places.

**Question:** Is Virginia pine from the Louisiana Office of Forestry the same as Virginia pine from the Louisiana-Mississippi Christmas Tree Growers' Association?

**Comment:** No. I understand that the Virginia pine seedlings now coming from the Louisiana Office of Forestry are "improved;" however, they are not from the same seed source as the genetically improved seedlings which the Louisiana-Mississippi Association obtains from the Kimberly-Clark nursery in Alabama.
SITE SELECTION, PREPARATION, AND PLANTING FOR SUCCESSFUL CHRISTMAS TREE PLANTATIONS

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Executive Secretary, LA-MS Christmas Tree Association
Starkville, Mississippi

Selecting a reproductive planting site, adequately preparing the site and soil, and properly planting healthy seedlings are the most important steps in establishing a successful Christmas tree plantation. When these steps are completed, you are "locked in" with the results and consequences for the duration of the production cycle. Plantation establishment can be compared to building the foundation of a house. If the foundation is improperly constructed for the site and the type of house to be built upon it, you may not suffer damage for several years. Then, it is too late and too expensive to correct a failing structure. Proper establishment of the foundation is the key to avoiding major problems and minimizing damage from minor problems that may arise in the future. Damage from insects, weeds, disease, wind, ice, and water can often be easily overcome if the house/tree is on a proper foundation.

Spend all the time and money you can afford to select the site, prepare the foundation, and plant the seedlings. The cost of proper establishment is only 5 to 6 percent of the total cost that will be incurred over the production cycle. If you can't afford the time or money to do the proper job now, I advise you to give what time/money you do have to the church or to the local liquor store, whichever gives you the greatest satisfaction, because your success as a Christmas tree grower is highly doubtful.

Site Selection

Selecting the proper site for the species to be grown and the equipment to be used is the first step. There are many factors to be considered in the site selection process.

1. Topography - The amount of slope dictates the types of mechanical equipment and cultural practices that can be used and, to a degree, the internal soil-water relations or drainage and the species that may be grown. Aspect, or direction the slope is facing, can also influence species selection.

2. Drainage - Avoid poorly drained areas. Most Christmas tree species can not tolerate "wet feet" for extended periods of time. Saturated soils restrict root development, soil aeration, and movement of chemicals and fertilizers. The inability to use mechanical equipment for timely application of cultural practices is also a serious consequence of poorly drained areas.
3. Soil structure/type - Avoid heavy clays and deep sands. Soil structure can seriously affect the use of equipment, rates and applicability of herbicides, availability of soil moisture and nutrients, and growth of tree root systems. The most desirable agricultural soil types are also the most desirable for Christmas tree production.

4. Soil fertility and pH - Almost any moderately fertile soil with a pH of 5.0 to 6.5 will grow Christmas trees. Poor soil fertility increases the production period and fertilization costs, but fertility can be controlled and/or adjusted relatively easily. Soil pH is probably more critical than fertility. Soil pH can be increased with a broadcast application of lime prior to plantation establishment, but it is too costly to lower the pH more than a few "points." Repeated applications of nitrogen fertilizer and sulphur compounds will lower the pH a few points; however, initial seedling survival and growth in soils with pH above 6.5 will be unsatisfactory. Ideal pH (for Virginia pine) is about 5.8, with an acceptable range of 5.4 to 6.2. Avoid soils with a pH greater than 6.5.

5. Accessibility - Nearness of the plantation to good roads and easy access for cultural and marketing practices are desirable aspects to consider. Accessibility in remote areas must be controlled to prevent fire and theft. The degree of accessibility required is primarily a function of the type of equipment to be used in cultural and harvesting operations; however, accessibility in wholesale operations requires "negotiable" access, trafficable roads in wet weather, and turn-around room for large, heavy trucks; whereas a choose-and-cut operation requires convenient access, "comfortable" roads, and adequate parking for customer automobiles. Don't forget about weight limits on roads and bridges and the general safety of the potential customer. Plan for all marketing possibilities, because you never know what the situation will be several years after time of establishment.

6. Vegetation and Current Use - The most desirable sites are fields that have been recently cultivated, because they are generally free of competing vegetation. Be careful, however, of fields that are heavily infested with uncontrollable or difficult to control vegetation such as nutgrass, johnsongrass, or sicklepod (coffee weed). Pastures are acceptable, but surface soil compaction and subsurface hard pans will have to be eliminated during soil preparation practices. Avoid sites that were recently covered with large trees unless they have been thoroughly prepared by root raking and complete stump removal. Decaying roots and stumps increase the chances of attack by pales weevils and various types of grubs.

7. Easements, Mineral Rights, and Conveyances - If you are purchasing the property, be sure to have a title search performed by an attorney. It would be most unfortunate to find out just before harvest that someone has decided to exercise his legal rights and build a road or powerline or mine for minerals through your plantation. Oil or gas wells on your property are acceptable, as long as you own some of the mineral rights!
8. Acreage for Expansion - Avoid sites that do not have enough acreage to allow for expansion or several crops of trees. Moving equipment and people between several locations is not only expensive, but it may seriously affect the timely application of necessary cultural practices.

9. Soil Testing - Soil testing is absolutely necessary to determine soil fertility and pH of potential sites. Don't trust visual observations or personal recommendations of previous owners. Don't guess, test! Soil test results will help determine cost and success of future cultural practices. Following the recommendations is as important as having the test made.

The Christmas tree business is not a "get rich quick" proposition; in fact, it has as many risks as any other agricultural business involved in the production of ornamental plants. You should thoroughly investigate the money and time that will be required to grow Christmas trees before making a real commitment. Efficient production of high-quality, marketable trees with sound management practices is the key to success. You cannot produce quality trees on an undesirable site with the best cultural practices, so careful site analysis and selection is absolutely necessary for success.

Site and Soil Preparation

Proper preparation of the site and soil allows easier cultural and harvesting operations, increases planting survival, and promotes early and continued tree growth. The amount of preparation needed depends on previous land use, existing vegetation, internal and external soil conditions, degree of mechanization, and method of sale.

Access roads, fences, storage buildings, power and water lines, drainage ditches, and other permanent requirements should be located prior to laying-off and preparing the actual planting sites. If possible, locate roads, buildings, etc. on nonproduction areas, but be careful not to reduce the overall efficiency of future operations for a few square feet of productive soil.

Don't forget about access lanes within the plantations; they will have to be connected to the primary access roads. Access lanes should not be disturbed during soil preparation practices so they can provide a firm foundation for easy access during wet soil conditions. The distance between access lanes and their width depends on the size of the plantation and the equipment that will be used on them. For large plantations, access lanes should be placed around each 3- to 5-acre block. For small plantations with limited acreage, one access lane or road around the entire plantation may be sufficient. The larger the equipment to be used within the plantation, the wider the access lane must be. Approximately 12 to 15 feet should be sufficient width for most operations. Access lanes should cross the planting rows at right angles, thus providing easy access to each row and a convenient turn around for field equipment.
Lay-off the planting sites or blocks for each year's planting as soon as the access roads, buildings, and other permanent facilities are located. The size of the planting block is determined by the available acreage, the number of years it takes to produce a harvestable crop, and the number of crops you plan to have on the total acreage. For example, if you have 40 acres available for planting and you want to harvest a crop of 4-year-old trees each year you will need four 10-acre blocks for a sustained crop rotation.

Planting blocks should be identified by name or number; defined by roads or topographic features; homogeneous as possible with regard to soils, vegetation, topography, etc.; and arranged in a logical sequence by planting date/tree age. It is best to keep planting blocks with trees of similar age and size adjacent to one another so similar cultural practices can be applied efficiently. Adjacent ages/sizes are particularly important when applying herbicides and insecticides at different rates and there is a potential for drift damage to younger trees. Homogeneous conditions within blocks facilitate the uniform application of cultural practices. It is time-consuming and expensive to apply several different treatments or to re-adjust equipment for varying tree size or other conditions in the same planting block.

The vegetative cover and soil condition will determine how much soil preparation will be required and the appropriate method to be used. The planting site should be prepared in late summer and early fall prior to planting. Site preparation should remove competing vegetation, level the ground for mechanical operations, remove hardpans for root development, prepare the soil for seedling placement, provide a desirable ground cover for erosion protection and weed prevention, and establish recommended nutrient and pH levels.

If the land is tillable and not subject to sheet erosion, it should be turned deeply and then disked and harrowed level. Land that has been in cultivation or pasture should be subsoiled to remove subsurface hardpans. Turning plows and chisel-point plows do not generally penetrate deeply enough or fracture hardpans sufficiently. A subsoil plow should be used, at least along where each planting row will be. The subsoiler can be used prior to planting to lay-off the planting rows. Plowing should be completed in late fall to allow time for the ground to settle a month or so prior to planting. Freshly plowed soil has numerous air pockets which will cause tree mortality.

If land is not tillable, the vegetation can be killed in strips or planting bands with herbicides in late summer. A close mowing and/or fire can be used prior to the herbicides. Trees should not be planted in heavy sods of bermuda, bahia, tall fescue, etc. Herbicides like Roundup, Tordon, Velpar-L, and Goal can be used; Dalapon does a good job on bahiagrass. Ask your County Agent for current herbicide recommendations. Old pastures will probably have a hardpan, so subsoil and/or rototill the planting bands. Prepare at least a 30- to 36-inch planting band. Align the bands on the contour to reduce erosion.
Don't forget that you can apply a pre-emergence herbicide to the planting band in the late summer and early fall where there is a large residual supply of weed seeds.

Establishing a cover crop of wheat, rye, or oats in the fall will prevent erosion, provide some protection to seedlings from cold, drying winds, and reduce the sprouting of competing vegetation next spring. A cover crop also helps to stabilize the soil and make it possible for planting during wet soil conditions. The seed can be broadcast with a balanced fertilizer or drilled in with a grain drill and fertilized later. Annual crops will die by the time the seedlings really start growing. If necessary, an over-the-top band application of Goal, Velpar-L, or other recommended herbicides can be used to kill the cover crop. Don't use a perennial crop or one that gets tall, such as ryegrass.

Apply lime and recommended amounts of P and K during site preparation. Apply nitrogen in the late spring after planting when seedlings have developed root systems to absorb the nitrogen and the initial flush of weeds is under control. Potash (K) promotes root development, but it does not move downward in the soil; it should be disked-in deeply or drilled to a depth of 2 to 4 inches. It is possible to drill potash behind the subsoiler foot.

Don't try to save money by not applying recommended lime or fertilizer; that's like trying to save money by reducing the amount of concrete or re-enforcement steel in a house foundation. Soils that need lime, i.e. the pH is low, will tie-up certain nutrients and they will not be available to the tree. Applying fertilizer to soils with a low pH is a waster of money! You might as well buy whiskey with your fertilizer money or give it to the church, whichever gives you greatest satisfaction, because you probably aren't benefiting the tree anyway.

As a side comment, the majority of the tree problems I have seen in first-year plantations were caused by improper site preparation practices for hardpans, competing vegetation, and soil nutrients/pH. Hardpans were the basis for the majority of the most serious problems.

**Seedling Transport, Storage, and Care**

Seedling handling practices are just as important as site preparation practices, if not more so. Improper handling of planting stock can cause excessive mortality that will not show up until spring when the weather warms up and growth begins. The needles of most conifer species will not turn brown until spring (or until warm temperatures are reached) if the tree dies during the dormant period. Thank goodness for this delayed reaction, otherwise we wouldn't be trying to grow Christmas trees for cutting and putting into the homes of anxious consumers. This "physiological response" means that if we mishandle seedlings and they die, we will be planting "dead" seedlings and not
know it. What a waste of time and money; and needless to say, a traumatic experience. Since we can't visually determine when a seedling is dead, we must use every possible precaution to insure survival.

Seedlings should not be lifted until weather conditions have been sufficient to insure complete dormancy. To be on the safe side, here are a few suggestions that should cover most eventualities:

1. Seedlings picked up at the nursery prior to December 15 should be transported immediately and placed in cold storage at 35 to 40 degrees F for at least a week.

2. Cold storage is not necessary if the seedlings are dormant, well packaged with a water-holding material around the roots, and stored in a building where the temperature is cool (below 45 degrees) and constant. I think cold storage is preferable to heeling-in when there is a chance the seedlings will break dormancy before they are planted near the end of the planting season. Planting a live, growing seedling is risky.

3. Protect seedlings from drying winds and cold temperatures during transport. Seedling bundles should be transported in an enclosed truck for long distances, or tarped very tightly for short distances. Seedlings can freeze in the bundles.

4. Water the seedlings in the bundles, very lightly, before storage and at 7-day intervals thereafter. A three-foot piece of copper tubing with a series of holes drilled in the last 12 inches and the end brazed closed can be attached to a water hose for watering the "center of the seedling bundles." A dormant plant is transpiring some, and water loss can be substantial in only a few days.

5. Place seedling bundles on racks that slope forward to allow excess water to drain out; rotate bundles every 3 to 4 days. Water can settle into the bottom of the bundles.

6. Separate bundles and leave room for air circulation. Do not stack them closely in a pile; seedlings can go through a "heat." Check the bundles every few days for heat buildup and moisture condition.

7. Open bundles as they are needed, root-prune the seedlings, dip the roots in "gel" or place the seedlings in a bucket with wet sawdust, and plant as soon as possible. Seedlings with "gel-dipped" roots can be stored about 3 weeks without watering them. In fact, a recent experience indicated that non-dormant seedlings with "gel-dipped" roots were stored safely out of refrigeration for about 2 weeks.

8. Keep seedling roots protected from the sun and drying wind during planting. Cover seedlings with moist burlap or keep them in a bucket with wet
sawdust. The "gel solutions" will also prevent the roots from drying out. A few minutes in the sun and wind will dry out the small feeder and lateral roots.

**Spacing, Planting, and Staking**

Tree and row spacing is optional. Spacing is dependent upon the acreage available, the growth requirements of the species, and the types of equipment that will be used. I believe that a 6-foot tree will be 4.2 feet in width at a 70% taper. That doesn't leave much room for shearing and lower limb development. I have observed many plantations with a 6-foot tree spacing where the grade had been reduced at least one grade because of holes, flat sides, and poor lower limb development on trees 7 and 8 feet in height. I strongly recommend a tree spacing greater than 6 feet for Virginia pine, particularly if the trees are expected to exceed 6 feet in height at time of sale.

Row spacing is strictly a function of acreage and equipment size. Most growers fail to realize the lateral growth/size that Christmas trees will attain by the end of the rotation when it is so important to be able to use mechanical equipment for spraying insecticides, herbicides, and colorant, and for harvesting. A row spacing at least 4 feet wider than the widest piece of equipment is essential; some say 3 feet, but that is minimal to say the least. I know several growers who planted on a 7-foot row spacing and can't get their tractors into the field the last year before harvest.

I believe a spacing of 7 feet by 7 feet (889 trees per acre) is the most desirable for Virginia pine. A spacing of 6 by 7 feet (1,037 trees per acre) is probably second choice. My best advice is to plan ahead and visit some older plantations in your area.

A checker-board arrangement/pattern is esthetically pleasing, but straight rows and uniform tree spacing within the row are more important when mechanized equipment and chemical weed control practices are to be used. A checker-board pattern is difficult to establish and only advantageous for cross-mowing when weeds are not chemically controlled in bands. Most growers have found that it is cheaper and more efficient to apply all treatments to a continuous band than it is to "spot-apply" them.

If you find it desirable to establish a checker-board pattern, here are several methods for doing it efficiently. Use cultivators spaced at the desired distance to "cross-hatch" the field in both directions; plant at the intersections of the furrows. This method requires row and tree spacing to be the same unless you change to cultivator spacing when you make the "90-degree" furrows. If you are going to use a mechanical planter without a seedling spacing chain or "clicker," put the spacing furrows in only one direction. Pull the planter at 90 degrees to the tree spacing furrows, using a spacing boom to maintain distance between rows, and plant a seedling as you cross the
spacing furrow. The spacing furrows are run at 90 degrees to the desired direction of the rows. Do not use the spacing furrow method on steep terrain or on soils that erode easily; severe erosion can result from water running down the furrows, before and after planting.

Planting is usually accomplished from about December 1 until March 15, depending on the weather, soil moisture, the section of the country, and the method of seedling storage. Early planting is strictly a function of seedling dormancy and soil moisture. I personally prefer to plant late in the season so the seedlings are definitely dormant and they won't have to be subjected to freezing/thawing cycles and cold, drying winds. My preference assumes that minimal root growth will take place due to cold soil temperatures prior to spring. Growers along the Gulf Coast like to plant early because the trees will actually begin to grow during warm periods in February.

Early planting is necessary if cold storage is not available and if seedlings are heeled-in. Researchers tell me that Virginia pine does not store as well as other southern pines for long periods of time, possibly because of a buildup in the emissions of ethylene gas during storage. Ethylene is a hormone produced by the seedling in response to root-system wounds incurred during lifting. Research is currently underway at Mississippi State University and other universities to determine the physiological role of ethylene during periods of seedling storage.

Seedlings can be planted with the standard dibble bar, the new (controversial) spike bar, or a mechanical planter. The equipment used is not as important as seedling placement. Proper placement involves opening a trench/slot to the proper depth, putting the seedling roots into the trench/slot in such a manner as to keep the tap root straight and the root system at a depth equal to or slightly greater than it was in the nursery, and closing the trench/slot to remove air pockets from around the roots and to keep the seedling straight/vertical.

Planting depth is extremely critical. The trench must be deep enough to allow the seedling to be placed ½ to 1 inch deeper that it was in the nursery, because the ground will settle, possibly exposing roots. The tap roots should be pruned off to the point the roots are stiff enough to be "pushed" into the trench without curling up, i.e. "J-rooting." Don't prune lateral roots. J-rooted seedlings will die immediately or will be stunted throughout the rotation. If a moisture stress occurs, J-rooted trees will be affected first. J-rooting also reduces the tree's stability and makes it susceptible to windthrow. J-rooting is the most common problem encountered in planting.

Root pruning is necessary with all planting methods to prevent J-rooting when the seedling is inserted into the trench or slot. During mechanical planting, the speed/movement of the planter as the trench is being closed will cause the roots to be "L-shaped" along the bottom of the trench. The speed of the planter and the timing of the seedling release in the trench can cause
seedlings to lean forward or backward, parallel to the direction of travel. Clipping the seedling too shallow will cause it to lean opposite the direction of travel. The length of the root system must be used to judge the proper clipping positions, not the root collar.

Closing the trench at the top and bottom is essential when planting in firm sod or soil where loose soil will not "melt" quickly around the root system. The spike bar should only be used in very loose, friable soils, because the "round hole" is not closed after seedling placement. The developer of the spike bar, Ed Hoover of International Paper Company, recommends the hole not be closed, so that silt and fine particles can wash into the hole and fill it from the bottom upward. I personally prefer to "squeeze the top of the hole" with my fingers to hold the seedling in place, not closing it completely. Other growers just place the seedling in the hole and walk off.

I recommend that the spike have a maximum diameter of 5/8 inch and minimum length of 10 inches. A smooth, rolled steel bar is preferable to rough re-enforcement steel, because clay does not build up as much on the smooth steel. The handle and the main shaft can be made from aluminum or steel conduit to the same dimensions as a standard dibble bar. The spike bar is light in weight and easy to use; women can even use it—don't tell them I said that!

When using a standard dibble bar, it is essential to "close the bottom of the trench" firmly by pulling back on the handle after the bar is inserted about 2 inches behind the planting slot. Closing the top, i.e. pushing forward before closing the bottom, will leave air pockets around the roots. An open-top slit will allow silt to wash in and fill the space.

Check for "seedling tightness" by grasping 3 or 4 needles and trying to pull the seedling out of the ground. If it is easily removed with 3 or 4 needles, the trench is not closed properly. This rule doesn't apply for the spike bar—only the dibble or mechanical planters.

Staking recently planted Virginia pine is becoming a common practice. Virginia pine has a natural tendency to develop crooked stems. Staking can be reduced by planting the seedlings deeper than they grew in the nursery, but some staking will most likely have to be done. Stakes should be placed firmly against the seedlings on the side of the lean. If the stake is placed on the opposite side from the direction of lean, the seedling will "bend" toward the stake when tied up and a crook will result. Seedlings should be tied with a material that will decay within a few months; don't use garbage bag twist-ties; they have wire in them. Common masking (not electrical) tape about 1/2 to 3/4 inches in width works well. A hand-operated "tapener" is being used by some growers. It can be ordered from most horticultural supply firms.
Importance of Early Weed Control

I believe that early weed control is actually a part of establishment. A later speaker will handle weed control in more detail, but here are some thoughts and slides to start you thinking. I think a herbicide with pre-emerge activity is absolutely necessary after planting. Princep and Surflan have been used for many years, but they will only last about 45-60 days, and then you'll have to use something like Roundup for cleanup. Goal is good and safe, but it won't hold up long either. I really like Velpar-L; it is relatively safe if used properly, it has both pre- and post-emerge activity, and it is very residual. I have heard reports about mixing it with Surflan or Goal for excellent results.

Importance of Fertilization

I am so convinced that proper fertilization is essential to produce a quality tree that I am going to pre-empt the speaker on fertilization and offer my biased, but experienced-based comments early. Virginia pine, being a native of areas with thin, relatively unfertile soils, will practically "grow on a rock." It will show unbelievable height growth on moderately fertile soils, so most growers believe that fertilizer is not needed and applying it will increase the number of shearings. True, fertilizer will increase the overall growth rate, but the most significant effect will be the tree's ability to "respond" promptly to shearing by setting buds and commencing growth.

Research at LSU by Drs. Tony Hu and Paul Burns indicated that the addition of more than 0.4 lb of 8-8-8 (about 0.51 ounces of nitrogen) to 2-year-old trees did not increase height growth over the 0.4-lb rate. They did, however, observe that fertilized trees were greener and appeared more attractive than unfertilized trees. The height growth of fertilized trees (at the 0.4 lb rate) was only 5.3 inches more than on the unfertilized trees; 30.9 inches for fertilized versus 25.6 inches for unfertilized.

I recommend that Virginia pine be fertilized with nitrogen at least once each year prior to the harvest year and twice the year of harvest. Limited research but years of personal experience indicates that a rate of 0.25 to 0.33 ounces of actual nitrogen per tree per year of growth should be sufficient. This amount translates to approximately 1 ounce of ammonium nitrate or the volume equivalent of a 35-mm film container. The general recommendation of 30-40 lbs of actual nitrogen per acre can also be converted to a per-square-foot basis for individual trees.

I have observed several plantations that appeared to be in what I called "shearing shock" several months after a heavy shearing. The plantations had received no fertilization and the soil pH was below 5.5. The trees were off-color (sort of chlorotic looking) and had not set new buds or initiated growth that would "heal over" the limb stubs prior to sale that year.
"Shearing shock" appears to be more evident after mechanical shearing than after hand shearing; perhaps it is the vibration of the rotary blades that amplifies the problem. I believe the "shearing shock" response is present with hand shearing, but is not as easily detected.

Time is money in the Christmas tree business and when trees don't respond promptly to shearing, we are losing money. A tall tree without proper density, shape, or color is not a quality product. Experience has shown that fertilization improves tree quality without increasing shearing costs significantly. It's your decision now; I've given you my biased opinions.

Discussion

Question: Can I use browntop millet for a cover crop?
Answer: I wouldn't use it because it gets too tall. I want to use something that doesn't get too tall and will die off on its own like oats and wheat, or if it doesn't die off I can kill it easily.

Question: Dr. Parker, would you expand a little bit on the right time for planting seedlings?
Answer: You really need to stick them in the ground when you have enough moisture, beginning in the fall. Let's assume you have a dormant season beginning at the end of November or the first of December. Then if you could hold the seedling in a dormant state, you could plant as late as July 4. The key factor is the condition of the seedling when it goes in the ground. But as a grower you are going to have to pick the seedling up and get it in the ground before it breaks dormancy and before the temperatures get out of the acceptable range. If you can keep the seedling at 40 degrees F. and water it readily, you can plant on into the end of April and May, depending on where you are in the South. But if you heel that seedling in, and it is going to break dormancy by the first of March, as in South Louisiana, you have to plant prior to that. I would say it depends on the dormancy of the seedling and the conditions. Research has shown that you can do some planting in mid-summer if you have adequate moisture.

Question: Can we consider that the seedlings we get from the Louisiana-Mississippi Christmas Tree Growers' Association are dormant?
Answer: Yes. We pick our seedlings up from the nursery in January.

Question: If the subsoil has a hardpan, should you break the hardpan all the way across the field?
Answer: You can plant through the whole field that way if you want to spend time and money, but at least break the hardpan down along the planting rows.

Question: Should you fertilize after your cover crop is down, or right away?

Answer: I would never fertilize a newly planted tree until it has enough root system to use it, which means May or June.
FERTILIZATION OF CHRISTMAS TREE PLANTATIONS

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Introduction

One of the primary objectives of most Christmas tree growers is to produce the best quality tree in the least amount of time. Reducing the number of years required to produce a tree substantially reduces the production costs by reducing the shearings a tree may require, by reducing weed and insect control costs, and by reducing the amount of time the grower has his land and capital invested in a crop of trees. The main advantage southern Christmas tree growers have over their northern counterparts is a shorter rotation time. Virginia pine (Pinus virginiana Mill.), under normal conditions, can be grown to a merchantable size in four to six years.

One possible way of increasing the growth and quality of Christmas trees may be to increase the fertility level of the soil in which the trees are growing. However, many of you may already have tried fertilizing your trees and have not noticed any appreciable changes. In fact, in certain instances, it may be detrimental to tree growth to indiscriminately apply certain types of fertilizers. The objective of this paper is not to specify how much of which fertilizer to use each year, but rather to present some of what is already known about basic fertility requirements of trees and various responses to past fertilization experiments. With this information and with the knowledge of your soil type, existing fertility levels, and management techniques, you should be able to better understand your soils and make better decisions on how to optimize your tree growth. Because Virginia pine is the primary Christmas tree species in the South, most of my comments will be directed to it.

Past Results

The use of fertilizers in forestry has been largely restricted to soils with a clearly defined mineral deficiency (Merrifield and Foil 1967). One of the reasons why fertilizers have not been widely used is that past studies have not demonstrated consistent growth responses. For every study which shows a positive response to the addition of an element, such as nitrogen, you can find one which shows no response and another which demonstrates a negative effect. Many of the studies do not document fertility levels of other elements or of the acidity levels (pH) and, therefore, cannot offer explanations of their results. However, several studies have potentially valuable information for growers of Virginia pine.
Fowells and Krauss (1959) and Sucoff (1962) have demonstrated that Virginia pine and loblolly pine have practically the same requirements for nitrogen (N), phosphorus (P), and potassium (K). Because of this, we can also look at past studies of loblolly pine and expect similar results if applied to Virginia pine. Addition of nitrogen has been shown both to increase tree growth (Wells 1970) and to decrease tree growth (Merrifield and Foil 1967). In the first case, the soils were relatively fertile in both P and K. The addition of N decreased the soil pH from 5.9 to 5.4. In the second case, the addition of N decreased the soil pH from 5.3 to 4.5, which induced a phosphorus deficiency. The pH of the soil greatly affects the availability of most plant nutrients. At low pH's (below 5.0), the availability of calcium (Ca), magnesium (Mg), phosphorus (P), potassium (K) and sulfur (S) is greatly reduced. At high pH's (above 7.0) the availability of iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu) is severely limited. The application of a fertilizer or lime may alter the pH of the soil to such an extent that a nutrient level which previously was marginally adequate will become a limiting factor for growth.

Nitrogen not only affects the pH of the soil but may also influence the uptake of other nutrients, and vice-versa. Hughes and Jackson (1961) reported a significant N*K interaction, in which the addition of N without K or K without N both retarded tree growth. On potassium-deficient sites, Heiberg et al. (1959) found that additions of K did not affect P uptake but did cause an increase in total N uptake. Switzer and Nelson (1956) have also reported that total K uptake was increased by adding N to the soil. In nitrogen-deficient soils, Wells (1970) did not observe a growth response to potassium; however, addition of K decreased the Ca and N uptake.

Calcium, magnesium and potassium are all absorbed as cations, and may compete with each other for uptake. Raising the level of one may cause a reduced uptake of another. If the other was marginally sufficient, then the reduced uptake may retard growth. Specific interactions between Mg and Ca (Sucoff 1962), K and Mg, K and P, and K and heavy metals (Shear et al. 1953) have been demonstrated on trees.

Another possible side effect of fertilization of Christmas tree plantations is its effect on weed competition. If weeds are not adequately controlled, fertilization may stimulate the weeds more than the trees. In at least one case, fertilization with a balanced fertilizer has decreased tree growth due to weed competition (Gilmore and Boggess 1963).

What does the above mean for the average grower of Virginia pine Christmas trees? If he blindly fertilizes his field, he may increase or decrease tree growth depending on his own particular set of circumstances. The grower must know the fertility requirements of Virginia pine in the field (which have not been established) and the fertility levels of his soil, which he can obtain from standardized soil tests. Finally he must realize that the addition of any fertilizer or lime may cause several interactions among many of the key elements.
Fertility and Growth of Virginia Pine

To develop more specific information for Christmas tree growers, we began to study the fertility requirements of Virginia pine in 1980. Our first experiment was established to test the relationships of various levels of nutrients on the growth of Virginia pine Christmas trees. To minimize geographical effects, eight separate locations were selected in north Alabama. The soils on all locations were clay loams. The Virginia pines on these locations had all originated from the same seed source from the same nursery. Trees selected for this study had completed their second growing season in the field and had not been sheared.

At each location, at least four four-tree plots were established. The plots were visually selected to represent the best, average, and worst tree growth on each location. Each of the four trees per plot was measured for total height and stem diameter. From each plot a soil sample comprised of soil from the top 25 cm from five locations among the four trees was taken. The soil samples were analyzed for pH, phosphorus, potassium, magnesium, calcium, and organic matter (all standard tests available to Christmas tree growers). The fertility data and growth measurements were analyzed using multiple regression techniques.

As anticipated, there was a large variation between the growth on the best plot (ht = 157.5 cm and diam = 2.98 cm) and the worst plot (ht = 67.3 and diam = 0.64 cm). Average growth varied from 89.4 to 126.4 cm in height and 1.14 to 2.38 cm in diameter. This variation was also expected due to possible fertility differences and the wide range of cultural practices encountered, which ranged from no weed or insect control to very intensive weed and insect control. The variation caused by the differences in cultural practices was purposely included in this experiment because it should be part of the location effect in the analysis of the data. This makes it possible to compare the relative importance of cultural practices with fertility levels.

Using all six of the above soil factors, none was found to account for a significant portion of the variation in heights (Table 1). Both potassium and magnesium were found to be significant predictors of diameter growth (Table 1). Approximately 27% of the variation in height and 48% of the variation in diameter were explained by use of all six soil factors. Interactions of all the soil factors were then tested, including the interactions with pH expressed in hydrogen-ion concentrations. The potassium x magnesium interaction was found to be significant for both height and diameter. This interaction was further tested using each of the other soil factors. Their interactions and location effect resulted in the following equations:

1. \[ \text{Height} = 80.063 + 0.493 \text{ (potassium)} - 0.003 \text{ (potassium x magnesium)} \]
   \[ \text{PR} > F = 0.033 \quad R^2 = 0.198 \]
Table 1. Regression analysis of six soil factors for height and diameter of Virginia pine.

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<th>Parameter</th>
<th>Height</th>
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<th>Diameter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>PR/T/</td>
<td></td>
<td>Estimate</td>
<td>PR/T/</td>
</tr>
<tr>
<td>Intercept</td>
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<td>0.733</td>
<td></td>
<td>-0.011</td>
<td>0.997</td>
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<tr>
<td>pH</td>
<td>9.239</td>
<td>0.644</td>
<td></td>
<td>0.319</td>
<td>0.473</td>
</tr>
<tr>
<td>Phosphorus</td>
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<td>0.653</td>
<td></td>
<td>0.021</td>
<td>0.180</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.004</td>
<td>0.763</td>
<td></td>
<td>0.001</td>
<td>0.492</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.1311</td>
<td>0.274</td>
<td></td>
<td>0.006</td>
<td>0.019</td>
</tr>
<tr>
<td>Magnesium</td>
<td>-0.2756</td>
<td>0.084</td>
<td></td>
<td>-0.011</td>
<td>0.004</td>
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<tr>
<td>Organic matter</td>
<td>6.665</td>
<td>0.502</td>
<td></td>
<td>-0.141</td>
<td>0.523</td>
</tr>
</tbody>
</table>

All parameters PR>F = 0.1711
R-Square = 0.269

PR>F = 0.0048
R-Square = 0.476
2. Diameter = 0.7511 + 0.0194 (potassium) - 0.001 (potassium x magnesium)  
\[ PR > F = 0.001 \quad R^2 = 0.443 \]

All other factors were found to be insignificant, lowering the reliability of the equations and not substantially increasing the R\(^2\) value.

The potassium level was a significant predictor of both height and diameter only after the variation attributed to the potassium x magnesium was accounted for. Less than 120 pounds per acre of available potassium resulted in depressed growth (Table 2). Magnesium and potassium are both cations and may compete with each other for plant uptake. Shear et al. (1953) found an interaction between potassium and magnesium and suggested using a potassium/magnesium ratio for predicting magnesium deficiency of tung trees. Such a ratio is also presented in Table 2. Magnesium level may affect potassium uptake. Both are cations and may compete with each other for exchange sites. It appears that there must be at least one and a half times more available potassium per acre than magnesium for satisfactory tree growth.

Maximum growth rates were observed on soils which had between 51 and 90 pounds per acre of magnesium (Table 2). On plots with less than 50 pounds per acre, heights and diameters were 15% less than the 50 to 90 range, indicating a possible magnesium deficiency. Greater than 90 pounds per acre also depressed growth rates, most likely due to the potassium x magnesium interaction. The overall effect of magnesium was negative; increasing levels of magnesium decreased both height and diameter growth.

The level of phosphorus and the phosphorus x pH interaction were not significant. However, a closer look at the growth from different levels of phosphorus (Table 2) indicates that less than 5 pounds per acre may limit tree growth. Five pounds or more seem to be adequate. Higher levels of phosphorus did not substantially and consistently increase tree growth.

The pH level was not a significant factor for predicting either height or diameter growth. There appears to be no difference in growth rates of Virginia pine from a pH of 5.0 to 6.4. We are not implying that pH is not important, but rather that the range of pH's encountered was not critical for tree growth. Organic matter level and calcium level also were not significant and appeared not to affect tree growth within the ranges tested.

As stated before, there was a large amount of variation in heights and diameters among the eight locations. When used alone, location was a significant predictor of growth. However, when the variation due to potassium and the potassium x magnesium interaction was accounted for, location effects were no longer significant. The effects of potassium and magnesium levels established a trend covering all eight locations, whereas the variation caused by location effects could only be accounted for by a relatively small sample size per location, thus decreasing its statistical significance. It is
Table 2. Average height and diameter of two-year-old Virginia pines at different levels of potassium, magnesium, phosphorus, and pH.

<table>
<thead>
<tr>
<th>Element</th>
<th>Level (lbs/acre)</th>
<th>Sample size (no. of trees)</th>
<th>Height (cm)</th>
<th>Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>40-80</td>
<td>36</td>
<td>96.6</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>80-120</td>
<td>52</td>
<td>97.9</td>
<td>1.69</td>
</tr>
<tr>
<td></td>
<td>120-160</td>
<td>28</td>
<td>116.8</td>
<td>2.03</td>
</tr>
<tr>
<td></td>
<td>160</td>
<td>20</td>
<td>117.2</td>
<td>2.32</td>
</tr>
<tr>
<td>Magnesium</td>
<td>30-50</td>
<td>32</td>
<td>99.1</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>51-90</td>
<td>44</td>
<td>117.7</td>
<td>2.12</td>
</tr>
<tr>
<td></td>
<td>91-130</td>
<td>44</td>
<td>102.1</td>
<td>1.72</td>
</tr>
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<td></td>
<td>131-160</td>
<td>16</td>
<td>84.0</td>
<td>1.27</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>3-4</td>
<td>20</td>
<td>86.6</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>20</td>
<td>107.7</td>
<td>1.66</td>
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<td></td>
<td>6-10</td>
<td>40</td>
<td>113.1</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>11-20</td>
<td>32</td>
<td>98.1</td>
<td>1.81</td>
</tr>
<tr>
<td></td>
<td>21-30</td>
<td>24</td>
<td>109.7</td>
<td>2.30</td>
</tr>
<tr>
<td>pH</td>
<td>5.0-5.3</td>
<td>36</td>
<td>103.1</td>
<td>1.94</td>
</tr>
<tr>
<td></td>
<td>5.4-5.7</td>
<td>56</td>
<td>101.0</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>5.8-6.0</td>
<td>24</td>
<td>111.0</td>
<td>1.93</td>
</tr>
<tr>
<td>Potassium/Magnesium ratio</td>
<td>.50-.99</td>
<td>36</td>
<td>93.3</td>
<td>1.24</td>
</tr>
<tr>
<td></td>
<td>1.00-1.49</td>
<td>36</td>
<td>99.0</td>
<td>1.66</td>
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<tr>
<td></td>
<td>1.50-1.99</td>
<td>40</td>
<td>112.0</td>
<td>2.11</td>
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<td></td>
<td>2.00-2.80</td>
<td>32</td>
<td>115.9</td>
<td>2.38</td>
</tr>
</tbody>
</table>
important to note that the effects of different levels of potassium and magnesium were significant in spite of the variation caused by location effects (such as cultural practices).

Using the above information, the following set of criteria was selected for optimum growth of Virginia pine: (1) potassium level should be greater than 120 lbs/acre, (2) magnesium level should be between 50 and 90 lbs/acre, (3) the potassium/magnesium ratio should be greater than 1.5, and (4) phosphorus level should be 5 lbs/acre or greater. A total of six four-tree plots were found to satisfy all of the above criteria. Average heights and diameters on these plots were 129.8 cm and 2.51 cm, approximately 25% and 39% more than the average for all plots. The best six plots based on height growth were 139.7 cm tall with a diameter of 2.63 cm, or only 7% taller and 5% larger in diameter than the six plots selected by the above criteria.

**Potassium-Magnesium Fertilization**

If, according to our previous results, potassium and magnesium are critical to tree growth, then it would logically appear that addition of potassium should increase growth and magnesium decrease growth. To test this theory, we set up an experiment on one- and two-year-old Virginia pines. In this test we added either no fertilizer, 100 lbs. of potassium, 200 lbs. of potassium, or 100 lbs. of magnesium, replicated six times per age class. Two years later we remeasured height and diameters and resampled the soil from each experimental unit (a rectangular plot of 12 trees).

The fertilizer treatments did not significantly affect height or diameter growth over the two-year period. One possible explanation for this could be that the fertilizer applications did not change the nutrient levels of the soil. However, the analyses of the soil samples indicate that addition of 100 lbs. of potassium raised the potassium level between 20 and 40 lbs. per acre. The addition of magnesium also significantly raised the magnesium level in the soil. If we changed the potassium and magnesium levels of the soil, then why were these changes not reflected in the growth of the trees?

In an effort to answer this question, regressions of the height and diameter measurements on soil nutrient level were performed. The results of these analyses indicated a complex situation. The soil nutrient levels affecting one-year-old trees differed from those affecting two-year-old trees. Soil characteristics which affected heights of trees also differed from those which affected diameters. Potassium, magnesium, calcium, phosphorus, nitrogen, organic matter, and the interactions of potassium x magnesium, potassium x nitrogen, phosphorus x pH and potassium x magnesium x nitrogen were all found to significantly influence the growth of Virginia pines. Each experimental unit appeared to respond to a unique set of soil conditions. The combined effect of these soil factors out-weighed any noticeable influence of the four treatments.
Further studies are needed to arrive at specific recommendations for the fertilization of Virginia pine Christmas tree plantations. We feel confident that in situations where soils are deficient in specific elements, correction of these deficiencies will result in increased tree growth. Blind applications of fertilizers may or may not increase growth depending on which elements are at critically low levels. The applications of a fertilizer may cause an interaction which potentially could reduce tree growth.

**Literature Cited**


**Discussion**

**Question:** Is fertilizer always important?

**Answer:** If you let the pH go down, then you are going to run into a lot of problems; but if you keep the pH up, then the plants can utilize more of the elements. If you add, say phosphorus (if you are marginally low on phosphorus), by raising the pH, phosphorus will become more available. But if you have a potassium or magnesium problem, by raising your pH, you may create a problem, depending on what type of lime you use. When you add dolomitic lime you are adding magnesium as well as calcium to your site. If you have a high level of magnesium, adding the dolomitic lime may increase the magnesium level to such a point that you will induce a potassium deficiency.

What I am trying to say is, get your soils tested. Know what level of nutrients you have. If you are low on phosphorus, don't even think about adding nitrogen until you get the phosphorus level up. If you are low in pH, don't think about adding nitrogen until you get the pH up. If your soil is high in magnesium, as a lot of our soils are, do not consider using dolomitic lime; get a calcidic lime.

**Question:** Would it be a good idea to get my soil tested every year?

**Answer:** I don't think that is really necessary. It depends on what you have applied. If you are at pH 6.2, and you have added 200 pounds of nitrogen and your level of phosphorus is good, I wouldn't bother getting the soil tested the next year. If you are at pH 5.4 and you added 200 pounds of nitrogen, yes, I would want to see what happened to the pH level. If you continuously add nitrogen over the years, then you need to start looking every so many years at what the pH is.

**Question:** If you fertilize you will make a tree grow, but are you going to get a tall tree with not enough branches?

**Answer:** The question is, if you fertilize is your tree going to get too "leggy," and I would say that depends. If you go with a heavy nitrogen fertilization regime, it may. But we want to keep our fertilizer fairly balanced. You need to keep the entire tree in a healthy state, as healthy as possible. In fact, I believe Dr. S.C. Hu conducted a research project which showed that fertilization did increase the density of the tree.

**Question:** It's hard to know what is going to happen. How are we to know that we are going to get a leggy tree until it is too late? What do you do?
Answer: Shear it back.

Question: Is it your opinion that a bottom-line figure such as a four-year rotation would be beneficial with a good fertilizing program?

Answer: If you know what you are doing—if you do not do it blindly. If you look at your pH, if you look at your phosphorus level, if you look at your potassium level, and if you look at your magnesium level. I believe one person earlier mentioned that he did a soil test and followed the test lab's recommendations. I am not sure how it is in Louisiana, but we do not have specific fertilizer recommendations yet for Virginia pine Christmas trees in Alabama. What I was told we are using is the least demanding crop, which is pasture. They are making recommendations based on pasture, which I am not sure are going to be the same as what we need on Virginia pine. It is going to take a few more years to work out, specifically, how much of what fertilizer we need.

Comment: One thing you have to be careful to consider here is not merely the effect of fertilization on height growth, but the interaction of fertilization with cultural practices. Let's assume we are going to shear a Virginia pine six times. The name of the game is to produce a quality product in a short period of time. If we can fertilize and have that tree respond to our cultural practice of shearing, why can't we put six shearings in two years? We can't separate the fertilization and cultural practices.

Dr. Parker: I think I agree with your statement. But I have heard some of the people here say that you can't grow the trees too fast, because they get too leggy, and you have to work too much at it. I will take the opposite point of view. I want the tree to grow as fast as it can, and if it causes me to shear three times in one year, that's fine. I'll do it.

Most of what I have just talked about should be done prior to planting. You should have your soil tested, you should decide what would be best for your own area, for your plantation, and incorporate it prior to planting; do not try to wait until afterwards.

Question: Would it be best to put fertilizer on each individual tree or to broadcast it?

Answer: On one-year-old trees it is best on each individual tree. If you broadcast it, about 90% of it is not going to be available for that tree in the next couple of years. But I would not limit fertilizer to just the six inches around a one-year-old tree. I would broaden it out so that it would become available for the tree in the next...
few years. The root system on the tree should spread at least as far if not farther than the crown spread.

One point, though. You are going to change the micro-environment of that specific site very drastically if you put too much fertilizer on it. You can burn a tree right up. Don't put three cups of fertilizer right on top of a tree.

**Question:** Do extension services routinely report on magnesium in their reports on soil analysis?

**Answer:** In Alabama, they do. They report it. We can get organic matter, phosphorus, potassium, and magnesium.

**Comment:** I can't remember all the elements which are reported, but I can tell you that in Mississippi soil recommendations are based on trees, not pasture.

**Answer:** That's a step in the right direction. In the next few years most of the southern states will have specific recommendations based on tree requirements. We also know that we have not ironed out the tree requirements yet, speaking as a researcher.

**Question:** How do we take a soil sample and find out the level of nutrients?

**Answer:** In general you should contact your county extension agent. Usually county agents have their office in the county courthouse. They have soil sample kits, and they have instructions on how to take soil samples.

**Question:** If a tree needs fertilizer, how old should it be before you fertilize?

**Answer:** If it needs some of the basic elements like potassium, or phosphorus, or magnesium, or changing the pH, apply fertilizer or lime before you plant the tree. However, you should give nitrogen some time. Nitrogen should be applied only when a tree needs it, because nitrogen will leach out of the soil. About a month or two after you apply nitrogen, whatever you applied is either taken up or gone. Do not blindly put on nitrogen unless you put it on in slow-release form and expect it to hang around until next year. It will have its effect and be gone.

**Question:** How long should the tree be in the ground before you need fertilizer?

**Answer:** If you're talking specifically about nitrogen, I wouldn't apply it too heavily the first year. I would feel a lot more confident applying it during the second year.
Question: How deep should you take your soil sample for testing?

Answer: What you want to do is get a fair representative sample of the root growing zone. Look at your fields and decide which fields are different. If you have more than one soil type, do not mix soil samples. Take a soil sample from one site, and another separate soil sample from the other site. Once you decide on a uniform site, you can take at least 10 different samples and take them from a spot, 1 inch, 3 inches, 6 inches, maybe down to an 8-inch depth, and then mix those samples from the various depths from around that site into one sample that is going to be representative of that site.

Question: How extensive is the root growth on a Virginia pine tree which is four or five years old?

Answer: My experience is that root growth varies a lot. Roots can go out several feet. I have seen roots five to seven feet long in a four- or five-year-old tree.

Question: How deep?

Answer: That depends on the presence of a hardpan and how far the roots can penetrate. I've never dug one down to its maximum depth. Root-system development will ultimately depend on soil type. The lighter the soil and the more the moisture stress, the deeper and farther the roots are going to go. If you have perfect fertility, perfect water, and fairly heavy soil the roots won't go down as far, because they don't have to. And they are a lot more susceptible to drought.
VEGETATION CONTROL IN CHRISTMAS TREE PLANTATIONS

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Christmas tree production is increasing in the southern United States primarily due to the production of Virginia pine (*Pinus virginiana* Mill.). Virginia pine are currently being grown as Christmas trees from North Carolina across the southern tier of states to Texas. Research and grower experience has demonstrated that Virginia pine can be grown into a desirable Christmas tree.

Virginia pine is well adapted to the rainfall and soil conditions of the southern states. It grows well on soils ranging in texture from sand to clay loams. It is adapted to annual rainfall areas of 40 to 65 inches or more per year if the soils are well drained.

Virginia pine is a fast-growing tree reaching harvest 3 to 5 years after transplanting primarily due to the long growing season in the southern states. Costs for production over the life of the tree are, therefore, lower than northern trees due to the shorter period to harvest. Shipping charges to southern consumers are also lower. Its production in the South also gives a fresher tree to the consumer since the trees need to be harvested only a few days before the consumer's purchase.

Proper production management is essential for production of Virginia pine. Insect and disease control, weed control, and shearing are equal links required for maximum production of the trees. Without any one of these links, the number of years until harvest will be increased and quality will be reduced, leading to a disappointed customer that will probably seek a different tree the next year.

The need for continuous pest control requires that the trees be planted in rows wide enough to permit the machinery to move through the trees without injury. Wounds to the tree are entry points for disease organisms such as pitch canker which can weaken or destroy a tree. Virginia pines are usually spaced 6 or 7 feet within the row. The rows are usually 7 feet apart to allow easy access by machinery for spraying insecticides and herbicides.

Weed control is an important link to growing high quality trees. It is just as important as insect control, disease control, and shearing. Weeds affect the tree growth due to competition for soil moisture, nutrients, sunlight, and space. Soil moisture can be a critical factor affecting the growth of the trees. Both grasses and broadleaf weeds consume much moisture from the soil creating a moisture stress on the trees many times during the
long growing season in the southern states. Weed competition can retard the trees' growth to the extent that one or two extra years of growth may be needed before the tree is ready to sell. Weeds also absorb nutrients from the soil that are essential to tree growth, just as they are essential to the growth of any other crop.

Sunlight is a critical factor in tree production. The tree can easily be dwarfed by large broadleaf weeds in the first year of growth. Heavy infestations of weeds such as common lambsquarters (Chenopodium album L.) and common cocklebur (Xanthium pennsylvanicum Wallr.) can shade the tree enough that the growth may be totally inhibited the first year. Weeds also compete for sunlight in the following years of production. Grasses such as crabgrass (Digitaria spp.), bermudagrass [Cynodon dactylon (L.) Pers.], bahiagrass (Paspalum notatum), and sandburs (Cenchrus spp.) growing beneath the trees shade the lower limbs and needles causing needle drop. Bare-bottoned trees are the result of the grass competition. Bare limbs at the base will leave a tree that will not be sold or will bring a poor quality price. Choose-and-cut customers often find to their disappointment that the tree they have just selected and cut is bare at the bottom due to the grass competition.

Weeds also compete with the trees for space. Winter annual broadleaf weeds such as Virginia pepperweed (Lepidium virginicum L.) and horseweed [Conyza canadensis (L.) Cronq.] compete for space. In the fall and winter months of the southern states, weeds such as these emerge and remain in a semidormant state so that they look harmless to the tree. During the winter months, they will remain as very low-growing plants often being just visible or only a very few inches tall. However, with the coming of warmer late winter or spring days, these weeds will begin to grow with a vigor and reach several feet in height or 2 to 3 feet in diameter by April or May. At this point, a weed that is within 1 to 2 feet of the tree will compete for space. This space competition will result when the tree limbs grow to the weed. The limb will then either stop growth or change the direction of its growth, eventually creating a tree with one or more bad sides, resulting in a lower quality. This is the same effect as growing trees too close together. Therefore, recommendations are currently emphasizing that the grower control or eliminate these winter annual weeds.

Another factor in which weeds affect tree quality is the presence of weed trash and especially the presence of burs, primarily sandbur. Sandbur is a summer annual grass found in all the southern states which if allowed to grow produces a seedbur that is painful if grabbed or brushed against.

Weed Control

Growers and university personnel have found that both chemical and mechanical control measures are essential for adequate weed control. Mechanical control alone, such as mowing or cultivation, is not effective for
maintaining the weed control necessary for fast growth and high quality.
Mowing is used along with herbicides in those plantings that produce the best
trees at the lowest cost. Mowing is used to maintain a low-growing sod in the
row middle that competes very little with the tree, yet reduces erosion in
sloping areas and gives traction that's needed for spray equipment after recent
rains. Mowing is suggested along the rows, but not across the rows since more
labor and equipment time and expenses are needed. Mowing across the rows would
require greater spacing between the trees, which will allow a smaller number of
trees per acre. Mowers should be narrow in width so that the trees are not
injured.

Cultivation is not suggested due to the erosion and equipment traction
problems; it would be more expensive than maintaining mowed sod. Neither
mowing nor cultivation will control the weeds that are most damaging to the
trees. Herbicides are used in a band over or along each side of the tree row,
covering a total of 1/2 to 2/3 of the area or extending to the drip line of the
older trees. Mowing is used to maintain the remainder of the area. Present
herbicides are available that will control many weeds before they emerge
(preemergence) and that may be used over-the-top or directed to the base of the
tree without injury to the tree. However, most herbicides that will control
weeds after emergence (postemergence) will also cause injury or death to the
tree. Therefore, herbicide programs must be designed that will control the
weeds before emergence. Postemergence nonselective herbicides may be used
without injury through a shielded sprayer that will help to control weeds that
have escaped preemergence herbicide applications. However, this procedure
alone is not satisfactory for adequate weed control due to the problem that
weeds that are very close to the tree are not sprayed.

Perennial weeds such as bermudagrass, nutsedge (Cyperus spp.),
johnsongrass [Sorghum halepense (L.) Pers.], and bahiagrass may emerge each
spring from both seed and underground stolons, tubers, and rhizomes. Current
preemergence herbicides are effective for control of those weeds that emerge
from seed, but will not control those emerging from the perennial root parts.
Therefore, control of these perennial weeds is very difficult, and they are
usually only partially controlled with the postemergence shielded-spray
treatments.

Control of perennial weeds is best accomplished with proper site
preparation before transplanting the trees into the area. The herbicide
Roundup, by Monsanto Company, is very effective as a site preparation treatment
on most perennial weeds. It is translocated through the foliage to the roots of
the weeds. It should be used the summer preceding tree transplanting while the
weeds are still actively growing. Once the weeds have become dormant due to
cold weather, Roundup will not be effective. Roundup will control only the
weeds, both annual and perennial, present at the time of application and will
not give soil residual control of weeds that emerge from seed. If the area to
be transplanted with trees has no perennial weeds present, Roundup will not be
needed since annual weeds emerge only from seed and can be controlled with
preemergence treatments applied after transplanting. Paraquat is another herbicide that will provide quick burndown of both annual and perennial weeds. However, it is not translocated into the roots; therefore, perennial weeds emerge again soon after treatment. Therefore, Paraquat is usually not effective as a site preparation treatment.

After transplanting the trees, various herbicides are used to control weeds throughout the growing season. One or more herbicides are usually applied soon after transplanting so that they will be present to control weeds before they begin to emerge. It is usually suggested that application be delayed until rain settles the soil around the root system of the tree so that the chance of herbicide injury to the tree is reduced. The herbicide or herbicides are selected to control the weed species expected in the area. They are selected to control both grasses and broadleaf weeds and should be active for several months or more into the season. Treatments are then applied early each spring and possibly in the fall in the following year.

Current research on effective herbicides nonphytotoxic to Virginia pine Christmas trees is very limited. Research and extension weed scientists in the southern U.S. are currently conducting research tests and demonstrations to find the answers for the numerous weed problems in the specific states.

Studies were conducted in Georgia in 1980, 1981, and 1982 to evaluate herbicides applied before emergence of spring annual weeds in newly transplanted trees and trees that had been established in the field one and two years. Soil types in the studies were loamy sands and sandy loams in 1980 and sand in 1981 and 1982. Weed control ratings and tree injury ratings were taken during the season. A count of trees surviving at the end of the season was also taken.

In 1980, treatments were made to newly transplanted Virginia pine (Table 1). At 3½ months after application, Princep 80W (simazine) at 2½ pounds per acre (lbs./A) did not satisfactorily control the weeds present. All other treatments continued to provide control of the weeds. Several of the treatments provided control with little or no injury to the trees. Sinbar 80W (terbacil) at either one or two pounds per acre and Velpar 90W (hexazinone) at either 1/2 or 1 pound per acre caused injury during the season and significantly reduced the percent tree survival to 13%, 13%, 69%, and 13%, respectively. Surflan 75W (oryzalin) at 4 lbs./A, Princep 80W at 2½ lbs./A, Surflan 75W + Princep 80W at 2½ + 1½ lbs./A, and Devrinol 50W (napropamide) + Princep 80W at 8 + 1½ lbs./A did not significantly injure or reduce the percent tree survival.

Several treatments were also made in 1980 to Virginia pine that had been established one year in the field (Table 2). The weed population was not heavy, but most of the treatments provided control of the Florida pusley
Table 1. Evaluation of herbicides applied in 1980 (newly transplanted Virginia pines) before emergence of annual weeds.

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment</th>
<th>Rate (lb./A)</th>
<th>Visual ratings (% control)</th>
<th>%Tree survival</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pigweed</td>
<td>Lambsq.</td>
</tr>
<tr>
<td>1.</td>
<td>Surflan 75W</td>
<td>4</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Surflan 75W + Princep 80W</td>
<td>2½ + 2½</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>Princep 80W</td>
<td>2½</td>
<td>25</td>
<td>63</td>
</tr>
<tr>
<td>4.</td>
<td>Devrinol 50W + Princep 80W</td>
<td>8 + 1½</td>
<td>63</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Sinbar 80W</td>
<td>1</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>6.</td>
<td>Sinbar 80W</td>
<td>2</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>7.</td>
<td>Velpar 90W</td>
<td>½</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>8.</td>
<td>Velpar 90W</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>9.</td>
<td>Check</td>
<td>---</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Visual ratings of weed control were made 3½ months after treatment. Percent tree survival was taken at the end of the growing season. * Indicates percent tree survival was significantly reduced (DNMR, .05).
Table 2. Evaluation of herbicides applied in 1980 (one-year-old Virginia pine plantation) before emergence of annual weeds.

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment</th>
<th>Rate (lb./A)</th>
<th>Visual ratings (%)</th>
<th>% Tree survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Surflan 75W</td>
<td>5</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Princep 80W</td>
<td>2 1/2</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>Princep 80W</td>
<td>5</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>4.</td>
<td>Devrinol 50W + Princep 80W</td>
<td>8 + 1 1/2</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Surflan 75W + Princep 80W</td>
<td>2 1/2 + 1 1/2</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>6.</td>
<td>Surflan 75W + Princep 80W</td>
<td>2 1/2 + 2 1/2</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>7.</td>
<td>Sinbar 80W</td>
<td>2</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Velpar 90W + surfactant</td>
<td>1/2 + 1/2%</td>
<td>18</td>
<td>100</td>
</tr>
<tr>
<td>9.</td>
<td>Velpar 90W + surfactant</td>
<td>1 1/2 + 1/2%</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>10.</td>
<td>Check</td>
<td>---</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

Percent tree survival was taken at the end of the growing season.
(Richardia scabra L.). Sinbar 80W at 2 lbs./A killed 100% of the trees sprayed. Velpar 90W, which had caused substantial kill of the newly transplanted trees, did not cause any injury to the trees established one year.

The same treatments were made to trees established two years in the field. None of the treatments, including Sinbar, caused any visible injury or reduced tree survival.

Further studies were conducted in 1981 to try to duplicate the results obtained in 1980 and to evaluate new herbicide possibilities. Sinbar was dropped from the test due to tree kill obtained in 1980. Goal (oxyfluorfen) was added for evaluation (Table 3). All treatments evaluated provided control of the weeds present five weeks after treatment, which included crabgrass, Florida pursley, and common lambsquarters. However, by late August neither Princep at 3 qts./A or Goal 2E at 1 qt./A were controlling crabgrass. All treatments continued to control common lambsquarters. Visual ratings and percent tree survival were made of the newly transplanted Virginia pine. Only Velpar 2 at 1 qt./A and Velpar 2 + Surflan at 1 qt. + 3 qts./A caused substantial injury. Percent tree survival was 25 and 44, respectively.

The same treatments were made in 1981 to trees established one year (data not shown). However, the rate of Goal was double that used in the newly transplanted trees. Velpar and Brake caused injury early in the season. However, only 1 of 32 trees treated continued to show injury from Velpar at the August rating and at the end of the season.

Several of these same treatments and some new ones were applied again in 1982 (Table 4). Most treatments gave early season crabgrass and sandbur control. However, at 4 months after treatment application the grass control was ineffective with Sonalan, Devrinol, Goal, Princep, and Karmex. Several treatments were ineffective for controlling tropic croton (Croton glandulosus L.). The best treatments for weed control were Surflan + Princep, Devrinol + Princep, and Oust. Oust caused early season chlorosis and stunting. One year after application, Oust at 5 and 7 ounces per acre caused a reduction in tree survival and some stunting. Karmex caused the most severe injury.

Conclusions

All ages of Virginia pine seem to be tolerant to the use of either Surflan, Princep, Devrinol, or Goal. Combinations of Surflan + Princep or Devrinol + Princep seem to give control of most annual grasses and broadleaf weeds. Trees established two years or more have been shown to be tolerant to Velpar. Velpar will probably need to be tank-mixed with some grass control herbicide for broad spectrum control. Oust shows promise for broad spectrum control in trees established one year or more. Lower rates of Oust will be evaluated for crop tolerance and weed control in 1983.
Table 3. Evaluation of herbicides applied in 1981 (newly transplanted Virginia pines) before emergence of annual weeds.

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment</th>
<th>Rate/Acre</th>
<th>Visual ratings (%)</th>
<th>%Tree Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weeds (5WAT)</td>
<td>Cg.</td>
</tr>
<tr>
<td>1.</td>
<td>Surflan 4AS</td>
<td>3 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Surflan 4AS</td>
<td>4 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3.</td>
<td>Surflan 4AS + Princep 4L</td>
<td>3 qts. + 2 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4.</td>
<td>Surflan 4AS + Princep 4L</td>
<td>3 qts. + 3 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Devrinol 50W + Princep 4L</td>
<td>8 lbs. + 2 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>6.</td>
<td>Devrinol 50W + Princep 4L</td>
<td>10 lbs. + 2 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>7.</td>
<td>Princep 4L</td>
<td>3 qts.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Velpar 2</td>
<td>1 qt.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>9.</td>
<td>Velpar 2 + Surflan 4L</td>
<td>1 qt. + 3 qts.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>10.</td>
<td>Goal 2E</td>
<td>1 qt.</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>11.</td>
<td>Check</td>
<td>---</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

5WAT indicates the rating was made for crabgrass, Florida pusley, and common lambsquarters at 5 weeks after treatment.

Cg. and Lq. are crabgrass and lambsquarters, respectively, rated 5 months after treatment.

* Indicates these treatments reduced the stand significantly.
Table 4. Evaluation of herbicides applied in 1982 (newly transplanted Virginia pines) before emergence of annual weeds.

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment</th>
<th>Rate</th>
<th>Percent control</th>
<th>% Tree</th>
<th>Surv.</th>
<th>Stunting*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 mo. Grass</td>
<td>4 mo. Grass T. croton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Sonalan</td>
<td>3 pts.</td>
<td>80</td>
<td>0</td>
<td>33</td>
<td>69</td>
</tr>
<tr>
<td>2.</td>
<td>Sonalan</td>
<td>6 pts.</td>
<td>91</td>
<td>0</td>
<td>0</td>
<td>69</td>
</tr>
<tr>
<td>3.</td>
<td>Surflan 4AS</td>
<td>4 qts.</td>
<td>95</td>
<td>100</td>
<td>60</td>
<td>88</td>
</tr>
<tr>
<td>4.</td>
<td>Surflan 4AS</td>
<td>6 qts.</td>
<td>95</td>
<td>100</td>
<td>65</td>
<td>100</td>
</tr>
<tr>
<td>5.</td>
<td>Surflan 4AS</td>
<td>4 qts. + 2 qts.</td>
<td>100</td>
<td>100</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>+ Princep 4L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Surflan 4AS</td>
<td>4 qts. + 4 qts.</td>
<td>98</td>
<td>100</td>
<td>99</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>+ Princep 4L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Devrinol 50W</td>
<td>8 lbs.</td>
<td>75</td>
<td>65</td>
<td>33</td>
<td>81</td>
</tr>
<tr>
<td>8.</td>
<td>Devrinol 50W</td>
<td>8 lbs. + 2 qts.</td>
<td>99</td>
<td>63</td>
<td>95</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>+ Princep 4L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Goal 2E</td>
<td>2 qts.</td>
<td>93</td>
<td>20</td>
<td>--</td>
<td>81</td>
</tr>
<tr>
<td>10.</td>
<td>Goal 2E</td>
<td>4 qts.</td>
<td>87</td>
<td>20</td>
<td>--</td>
<td>44</td>
</tr>
<tr>
<td>11.</td>
<td>Princep 4L</td>
<td>2 qts.</td>
<td>85</td>
<td>10</td>
<td>--</td>
<td>75</td>
</tr>
<tr>
<td>12.</td>
<td>Oust 75DF</td>
<td>2½ oz.</td>
<td>100</td>
<td>94</td>
<td>92</td>
<td>88</td>
</tr>
<tr>
<td>13.</td>
<td>Oust 75DF</td>
<td>5 oz.</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>14.</td>
<td>Oust 75DF</td>
<td>7 oz.</td>
<td>100</td>
<td>100</td>
<td>99</td>
<td>75</td>
</tr>
<tr>
<td>15.</td>
<td>Karmex 80W</td>
<td>2½ lbs.</td>
<td>49</td>
<td>0</td>
<td>--</td>
<td>31</td>
</tr>
<tr>
<td>16.</td>
<td>Check</td>
<td>---</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>75</td>
</tr>
</tbody>
</table>

Grass includes crabgrass and sandbur.
T. croton is tropic croton.
Survival and stunting were measured one year after treatment application.
* Percent stunting was compared to the best trees and not the check plot since the check plot suffered weed competition damage.
Summary

The Virginia pine Christmas tree industry is growing in the South. Several herbicides have been tested in several states and seem to provide satisfactory control of many weeds. Different herbicides will continue to be evaluated since some weeds are not satisfactorily controlled with the current herbicides. Many of the herbicides that have been discussed are not registered by the Environmental Protection Agency (EPA) to be used on Virginia pine. Effort is under way by both industry and university personnel to receive approval for use of many of these herbicides in this increasing Christmas tree species.
SHEARING, SHAPING, AND PRUNING CHRISTMAS TREES

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University of Georgia
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Experiment, Georgia

Introduction

Very few Christmas trees in the South will reach the market and have good quality without some type of shearing or pruning. The term shaping is applied to any cutting done to shape the tree to its desired appearance. This may be done by shearing or pruning (Whitfield 1981). Shearing usually means cutting back the current year's growth of the terminal leader and lateral branches. Pruning is generally thought of as the removal of injured, dead or diseased material or wood older than the current growth. Most Christmas tree growers use only the term "shearing" for the task of giving trees good shape or form, so this will be used in this report. The time, frequency, and amount of shearing will vary by species, location, soil fertility, climate, or other factors (Davis 1982). This means that each species has to be studied to determine the proper shearing techniques for each location.

There is a fear throughout the country that there may be a "glut" on the market within a few more years, particularly in the South where growing conditions are excellent. Georgia's production has increased dramatically in the past few years. Over 2 1/2 million seedlings were sold for Christmas tree planting in 1982 (Murray et al. 1981), and it is estimated that 3 1/2 million seedlings were sold for 1983 plantings. Many feel that only the growers who produce good quality trees will survive this expected "glut." Therefore, it becomes mandatory that growers practice good cultural practices including shearing, weed control, and insect and disease control. It has always been a mystery as to why a grower will sometimes spend an enormous sum of money and time establishing a plantation, but then neglect to shear properly or carry out some other important cultural practice. Following the acquisition of good planting stock and planting properly on good land, a minimum of three important factors are essential for success in growing Christmas trees. These are: proper weed control, pest control, and shearing (Davis et al. 1981).

Virginia Pine (Pinus virginiana)

More people in the South are planting this species than any other species at this time. Over 2 million seedlings were sold in Georgia for planting in 1983. Much research has been conducted in Georgia over the past 23 years with this species (Davis 1972, 1977). The interest increased over the years in other states and studies were made in those areas (Brown 1979, Hu and Main 1980).
Proper shearing is one of the most critical factors in producing good quality Christmas trees. Common errors when shearing include: (a) not shearing enough, (b) not cutting the top or terminal shoot, (c) leaving more than one top, (d) too much taper, (e) not enough taper, (f) leaving rounded "shoulder," and (g) shearing at the wrong time. Figure 1 shows the generally accepted tapers for most Christmas trees. A taper of 70% is our goal, but anywhere between 60% and 80% is satisfactory. Virginia pine responds extremely well to shearing if performed at the proper time. It must be understood that proper shearing stimulates more growth buds, which in turn thickens the tree for more compactness. A premium tree, 7 feet tall, may be grown in 4 to 5 growing seasons, with proper care. The advantage with this tree is with its capability of growing throughout the state on varied sites. Shearing dates may vary slightly from the Florida line to the mountains, since growth begins earlier in the southern range. Most of the shearing research has been conducted in middle Georgia's Piedmont section. Therefore, it may be necessary to shear a little earlier than the suggested dates in the Coastal Plains and a little later in the mountains. Some trees have been grown to 7 feet in 3 to 4 years in south Georgia, on good land.

The frequency and time of shearing Virginia pine will determine its quality. A schedule has been worked out for the Georgia Piedmont which may serve as a guide for other areas. It is assumed that good seedlings will be planted straight (plumb) or they will be staked upright.

First Growing Season In The Field: No shearing is generally necessary. A few trees may develop some wild-growing branches which could be cut back in mid-summer. All trees should be reduced to single stems with hand "snips," and they should be straightened upright. Virginia pine will develop very crooked main stems if young trees are left leaning the first summer after transplanting.

Second Growing Season: One shearing is sufficient on most sites in the Piedmont. Budding response is good when trees are sheared any time from May 1 to August 15. However, in order to give trees sufficient time to put on an adequate amount of new growth following shearing, it should usually be done no later than from mid-June to mid-July. Some growers like to go through their plantation twice during this season. They shear only the larger trees early (May 1 to June 15) and shear the slower growing trees later (June 15 to July 15). In the Coastal Plains region where trees usually grow faster and the growing season is longer, two shearings may be necessary (from late April through May for the first shearing and from July 15 through August 15 the second time). One thing that should always be remembered is to cut the terminal shoot back a little every time trees are sheared. Many growers do not like to reduce the height of their trees by cutting the tops back, but this must be done if good quality trees are to be grown. Some new needles should always be left below the "snipped" terminal. As a general rule, the terminal branch should not be left longer than 10 to 12 inches. After the terminal has been cut back, at least the upper one-half of the tree may be tapered to 70% or
Acceptable Taper For Most Christmas Trees

Fig. 1. These width measurements (in feet) are for a tree 6 feet tall.
80% (Fig. 1). This is the beginning of a thicker, well-shaped tree. Trees this young do not usually have branches long enough all the way to the ground for shearing at this taper. As a result of cutting the top back and tapering the upper part of the tree, lower branches will then grow longer and can be sheared the following year. It should be noted that trees will never develop thick or compact foliage near the ground unless good weed control is practiced around their base. It is wise to prune off enough bottom branches, flush with the main stem, to form a good "handle." Approximately 1 inch for each foot of height when trees are harvested should be sufficient. A 7-foot tree should have about a 7-inch "handle" at the base.

The amount of new growth to remove by shearing will be determined by the amount trees have grown since the last shearing. Growth will be faster in spring, so more growth will be removed during the first shearing each summer. Most growers will remove from 1/4 to 1/2 of the new growth at each shearing. This varies due to varied growing conditions. The more branches that are sheared, the thicker the trees will become.

Third Growing Season: Two summer shearings are necessary in order to produce a tree with thick foliage. It may be possible to get by with one shearing in mid-summer where growth is slower, but trees will not be as full and shearing will be more difficult. The first shearing is usually from late April or the first of May through the third week of May, after new growth has slightly hardened. The second shearing is usually from July 15 through August 15, after the second flush of growth has slightly hardened. The second shearing is usually light, especially during dry summers.

Fourth and Subsequent Growing Seasons: Trees should be sheared twice each summer, the same as for the third season. Most Virginia pines are sold following the fourth and fifth growing seasons.

In the event that tops are completely broken out or killed by insects, new tops may be developed by selecting two lateral branches on opposite sides of the tree, turning them upright and tying them together. One of the two branches is then cut shorter than the other, leaving the longer for the new terminal. If a dead stub is left where the terminal was killed, then only one lateral branch can be turned upright and tied to the dead stub. This will develop into a new terminal branch.

When determining how much of the terminal shoot to cut back at each shearing time, it is generally best to cut it back far enough to at least be able to snip off the tips of most lateral branches, using 70% taper. A good rule to use in getting good taper is to leave the first lateral branches below the terminal shoot approximately 1/2 as long as the terminal. If the terminal shoot is left 10 inches long, the first lateral branches near the terminal should be left about 5 inches long. This begins the taper for the entire tree, and all branches should be cut if they fall outside this taper.
In order to induce bud formation and some growth following the last shearing each summer, shearing should be completed early enough for this to occur. This is why the last shearing should be completed about August 15, if possible. Tests have shown that trees sheared too late will develop a lot of dead stubs. This is caused by a killing frost prior to the new and tender growth from the last shearing having time to harden off.

Research has shown that shearing results in the stimulation of from 2.4 to 11.2 buds per lateral branch and from 8.7 to 25.0 buds per terminal shoot (Brown 1979). The primary factor determining the number of buds set is the diameter of the sheared branch, if sheared during the growing season. Tests have also shown that it is better to obtain tree "body" before too much height (Davis et al. 1981). If the consumer desires a taper from 60% to 80%, with the ideal being 70%, trees could be sheared to an 80% or 90% taper during the second growing season. This means the tree could be sheared with a broader base during the second season and the upper portion of the tree may have a taper of up to 90%. A tall, slender tree with a narrow base tends to produce more strong, vigorous leaders near the top with much less growth near the bottom. By starting with a shorter, broad-based tree, growth tends to be more uniform all over the tree. During the third growing season, taper can be reduced to no more than 80% and in the fourth growing season, from 80% down to 70%.

If trees are tapered correctly when first sheared, the task of shearing in the future will always be easier. All future shearings will then involve only the new growth. When mistakes are made in taper or a shearing is neglected or omitted, this means the next shearing will involve cutting into "old wood." This will damage or dull shearing knives, involves more difficult work and bud stimulation is not as good. It will also take longer to produce a good quality tree when it becomes necessary to cut into older wood.

White Pine (Pinus strobus)

This species is grown primarily in the mountains of Georgia but some trees are grown in the Piedmont and very few in the Coastal Plains. Shearing will stimulate more growth buds, making the trees more compact. These trees grow a little slower than Virginia pines, taking about 6 to 8 growing seasons to produce a 7-foot tree, depending upon the area. They tend to grow faster in the mountains where they grow naturally. Much less work is required to shear this species than the Virginia pine. Tests have shown that premium trees can be produced by shearing only once each growing season, from June 15 to July 15. The schedule should probably be 2 to 3 weeks earlier for trees grown in the Coastal Plains.

The first shearing for this species should not be made until the terminal shoot is over 10 inches long, on June 15. This may not occur until the tree reaches several feet tall or until it has been in the field 3 or 4 growing seasons in some areas. If the terminal shoot is 10 inches long or less on June
15, shearing will not be necessary that year and they need not be checked again for possible shearing until the following June 15. When the terminal shoot exceeds 10 inches on June 15, shearing should begin by cutting the leaders at a 45-degree angle, leaving them 10 to 12 inches long. It may be best to make the face of this 45-degree cut in a northerly direction to reduce drying (Whitfield 1972). Then the first whorl of lateral branches near the terminal should be left about 1/2 as long as the terminal. This serves as a guide for the taper of the entire tree, with 60% to 80% being acceptable. Once shearing has begun in white pines, trees must be sheared once every growing season until harvest, from June 15 to July 15.

**Eastern Redcedar (Juniperus virginiana)**

Most of the Eastern redcedar Christmas trees in Georgia are produced in the Coastal Plains and Piedmont areas. A 7-foot tree should be grown in 5 to 7 years, depending on the area. An unsheared tree is usually not a good quality tree, since the new growth will be too "flimsy" or limber for decorations. Excellent trees have been produced with only one light shearing each growing season, beginning when trees are about 4 feet tall. There is really no need to shear smaller trees. July is a good month for this work, but it may be performed most any time during the growing season. The tops should be snipped out when shearing and trees should be tapered 60% to 80%.

**Miscellaneous Species**

**Sand Pine** (*Pinus clausa*) is being grown in the sandy Coastal Plains area. Shearing for this species is similar to that for Virginia pine. In areas where it grows well, merchantable Christmas trees are sold after 3 to 5 growing seasons. In some areas, it is necessary to shear lightly during the first growing season and then begin two annual shearings the second growing season. It may be necessary to shear 2 to 3 weeks earlier than the dates given for the Piedmont Virginia pines. This means that the first shearing may be required in April and the second shearing may be required from late June to late July. In some areas of south Georgia, growers have found it necessary to "touch up" their pine plantations in late summer during the year of harvest, even after two shearings.

**Scotch Pine** (*Pinus sylvestris*) is grown in a few areas in the Georgia mountains and a very few are being tried in the Piedmont. There are so many strains of this species that an ideal strain has not been determined for Georgia. One reason for the small number being grown is that most Georgians prefer Virginia pine. Shearing is similar to that for Virginia pine. However, since it grows primarily in the mountains, the first shearing may be a year later than for Virginia pine. One annual shearing, during July, has been sufficient for this species due to the shorter growing season where it is grown.

**Colorado Blue Spruce** (*Picea pungens*), **Norway Spruce** (*Picea abies*), **White Spruce** (*Picea glauca*), **Balsam Fir** (*Abies balsamea*), and **Douglas Fir**
(Pseudotsuga menziesii) have all been tested in the Georgia mountains. It has taken from 6 to 10 years after field planting to produce 7-foot trees. Norway spruce and Douglas fir (Arizona strain) have outgrown the other species. Neither of these species has required more than one annual shearing in July. Colorado blue spruce has grown slower than the others, so it has required only a light "touch-up" shearing every July, beginning when it reaches 4 feet in height. Blue spruce may be lightly sheared with a pair of hand "snips" or with a knife. The Douglas fir and Norway spruce outgrew these other species, so they received a July shearing with knives each year after reaching 4 feet in height. White spruce and balsam fir received the same type shearing as Douglas fir and Norway spruce. Transplants for growing these species were from 3 to 5 years old when transplanted.

**Summary**

Dates for shearing and carrying out other cultural practices in Christmas trees will vary considerably within a given state and will vary by species. The shearing of certain species grown in Georgia has been discussed and may be used as a general guide for other areas similar to Georgia. The proper timing of shearing practices is just as important as the method of shearing. Improper timing with a good method is no better than an improper method with good timing. Both practices are necessary for premium quality trees. Weed control and the control of other pests are not discussed here but they are vitally important in growing good trees, along with shearing. A good quality Christmas tree, regardless of species, should have only one main stem which is straight, good taper, and a handle at the base of about 1 inch per foot of height at harvest. The fullness or thickness of a good tree may vary some by species but can be controlled by proper shearing.

**Literature Cited**


Discussion

Question: What's a good knife for shearing?

Answer: The best knife on display at this meeting in my opinion is one with a 10-inch handle and a 16-inch blade. That is the best blade and the best knife I have ever used. Of course, someone else may disagree. All my shearers like a 10-inch handle and a 16-inch blade. Of course, for little trees the first year or so, you could use a smaller knife—one of the shorter handles with a 16-inch blade—but you will find that you will like the 10-inch handle much better. Those shearing knives with long handles are for large trees, 8 to 9 feet tall. You might get one with a blade of 18 inches, but I believe you will be better satisfied with a 10-inch handle and a 16-inch blade.

Question: What is the average height of a tree when you first start shearing?

Answer: For Virginia pine it is hard to tell you in this meeting room. I would say somewhere close to 3 feet high. If you see the tree shooting up and getting too tall and spindly, you need to clip the top out of it. On white pine we always leave 10 inches. On Virginia pine it does not matter, but whatever length you leave the top shoot, you leave the first lateral branches next to the top one-half as long—no longer than one-half as long—as you left the top. If you leave the top four inches, leave the first side branch two inches; and if you leave the top eight inches, leave the first side branch four inches. That will give you the proper taper. Then test it. When you prune the top and you prune the first laterals near the top, you can put a straight edge all the way to the ground from those two clipped branches. You don't have to clip all the branches to the ground the first time, just so you clip about half the branches down to the ground. That will cause the bottom branches to come out longer next time, and the next time you prune they will be out there and you will get the bottom branches.
But the more branches you can hit as you clip the tips off, the thicker the tree you will have. Some people don't like a tree so thick, so you can start pruning a little bit more lightly. But you do not have to cut all the branches all the way to the ground the first time. The first time you clip just be sure you clip the upper one-half of the tree with that 80% angle. Then the next time the tree will put on new growth all over, and you will go to the next terminal and clip it. You should still follow that same rule and clip the first laterals at the top one-half as long as you left the top.

Question: Do you ever get out of the hardwood, in clipping terminals?

Answer: If you snip at the right angle, you will stay in the new tender growth all the time, if you start with the right taper the first time. But if you don't start with the right taper the first time, then you will be cutting back into old wood all the time, and that is what you want to get out of.

Question: You have to get it the first year?

Answer: Yes. It may be the second growing season for the tree, but the first time you prune the tree you should put a good taper on it. Don't leave a rounded top on it. If you do, you are going to be into old wood the next time. Always leave a straight top on the tree.
INSECT CONTROL ON CHRISTMAS TREES

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Introduction

A new crop has come South! Christmas trees can be grown successfully and profitably across the Southeast. Along with new opportunities always come new challenges. Insect pests have increased in importance as we have more extensively monocultured this crop.

Virginia pine (Pinus virginiana) is the major species grown for Christmas trees in the Southeast. Most of my comments will, therefore, be directed to control of major insect pests on Virginia pine.

Nantucket Pine Tip Moth (Rhyacionia frustrana)

Nantucket pine tip moth is the major insect pest on Virginia pine. Although other tip moth species are involved, Nantucket pine tip moth is the most common pest species (Miller and Wilson 1964). Adults are small, gray-bodied moths that first emerge on warm days in February and March. The front wings are coppery-brown mixed with gray. Eggs are deposited on both old and new growth and hatch in about a week. The larvae feed superficially on new growth and then bore into the bases of needles. Small webs encrusted with resin may be constructed between the needles and stem. Larvae then move up the new shoots and bore into the buds, where they feed for three to four weeks. Full-grown larvae are brown to orange in color and about one-half inch long. A rice-grain size pupa is formed outside the shoot and an adult moth emerges in about a week. There are three to five generations a year in most southeastern states, three in the northern areas, and four (Sumner and Hyche 1981) or five in the southern regions. The season's last generation of tip moths overwinter as pupae.

Proper timing for tip moth control is almost as important as the selection of an insecticide. Pheromone traps available commercially may be used to determine proper timing for a first and second spring spraying. In 1982 pheromone trap data became less reliable after the first field generation of tip moths.

Twig sampling is another means of determining when to apply the first spray. Weekly samples of 20 to 40 infested tips can be inspected beginning in mid-February. The first spray can be planned 10 to 12 days after 80% of a week's infested twig samples contain empty pupal cases. Caged, infested twigs can help to determine when emergence begins in the spring.
In the northern two-thirds of Alabama, the optimum time for the second spray application occurs approximately 6 weeks after the first spray treatment. Farther south, the second spraying was 4-5 weeks after the first in 1982. In areas where there are only three generations of tip moth yearly, growers may spray only 3 or 4 times. Farther south, growers spray monthly until late July, then every two to three weeks through September (Cobb 1982).

The two most widely used spray materials in the southeast for tip moth control are diethoate (Cygon \(^R\) 2E) and acephate (Orthene \(^R\) 75S). Both materials are systemic in that they are taken into the tree's water system. However, both are most effective when the tree is actively growing. Neither Cygon nor Orthene is taken into the plant to any great extent when tree growth slows down drastically, which often occurs during drought and heat stress in July and August. During this time any spray material serves primarily as a contact insecticide. Slow tree growth and the tip moth generation "overlap" that occurs in many areas at this time make spraying necessary every two to three weeks with Cygon or every ten days to two weeks with Orthene during late summer. Sometimes phytotoxicity (plant "burn") occurs when Cygon is sprayed to the point of drip. Thorough misting provides control without as much risk of "burn."

What about other spray materials? Many spray materials, timed properly, will give some control, and several new materials appear to hold promise. The synthetic pyrethroids—permethrin, fenvalerate, and others—provided excellent control in tests at rates of 0.10 lb active ingredient per acre. A supplemental label for Pydrin \(^R\) (fenvalerate) will probably be released in many southeastern states this year for tip moth control on Christmas trees. However, in 1982 excellent tip moth control with the synthetic pyrethroids was followed in treated areas by outbreaks of pine tortoise scale. Apparently, natural predators and parasites of the scale were also controlled early in the season by the pyrethroids. This allowed the scale populations to expand rapidly. Perhaps the pyrethroids could be used seasonally on young trees, and on older trees in late season to avoid excessive scale buildup. In addition, some phytotoxicity studies still need to be completed before the pyrethroids are used widely by growers.

Another promising spray material is diflubenzuron (Dimilin \(^R\)). Dimilin is an insect growth regulator that prevents the formation of the insect's exoskeleton ("shell") during molting. It does not affect adult insects, is harmless to many parasite/predator populations, and is not toxic to warm blooded animals. Dimilin, used with a sticker in 1982, provided excellent mid- to late-season control last year in tests (Cobb 1983). More information is needed about its activity during the early part of the season. If Dimilin controls tip moth in early season tests, many states will probably have a special local needs label (24c) for its use on Christmas trees this year.

Any new spray material that provides good tip moth control in test situations must also pass the "grower tests." How a material can best be used
in a seasonal control program, whether or not it is practical and cost-effective, must be determined.

Granular carbofuran is another widely used chemical for tip moth control. Furadan® 10G and now Furadan® 15G are labeled in many states. Furadan is incorporated into the soil under the tree. The tree's roots move this systemic insecticide out of the soil and into the plant. Carbofuran concentrates in the new growth, and generally remains active three months in the tree (Cobb 1979-81). In south Alabama, growers begin to apply Furadan in February. Growers in the central part of the state apply Furadan during the first week in March. North Alabama growers apply it in mid-March. Furadan does not work well in heavy clay soils or extremely sandy soils. If dry weather occurs when the second application is due (late May-early June) and soil moisture is low, the trees will not take in the insecticide. Therefore, at this time growers have the option of resuming a spray program rather than making a second application of Furadan. In many areas sprays are necessary in September even if Furadan is applied twice because the second application lasts only into August.

Many growers prefer a combination program, such as Furadan early and spraying mid- through late season; or one spray in the spring, with Furadan applications in April and July (if soil moisture is adequate). Extreme care should be taken to apply no more than the recommended amount of Furadan, because excessive amounts can result in tree "burn" or kill. Furadan is a restricted-use pesticide, so a grower must obtain a permit for its use.

Some growers are experimenting with liquid Furadan. This is an extremely toxic insecticide and it is hazardous to apply. It is not labeled for Christmas trees. Even if equipment could be devised that is adequate for knifing liquid Furadan into the soil, the formulation's high dermal toxicity would surely limit its practical use by the average Christmas tree grower.

Proper pruning and shearing help control tip moth on Christmas trees. Unless already pupated, insects don't survive to a great extent in pruned tips on the ground (Sumner 1981).

Younger trees are damaged more severely by tip moths. Once the shape of the tree is achieved, tip moth injury isn't generally as damaging.

Pine Tortoise Scale (Toumeyella parvicornis)

Blackened foliage from sooty mold growing on scale-produced honeydew is usually the first sign of tortoise scale infestation. Mature scales resemble "bumps" on the bark. There are two or three generations a year in most southeastern states. The first "crawlers" (tiny, newly hatched scales) hatch in May and migrate to the new growth. As crawlers settle, infested new growth has a "silvery sheen."
Controls are most effective if applied when crawlers are present. Unlike tip moth spraying where misting foliage provides control, scale sprays must be applied to the branches inside the tree, and a thorough drenching of it is required. Spray trees when crawlers are present in May and again two weeks later; spray again twice in August if necessary. Acephate (Orthene 75S) and bendiocarb (Ficam 75W) have been shown to be extremely effective materials for scale control (Williams and Cobb 1982).

**Bark Aphids (Cineria sp.)**

Bark aphids are seen on trees primarily after tip moth treatment stops in the fall and throughout the winter months. These insects may resemble ticks or spiders more than aphids and are black or dark brown in color. Bark aphids may be more of a "people problem" than a tree problem if they are present when the tree is cut and taken inside. However, aphid feeding on young trees may cause needle drop. Honeydew produced may make the resulting sooty mold the first sign of this pest.

Trees to be harvested in the fall should be sprayed with a "clean-up" spray about two weeks before cutting. Acephate (Orthene R), diazinon, malathion, or chlorpyrifos (Dursban R) are effective as clean-up sprays for aphids.

**Other Pests**

Bagworms (Thyridopteryx ephemeraeformis) are sometimes a problem on white pine (Pinus strobus) and Eastern and Southern redcedar (Juniperus virginiana; J. silicicola). Timing treatments early while bagworms are small and thorough coverage of foliage are the keys to controlling bagworms. Treat early in the summer, May to mid-June, to kill young larvae. The smaller the larvae, the easier they are to kill with the insecticide. Diazinon, acephate (Orthene R), or malathion are commonly used for bagworm control.

Pales weevil (Hylobius pales) may sometimes be a pest on pines planted near recent pulpwood cutting where weevils are attracted to freshly cut stumps. Damage may appear as "patches" of bark eaten off branches and stem; stems may be girdled. Most adult feeding occurs in April and May. Dursban spray, or Furadan granules at transplanting may provide control. If planting in or near cut-over areas can be delayed for a year, risk of weevil damage may be reduced.

Sawflies (Neodiprion sp.), the immature forms of very primitive wasps, feed in groups and may defoliate trees in a short time. Sawflies are usually found in the outer two or three rows in plantations. Diazinon or malathion sprays are effective controls.

Needle scale (Phenacaspis pinifoliae) is usually seen on older trees as white "flakes" on inner, older needles. There is little known about the life history of this insect. We're not sure when crawlers are present. In the
northern half of Alabama, May and August applications of Orthene or diazinon may keep this scale from becoming more severe on infested trees.

_Dioryctria_ (several species) is really a group of insect pests that bears watching. Moths may lay eggs in or near injuries on the tree during the summer. The caterpillars bore into twigs, feed and go through the winter caterpillar state. In some species moths emerge in spring or early summer. Moth emergence of some species was suspected in December of 1982 along Alabama's Gulf Coast. Identification of caterpillars is difficult. Little is known about their distribution and life history in the Southeast.

**Conclusions**

1. There is no substitute for regular inspection of trees. Spot check your trees at least weekly by walking through the field and examining trees here and there.

2. Know about potential pests. Be able to recognize and diagnose pest problems correctly before damage becomes extensive.

3. Maintain your trees properly. Proper pruning and shearing can help control tip moth.

4. Timing chemical controls correctly is essential to good insect control.

5. Develop an insect control program that works best for you. Take into consideration how much time and money you have to spend, the equipment you have, where you are located and other factors that may be unique to your situation. Seek help in developing your program and obtain up-to-date information from your extension staff and/or consultants. And keep working together through your state universities and local, state, and national grower associations.

**Literature Cited**


Discussion

Question: Are there parasites which prey on tip moths?

Answer: There are some parasites that prey on tip moths. The problem that we have with the tip moth predators sometimes is that the predators do not have a chance to build up to a level where they can control the tip moths adequately.

Question: This coming weekend, April 9-10 is it too late to put out granular Furadan in St. Tammany Parish, Louisiana?

Answer: Check with your extension people. You might need to spray now and use Furadan later in the season.

Question: How should Furadan be applied?

Answer: You don’t want to put it right up under the tree. That would be like putting a handful of fertilizer under a tomato plant. For a seedling, you should put it about an inch or an inch and a half out from the tree.

Question: How severely can a tree be damaged by Cygon and still overcome the damage?

Answer: I have not seen trees killed, but I have seen trees stunted so much that they lose at least a year’s growth.

Question: Have you experimented with three applications of Furadan?

Answer: Yes. I know that Furadan will last three months in the tree, and if I put on that third application I am not getting my money’s worth.
out of my Furadan. I am only controlling tip moth for about one month, or six weeks at the most, with that last application. It's cheaper for me to spray.

Question: In Louisiana, should I use the same amount of Furadan for seedlings as for larger trees?

Answer: No. You go more by tree height. Check with your extension people on the recommendations for Louisiana.
CONTROLLING CHRISTMAS TREE DISEASES

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Introduction

Growing Christmas trees has become an important industry in the South. Disease control is critical in producing quality Christmas trees. Although disease organisms seldom kill trees, they can reduce quality by spoiling the appearance. Many of the disease problems result from environmental factors which favor disease development. Proper management is the key to successful Christmas tree disease control. Such things as site selection, planting techniques, weed control, and pruning will affect disease severity. The best approach to disease control is prevention or at least early detection. This means inspecting trees at weekly intervals and perhaps even more often during rainy periods of early spring and fall. A number of diseases and other plant problems produce similar symptoms in the field. And, an early, accurate diagnosis is important.

General Disease Description

Cultural problems

There are a number of non-pathogenic problems that occur in Christmas tree plantations that may appear to be disease related. Plants may be stunted, off-color, have distorted growth, dead foliage or even completely dead. These problems may stem from such things as poor soil conditions, poor planting techniques (especially planting too deep or too shallow or allowing the seedlings to dry out), poor cultural practices or unfavorable environmental conditions.

It is important that growers keep good records of all production practices. This information may be essential in determining what the problem is.

Needle diseases

Needle diseases can be a serious problem, especially on Virginia pine. The fungi which are responsible for needle cast are known to attack at least 26 species and varieties of pine in North America. In Christmas tree plantations Virginia pine and spruce pine can be severely affected by these fungi. In early spring small, brown spots usually with yellow halos around them occur on last year’s needles. Late in the spring these spots enlarge and entire needles begin to turn yellow and then brown. Disease severity is usually worse on the
lower half of the tree but the entire tree may be uniformly infected. Brown needles begin to drop in early summer and continue to do so throughout the summer, depending upon the amount of rainfall. By late summer small black fruiting structures of the fungus can be seen in the infected portions of the needle. The fungus can overwinter on the tree in these infected areas. During the late spring the fungus resumes growth in the infected needles and causes death of the needle tissue. New infections begin in late summer and continue until mid-fall, especially during periods of wet weather. The most effective control of this disease can be achieved by fungicide application during periods of greatest chance of infection. In most parts of the Southeast, fungicide applications should begin the first part of April and continue through the first part of June at two- to four-week intervals. Fungicide application during the summer months is determined by the amount of rainfall. During seasons of heavy rainfall, fungicide applications may be needed during the summer months. Applications should begin again in September and continue at two-to four-week intervals into November. Additional sprays may be required during warm, wet weather at any time during the year.

Twig blights

Several fungus twig blights can occur on a number of species of Christmas trees, especially red cedar.

Phomopsis Blight

Phomopsis blight is caused by the fungus Phomopsis juniperovora. Phomopsis twig blight is a serious disease of red cedar and is difficult to control. The disease occurs on native cedars grown throughout the Southeast. Susceptible species include arborvitae, Arizona cypress, and eastern red cedar. During the spring tips of twigs or branches turn light green and then brown. Twigs and branches less than 1/3-inch in diameter are most commonly affected. In summer the dead foliage turns ash-gray and small, black spots appear in these areas. Close inspection reveals small cankers at the junction between dead and live tissue. The fungus can remain alive and produce fruiting bodies for at least two years. The following cultural practices and fungicide applications will decrease disease severity:

1. Infected branches should be pruned out during dry weather. Pruning and handling plants during wet weather should be avoided.

2. Good ventilation between plants should be provided to promote rapid drying after rains.

3. Control of Juniper twig blight can be achieved most successfully with fungicide applications. These should be applied beginning in late spring and during the periods of wet weather. Applications are not needed during dry periods.
Cercospora Blight

The latter stages of disease development of Cercospora and Phomopsis blight are very similar on red cedar. Cercospora blight affects the innermost part of the plant initially. The lower limbs are affected and the disease will gradually progress upward on the tree. In severe cases only the fresh green tips of the new growth are present. These symptoms are different from Phomopsis blight, which begins on the tips of the twigs and moves inward. Phomopsis and Cercospora blight can affect trees in any stage of growth, but if disease is severe look for predisposing factors such as drought, mechanical injury, chemical damage, or root disease. Fungicides will help keep the fungus in check but may not improve plant vigor until the underlying causes are corrected.

Pitch Canker

Pitch canker, caused by the fungus Fusarium moniliforme f. sp. subglutinans, has been observed in a number of Christmas tree plantations of Virginia pine in several of the southeastern states. Although this disease has not reached the point of being a severe problem at present, it certainly has the potential of being one of the most serious diseases occurring on Virginia pine in the Sunbelt. The fungus causes a heavy resin or pitch flow on the stem or branch that is infected. Shoot cankers result in dieback characterized by wilting and killing of the crown. Needles on infected shoots turn yellow to reddish-brown. These areas are sometimes confused with insect damage. However, if you cut into an infected branch a distinct zone between infected and healthy tissue can be observed and there is an absence of tunneling insects. The organism causing pitch canker has been isolated from numerous seedlings from pine nurseries. Growers should inspect seedlings carefully when they are received. Infected nursery trees show a graying to reddish-brown foliage. Pitch-soaked lesions occur at the soil line and sometimes in the region of nodes.

There are very few control procedures available for this particular disease. The major control method is, first of all, be sure that you are getting disease-free trees to transplant. Also, pruning is an acceptable method of removing the disease from side branches. Chemicals are not available that will kill the fungus inside the host tissue without affecting the tree. If the canker is on the main trunk or large limb close to the main trunk, the best control is to remove and destroy the tree.

Rusts

There are several stem-rust fungi that can be of some importance on a number of species of pine that are grown in the Southeast. White pine blister rust can be easily recognized during the early stages of pine development. Small, yellow-brown spots occur on the needles. During the second season,
Following needle infection, the limbs become infected and take on a yellow to orange color. When infection occurs on the main limb, the fungus will eventually girdle the tree and death will result.

Infection of Virginia pine by eastern gall rust occurs much the same way as the white pine blister rust. Rust cankers on branches may be removed by pruning if not too close to the main stem. Those trees with infected main stems should be removed and destroyed.

In the Southeast, Scotch and Virginia pines, as well as other native species of pine, are commonly hosts for the needle rust fungi. During the early spring and summer, small, white to yellow spots develop on the needles. These are later developed into blister-like structures, orange to yellow in color. When the blister ruptures, spores of the fungus are released and are wind-blown to alternate hosts. Heavily infected needles will turn brown, die, and drop from the tree.

Avoid planting sites that have poor air circulation and are surrounded by vegetation, especially those of the alternate hosts such as goldenrod and asters.

Spray Calendar

For most of the Sunbelt producers the major disease problems will be those affecting the needles (needle cast, brown spot and twig blight). Most growers are working on a four- or five-year crop cycle. For the most part, producers are not starting their fungicide program until the second season. Under normal circumstances these diseases are not severe enough the first year to warrant a regular spray program. However, spray programs should begin the second year and be continued up to harvest. The spray program the final two seasons is critical. Damage during this period may result in a misshapened tree or could result in carrying the tree over another year.

A general fungicide spray program should begin in April and continue until early July. The program can then be started again in September and continued through November. Fungicides may be needed during the summer months if rainfall is heavy. Follow label recommendations as to rates and intervals. Be sure to add a spreader sticker to the spray. Use sprayers that will drive the material into the canopy of the tree and spray until run-off. Following is a typical four-year disease control program as an average grower might apply it and a list of fungicides cleared for Christmas tree disease control in the Southeast. The number of fungicide applications will vary depending upon tree species grown and location.
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td>Normally no fungicides used (some growers will spray once in spring and once in fall).</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
</tr>
<tr>
<td>April through June</td>
<td>3 or 4 applications.</td>
</tr>
<tr>
<td>September through November</td>
<td>3 or 4 applications.</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
</tr>
<tr>
<td>April through June</td>
<td>3 or 4 applications.</td>
</tr>
<tr>
<td>July and August</td>
<td>2 applications (once per month).</td>
</tr>
<tr>
<td>September through November</td>
<td>3 or 4 applications.</td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
<td></td>
</tr>
<tr>
<td>Same schedule as Year 3</td>
<td></td>
</tr>
</tbody>
</table>
### PINE

<table>
<thead>
<tr>
<th>Disease</th>
<th>Fungicide</th>
<th>Application Rate</th>
<th>Application Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle Diseases (cast, brown spot)</td>
<td>Maneb</td>
<td>1.5 lbs./100 gal. water</td>
<td>Apply in early spring. Repeat at 2- to 4-week intervals.</td>
</tr>
<tr>
<td></td>
<td>Mancozeb</td>
<td>1.5 lbs./100 gal. water</td>
<td>Apply in early spring. Repeat at 2- to 4-week intervals.</td>
</tr>
<tr>
<td></td>
<td>Chlorothalonil</td>
<td>8 pints/100 gal. water</td>
<td>Apply in early spring. Repeat at 2- to 4-week intervals.</td>
</tr>
<tr>
<td>Rust (pine nursery only)</td>
<td>Bayleton</td>
<td>4 - 6 oz./acre</td>
<td>Spray weekly from emergence through June.</td>
</tr>
</tbody>
</table>

### CEDAR, JUNIPER CYRESS

<table>
<thead>
<tr>
<th>Disease</th>
<th>Fungicide</th>
<th>Application Rate</th>
<th>Application Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twig Blights (Cercospora and Phomopsis)</td>
<td>Fixed Copper or Bordeaux mixture</td>
<td>8 lbs. copper sulfate + 8 lbs. hydrated lime per 100 gal. water.</td>
<td>Start program in mid-May and spray at 2-week intervals through June.</td>
</tr>
<tr>
<td></td>
<td>Benomyl (Benlate)</td>
<td>$\frac{1}{2}$ lb./100 gal. water</td>
<td>Start program in mid-May and spray at 3- to 4-week intervals through June.</td>
</tr>
</tbody>
</table>
Discussion

Question: Have you done any work with benomyl?
Answer: Yes. On Phomopsis blight, benomyl will do a pretty good job. A lot of our growers will not use enough volume of water to get it really down into the tree canopy, but benomyl is a good fungicide.

Question: What about Dithane?
Answer: Dithane will do a good job. Here again, a fungicide is not going to do the job, I don't care if it's systemic or not, unless you get it out there as early as possible. Early diagnosis is very, very important.

Question: How long does it take trees to recover from needle cast?
Answer: It depends on environmental conditions. Many times the damage is not severe. Sometimes, if pruning techniques are good, trees can be marketable the next year. If damage is severe, then the trees are set back two more years.

Question: Could you name a spreader sticker?
Answer: There are a number of materials. Triton is one, put out by Rohm and Haas, I think. There are a number of agricultural products used for row crops that will do the job. I get questions like "How long do I have to put the material out there after it rains;" or, "Will it do any good before it starts raining." If you get the material out there and let it dry, and if you have a spreader sticker in it, you hold onto at least 90% of the material you put out.

Question: What about putting out a fungicide at the same time as an insecticide?
Answer: Most fungicides and insecticides are compatible. Many times you can go ahead and put your insecticide in with the fungicide and save a little money by making only one trip to the field.
CONTROL OF DAMAGING AGENTS OTHER THAN INSECTS AND DISEASE

James W. Chandler  
Extension Forester  
Texas Agricultural Extension Service  
Overton, Texas

There are several factors that can cause damage to a Christmas tree plantation other than insects or disease.

Pocket Gophers

Pocket gophers are medium-sized burrowing rodents that live almost entirely underground. Do not confuse them with moles that construct similar tunnels. Pocket gophers have prominent, yellow incisor teeth and large, deep, fur-lined cheek pouches. Different species vary in length from 6 to 13 inches. Color varies with species and locality from light brown to deep chocolate. Because of their underground life, pocket gophers have poor eyesight, but other senses are excellent. Their tails are sensitive and are used as feelers when the animals travel backwards in their burrows.

A single gopher may have a system of tunnels that extends as much as 800 feet and covers an acre of ground. Foraging tunnels may be 4 to 8 inches below the surface. Dirt from runways is pushed to the surface to form circular mounds. The surface opening, through which dirt is pushed from the tunnel, is finally plugged by pushing dirt into it, leaving a small horseshoe-like depression on one side of the mound. Since almost their entire life is spent underground, these animals are seldom seen. One pocket gopher to a runway is the rule except during mating and caring for young.

In high-quality Christmas tree plantations, gopher control should be an annual management exercise. The most practical and efficient method of controlling pocket gophers is the use of toxic baits. Use extreme care in handling bait materials with bare hands. The most commonly used commercial bait is milo maize mixed with strychnine alkaloid at the 0.35 percent active-ingredient rate.

Bait application methods are tunnel-builders that can be attached to tractors and hand-probe devices. The bait application rate for a tunnel-builder is 1 to 2 pounds per acre, whereas the rate for hand probing is about 1/8 pound per acre. The best management technique is a combination of the two methods.

For initial control, use the tunnel-builder to completely encircle the field with artificial runways. Then make strips about 30 feet apart the length of the field. Treat the area at least 2 to 3 weeks before planting the
seedlings. Fall application is best for December planting. Do not disk before treatment. Sod is a key factor in formation of artificial tunnels.

Use hand probes to treat fresh mounds. When a series of mounds are found, treat at least two of the fresh mounds for good control.

Excellent probes are made of 1/2-inch galvanized pipe cut in 34-inch lengths. One end is welded to a rounded point leaving the other end open. A 3/8-inch rod approximately 20 inches in length is shaped to a point on one end. Weld the blunt end of the rod to the open end of the pipe or attach with a set screw for closure within the pipe. Make a movable footrest of a 3/4-inch "T" joint slipped over the main probe and held in place with a set screw.

Locate the main runway by probing into the soil with the sharp end of the rod. Begin probing at the corner of the mound on the side where the horseshoe-like depression is found. Stay away from the center of the mound. When the probe drops into the runway, the release of ground friction is felt. Remove the probe and insert the larger, blunt end of the probe into the tunnel. This makes a larger opening and gives greater ease in putting a level tablespoon of poisonous grain in the tunnel. Place the sharp-pointed end of the rod behind the shoulder when making the poisonous grain entrance. Close the opening with a piece of paper, a leaf or rock, and cover with dirt to keep out all light and air.

With either application method, do not apply when soil moisture is concentrated. Use of gopher traps is another control method. In most cases, trapping is impractical because it is so time consuming. Location of the main runway is the first step in trapping. A hole is then dug to the runway and soil is cleared to expose openings in two directions. Then place a trap in each opening because the gopher could be occupying the tunnel in either direction. Attach each trap by a string to a stake on the surface to prevent the gopher from carrying the trap farther into the runway.

Livestock

Cattle, horses, goats, or other domestic livestock and Christmas tree production do not mix. Small seedlings may be nipped at the ground line as animals graze in the plantation. Larger trees are used as rubbing tools by livestock. If livestock is to be in the area, Christmas tree plantation borders should be fenced.

Deer and Rabbits

When population build-ups occur and food supply is limited, deer or rabbits can be a devastating factor to a Christmas tree plantation. Damage from these animals is usually restricted to one- and two-year-old trees where the crown is nipped down to a stub.
Taking up firearms and shooting the intruders can be a potential control measure if only a few animals are involved. But, if the population builds up like rabbit populations did in West Texas this winter, shooting will have minor results.

Fencing can be an economically feasible rabbit control. To trim cost as much as possible, try to determine the direction from which the rabbits are entering the plantation. This is probably in the direction of adjoining brushy habitat. On that border, construct a chicken-wire fence at a height of approximately 24 inches.

The use of repellents is another means of controlling deer and rabbit damage. Basically, there are two type of repellents: (1) odor, and (2) taste. Odor repellents, such as human hair, mothballs, rotten eggs, and commercial brands, are placed in various locations surrounding and within the plantation. These repellents are particularly useful in deer control. Taste repellents are applied to each tree and are useful in deer and rabbit control.

**Fire**

Fire can destroy an entire Christmas tree plantation in a matter of minutes. Weed control helps reduce damage from wildfire, but good insurance is obtained by establishing and maintaining a disked or plowed fire lane around the entire plantation. The fire lane should be far enough from the outside row of trees to allow for mowing equipment turn-around.

**Theft**

When Christmas tree growers do not reside in close proximity to their tree farm, theft looms as a substantial loss in overall profit. Location and accessibility are key factors in the amount of loss. These factors are also key factors in an optimum marketing situation. Therefore, the grower should cultivate a good relationship with resident neighbors. Give them a tree each year. Use them in the farm operations. Get them involved in the enterprise. They can be a tremendous asset as a "watch dog" during the Christmas season.

Also, contacts should be made with local law-enforcement officers. It may be possible that regular patrols could be established for November and December.

**Wind**

In areas where deep sandy soils prevail, wind can be a damaging factor to newly planted seedlings. Certain prerequisites must occur before damage will take place. First, the area must be large open acreage and flat in topography. This means there are no large trees or other physical structures that act as windbreaks. Second, the site is prepared in the usual fashion for planting; that is, the area is cleared of all competing vegetation by cultivation. In
this case, gusts of wind carry sand granules across the field and actually sand-blast the seedlings. To prevent this type of damage, the grower may wish to interplant a small grain, such as rye. This vegetation would die once warm weather arrived.

**Herbicide Drift**

If the Christmas tree grower or neighboring landowners are producing other crops on adjacent acreage, extreme care should be taken not to have crop herbicides that are toxic to the Christmas trees drift into the plantation.

Weather conditions directly affect the direction, amount, and distance of drift. Avoid applications when the wind is blowing toward the Christmas tree plantation.

Also avoid applications when early morning and late evening ground temperatures are considerably less than those during the middle of the day. This is explained due to the fact that as the ground temperature increases above the upper air temperature, the air near the ground rises and sets up convection and thermal air currents which lift small particles. These suspended particles may be carried some distance before they settle out.

**Discussion**

**Question:** Can you have any wildlife in a Christmas tree farm?

**Answer:** No. There was a grower in East Texas that tried goats to keep the weeds down. Another one tried sheep, but they don't know the difference between Christmas trees and the grass that they are supposed to keep down.

I have found out through observation as far as gopher control goes, it doesn't seem that they damage Deodar cedar in East Texas.

**Comment:** A few growers have had trouble with beavers. A little electric fence works well.

**Comment:** We have had problems with armadillos.

**Answer:** I have heard of a grower who built some armadillo traps, using plans developed by agricultural engineers of the Texas Agricultural Extension Service.
The improved Virginia pine has proven to be the best species to date for Christmas tree production in the eastern part of Texas. Producers must continually be looking for an improvement in this particular species or for new species to be grown for Christmas tree production. We planted seeds of the Florida sand pine and also planted seedlings of this particular species. The survival rate in both instances was very poor.

The equipment being used by the Christmas tree producers is usually small diesel tractors. These have proven to be adequate for Christmas tree production farms and are also small enough to work between trees that are planted on a six-foot by six-foot space. We have developed spray equipment for insect control, weed control, and spraying pine green on these trees.

Planting of the improved Virginia pine seedling is very important. We find that we have a better root development if we chisel the soil prior to planting. Chiseling in both directions while setting the spacing for tree planting at the same time has not only improved the tree growth, but it has also sped up the planting operation. It is extremely important that the tree roots are kept moist prior to planting. We like to plant as many seedlings as possible before Christmas and no later than the last of January. We are growing these trees in a high rainfall area (59 inches per year), and we cannot use normal planting equipment as our soils are usually wet during the planting season. We use the dibble to punch holes for the plants. Female workers usually place the seedlings in the holes and then a dibbler follows them up and closes the hole. We have also left the sod intact and ripped the ground with sub-soilers and planted seedlings using this method. We find that we get better growth if we work the soil up well first and then roll it and plant the seedlings.

We have developed a herbicide applicator which we use in placing Roundup or Goal beneath and around the trees to control weeds. We found that the T-jet 15004 spray nozzle does a good job and can be applied from a bar that is only six inches off the ground and still get good coverage. Roundup is the most widely used herbicide at the present time. Goal is used when seedlings are planted.

The pruning of Christmas trees is an important task that must be properly done two to three times a year. We usually prune one-year-old or younger seedlings with hand clippers. As the trees get larger, we use knives, and we have used electrical shears as well as gasoline-powered shears. The gasoline-powered shears have proven to be the faster as they have a cutting blade on
both sides; however, they require a lot of strength to operate. The knife is
second fastest, but its main drawback is the possibility of injury to the user.
The electrical clippers require a power generator and the cord is a nuisance.

The biggest insect problem that we have had to date in growing the
improved Virginia pine is the Nantucket pine tip moth. This insect is
prevalent in most areas that pines are grown in and seem to prefer the young
tender shoots of the improved Virginia pine. We find that our best control
methods used to date are systemics such as Furadan or Di-Syston. We normally
make our first application of the systemic insecticide during the latter part
of February or early in March. Our second application is applied in the latter
part of May before the dry season sets in. Depending on the weather situation
and insect activity, we will start spraying with material such as Orthene in
mid- to late summer. We have had severe infestations of these insects which
have required weekly applications of Orthene for up to six to seven weeks to
get them under control. Several different types of spray rigs have been built
to spray Orthene and also Benlate (a fungicide we use during certain times of
the year). The new synthetic insecticide, Pydrin, has just recently received
clearance for use on Christmas trees. It has been tested during the past year
and will be tested more during this year. They have reduced the use of liquid
to three gallons per acre when using a vegetable oil with this material. The
length of time that Pydrin controls these insects seems to be longer than
Orthene. The herbicide sprayer is used to apply the Pydrin and the oil in very
small quantities.

We have run into problems such as flooding, and Virginia Pine seems to be
able to take considerable flood water—during the wintertime, anyway. Once in
a while, a tornado moves through a Christmas-tree area, causing a problem with
standing trees.

The majority of the Christmas trees grown in Texas are marketed at choose-
and-cut operations. These operations are kept neat, mowed close; the trees are
tagged and the rows are lettered and numbered. In some instances, some late
pruning is needed to shape up some of the larger trees.

There are a half dozen or so growers in our area who are wholesalers and
are shipping their improved Virginia pines to other areas. It is important to
clean the dead needles out of the center of the tree prior to shipping. The
bagging of the trees is important and is a task that takes considerable time.
Cutting a thousand trees a day is quite a chore. Transporting the tree to its
destination and maintaining its quality is important.

The 1982 Christmas season was the first one that a Texas-grown improved
Virginia pine was placed in the Systems Building at Texas A&M University.
We have found that the improved Virginia pine holds its needles well when harvested in late November. In the South, use of fresher trees cut closer to Christmas reduces the fire hazard.

New innovations such as special equipment to dig stumps, new types of pruners, air blowers to clean the needles out of the trees, and other equipment are being developed by local growers. The Christmas tree industry is a high-labor, high-cost business. We need to work at reducing the cost as well as the labor requirement in the future.
INVESTMENT ANALYSIS FOR CHRISTMAS TREE PRODUCTION

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Introduction

The economic opportunities provided by investing in Christmas tree plantations in the South is well documented. Christmas tree production is well adapted to any size operation 1 acre and up, it requires a minimum capital outlay to get in, marketable trees can be grown in as little as 3 to 4 years, and returns of $1000 to $2000 per acre per year can be expected.

In the past, profitability was expected, given an adequate site and good management. Consequently, economic analyses may not have been necessary for justifying investments in Christmas tree production. Warnings have recently been voiced of an impending Christmas tree glut, however. Because of the renewed interest in the South and what that has meant in terms of new growers and expanded production, and because many large producers have been expanding their production, it has been estimated that two to three times as many trees have been planted in the ground as there have been annual sales over the last few years. If, as a result, a glut should happen, expected returns may fall. Growers will either have to accept a surplus of trees at the end of the Christmas season or they will have to decrease their prices to ensure a sellout of their stock.

Whatever the case, growers may no longer experience the $1000 to $2000 per acre per year returns experienced in the past. While costs will not likely decrease, gross income will. Consequently, an impending glut and its impact on net returns may make financial analyses necessary.

The purpose of this paper is to present a framework for conducting financial analyses of Christmas tree investment opportunities. The application of the framework to the costs and returns of a local grower will serve as an example of how to use and interpret the results of the financial model. Finally, "what if" questions concerning costs, prices, and numbers of trees sold will be analyzed to demonstrate how the framework can be used to answer questions about changes in the assumptions used.

Analytical Framework

This section describes a process for analyzing the economic worth of Christmas tree investment opportunities or for comparing alternative treatment schedules. In general, the process requires specifying the treatment schedules
being considered, estimating the cash flows associated with each schedule, evaluating the cash flows using interest rate formulae, and, finally, using financial decision criteria to accept or reject an investment opportunity or to choose the most profitable investment opportunity from among a set of possible investment alternatives. In the latter case, for example, you may be considering different management strategies or regimes such as rotation ages of 4 versus 5 years, planting on 6x6- versus 7x7-foot spacings, shearing twice versus three times a year, and so on.

The Christmas tree production process in the Louisiana-Mississippi area can be characterized as a process of intensive management operations implemented over a production cycle commonly ranging from 4 to 6 years. To conduct a financial analysis of this process requires different kinds of data. Two broad and general types required include data on the actual cultural and marketing practices used and on detailed financial information. With regard to the cultural and marketing practices employed, four main functions of the production process might include stand establishment, stand maintenance and improvement, harvesting, and marketing. Under each of these is a set of operations that cover, for example, site preparation and planting under stand establishment; shearing, pruning, fertilization, weed control, and insect and disease control under stand maintenance and improvement; and artificial coloring, cutting, tagging, and baling under the harvesting function. The operations required for marketing depend upon the kind of marketing method used: wholesale, choose-n-cut, sale at roadside, or sale at a retail lot.

Records should be kept on all equipment, labor, supplies, and other resources used, either on a per-acre basis or on a per-tree basis. Table 1 is an example of the kind of records required. From these, all costs and their timing associated with the production process can be established.

The most obvious and most simplistic financial framework to use in evaluating investment alternatives is to directly compare their associated costs and returns. The financial criterion would be to invest if returns exceed costs. This is the way most financial analyses are probably conducted by the typical Christmas tree grower. However, the procedure has a serious limitation, and that is that the time value of money is not considered.

A dollar today is not equal in value to a dollar tomorrow. The dollar today is worth more. In simple terms, if you received a dollar today and could invest it in a 10 percent interest-bearing bank account, you would have $1.10 next year, not a $1.00. Consequently, a $1.00 today is worth more than is a $1.00 tomorrow. Interest rate formulae are used to make dollar values in different time periods equivalent in value, and the process of doing this is often called discounting if present values (PV) are calculated and compounding if future values (FV) are calculated.

For example, we would not want to directly compare a return of $200 in 5 years to a $100 investment today. Without using our interest rate formulae we
Table 1. Example of a form for use in annual scheduling of operations or treatments in Christmas tree production over a four-year period.

<table>
<thead>
<tr>
<th>Operation/treatment</th>
<th>Labor</th>
<th>Equipment</th>
<th>Materials</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
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<td>3</td>
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<td>Stand establishment</td>
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<td>Site preparation</td>
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<td>Planting</td>
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<td>Stand maintenance</td>
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<td>Shearing</td>
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<td>Pruning</td>
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<td>Fertilizing</td>
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<td>Weed control</td>
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<tr>
<td>Disease and insect control</td>
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<tr>
<td>Harvesting</td>
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<tr>
<td>Colorant</td>
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<tr>
<td>Harvesting</td>
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<td>Tagging</td>
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<td>Baling</td>
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<td>Transportation</td>
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<tr>
<td>Marketing</td>
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<tr>
<td>Wholesale</td>
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<tr>
<td>Choose-n-cut</td>
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<tr>
<td>Sale at roadside</td>
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<tr>
<td>Sale at retail lot</td>
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</tbody>
</table>
would say that we doubled our money. But, since a dollar today is not equal to a dollar tomorrow, such a direct comparison should not be made.

One way to compare the $100 and $200 is to look at both five years from the present. In that case, the equivalent "future value" of $100 today five years from now would be $161.05 and would be calculated by the general formula

\[ FV = a(1+i)^t \]

where "a" is the dollar amount today, i is an alternative rate of return or cost of borrowing in percentage terms, t is the year in which "a" occurs, and FV is the value of "a" t years from now. The $161.05 is what you would have five years from now if you were to invest $100 in a 10 percent interest-bearing account. Thus, it is the amount that you would want to compare to the $200. The $200 is worth more since it is larger than the $161.05 you could get from an alternative investment promising a 10 percent rate of return, so the investment being considered would be a good one. Or, if a borrower, the $161.05 is the amount you would have to pay back to a lender at the end of the five-year period. This is your actual cost and the amount you should compare to the $200 received in five years to determine if the investment is worthwhile.

Another way to compare the $100 to the $200 is to find the "present value" of the $200 and compare it to the current $100 dollar cost of the investment. At 10 percent the present value of $200 received five years from now is $124 and is calculated by the general formula

\[ PV = \frac{a}{(1+i)^t} \]

where "a" is the dollar amount in year t and PV is the "present value" of "a" in today's dollar values.

In summary, compound interest costs are meant to reflect the value of time in multi-year production cycles. They are a cost of production, representing either the cost of borrowed money or the forfeiture by the owner of alternative investment opportunities. And they must be accounted for even if direct cash payments are not involved, as when a grower uses his own finances in an investment.

The final step in the decision framework is determining the financial worth of an investment opportunity or selecting the best alternative from a set of possible alternatives.

Present net worth (PNW) and internal rate of return (IRR) are two financial criteria most often used in determining the worth of investment alternatives. Both employ the time value of money concept. The two decision
criteria employ interest rate formulae to **discount** future sums of money so that they can be specified in today's dollars (present values) since equal dollar amounts specified in different time periods are not equivalent in value. This way, decisions are made with all future dollar amounts expressed in the same unit of value, and this can only be done if they are all expressed and compared in the same period of time, in this case, the present.

PNW is the present value of all net returns over and above the required rate of interest, where the required rate of interest is equal to either the best rate of interest (alternative rate of return) an investor can expect from his next best investment alternative or is equal to his borrowing rate of interest, whichever is higher. PNW can be interpreted as the amount by which an investor's assets will be increased or decreased by an investment.

The general model for calculating PNW is

\[
PNW = \frac{R_1 - C_1}{(1+i)^1} + \frac{R_2 - C_2}{(1+i)^2} + \ldots + \frac{R_n - C_n}{(1+i)^n}
\]

where \(R_i\) is the gross income in year \(t\), \(C_i\) is the sum of all costs in year \(t\), \(i\) is the borrowing rate of interest or the alternative rate of return, and \(n\) is the rotation age (age of final harvest). An investment alternative would be acceptable if PNW was greater than or equal to zero and would be unacceptable if less than zero.

The internal rate of return (IRR) is the rate of interest at which the present value of the costs will just equal the present value of the returns. It is also the interest rate at which PNW is equal to zero. IRR is interpreted as the average rate of growth of invested capital. It is calculated for \(i\) such that

\[
\sum_{t=0}^{\infty} \frac{R_t}{(1+i)^t} = \sum_{t=0}^{\infty} \frac{C_t}{(1+i)^t}
\]

where all revenues are discounted to the present on the left side of the equal sign and all costs are discounted to the present on the right side. The objective is to find \(i\) such that the two sides are equal.

An investment alternative would be acceptable if its IRR was greater than or equal to an investor's cost of borrowing or to his alternative rate of return and unacceptable if less. An investor, for example, would not want to invest in a proposal promising an 8 percent IRR if he knows another would bring him 12 percent.

The IRR criteria probably has two distinct advantages over PNW. First, an interest rate does not have to be prespecified and, possibly most importantly,
the interpretation of IRR is probably more intuitively obvious since most
investors are accustomed to thinking in terms of rates of return expected from
investments, such as money market certificates, money funds, bonds, and so on.

To illustrate the use of the decision criteria, assume an interest rate of
10 percent and the simplistic set of treatments and cash flows below:

<table>
<thead>
<tr>
<th>Item</th>
<th>Year</th>
<th>Cost/ Return</th>
<th>PV</th>
<th>Formula</th>
</tr>
</thead>
</table>
| Site prepare and plant| 1    | -600         | -545 | \[
PV = \frac{600}{(1 + .10)^1}\] |
| Weed Control and Shear| Year 1 | -450         | -409 | \[
PV = \frac{450}{(1 + .10)^1}\] |
|                       | Year 2 | -450         | -372 | \[
PV = \frac{450}{(1 + .10)^2}\] |
|                       | Year 3 | -650         | -488 | \[
PV = \frac{650}{(1 + .10)^3}\] |
|                       | Year 4 | -500         | -342 | \[
PV = \frac{500}{(1 + .10)^4}\] |
| Harvest               | 4    | +4000        | +2732| \[
PV = \frac{4000}{(1 + .10)^4}\] |

PNW = \$ 576

The PNW is \$576, while the IRR is 24 percent. The investor would seriously
consider investing in this project since PNW is greater than 0. Under the IRR
criterion, he would invest if his cost of borrowing and if his alternative rate
of return were less than the IRR, 24 percent.

An Example

In this section, a realistic example of a financial analysis of Christmas
tree plantation investments is provided. The cultural treatments and their
associated timing and costs, as well as the revenues generated, were obtained
from an experienced local Christmas tree grower. They represent what he
believes an experienced grower managing intensively and efficiently could
expect.
Approximately 890 trees are planted per acre on a 7x7-foot spacing on old-field conditions. About 97 percent of the seedlings survive after the first year and no replanting is done. A total of 780 trees are expected to be sold, half in the third year and the remaining trees in the fourth year.

Table 2 is a listing of the man-hours of labor required per acre per year. Production costs, by year, are presented in Table 3. Labor is assumed to cost $3.50 per acre. All future costs and prices exclude inflation and real price changes to simplify the analyses presented below.

**Site Preparation**

Disking and leveling is contracted out at $75 an acre. (All other operations discussed below requiring tractor time use an 18-hp tractor owned by the grower.) The $20 liming cost is for the lime only. Purchased in sufficient quantities, the lime truck lays the lime over the area at no additional cost to the grower. Three hundred pounds of fertilizer (8-24-24) are spread by hand at a cost of $33 per acre for the fertilizer and $10.50 for labor.

**Planting**

Approximately 890 improved Virginia pine seedlings are planted per acre on a 7x7-foot spacing. The seedlings cost $43 per 1000. The 24 man-hours required are relatively high because the planting operation is considered to be one of the more critical operations. Consequently extra care and time is spent in layout and planting.

**Weed Control**

Pre-emergent herbicides (Surflan and Princep) are applied twice a year for the first two years, each application costing $12 for materials and $10 for tractor and labor time. A post-emergent herbicide (Roundup) is applied once a year for the first two years at a cost of $40 per application -- $20 for the herbicide and $20 for the labor and tractor time. Mowing is done seven times a year, from April through October, costing $20 per cutting.

**Insect and Disease Control**

Insect control is required throughout the life of the plantation. The number of applications, application rates, and insecticides used vary, however. For example, Furadan is used in the first two years. It is applied twice the first year at a per-treatment cost of $10 for the chemical and $7.00 for labor. It is also applied twice in the second year; however, three times as much chemical is applied per tree. As a result, the cost per application in the second year is $30 for chemicals and $7.00 for labor.
Table 2. Labor and equipment requirements on a Christmas tree plantation planted on a 7x7-foot spacing—an example.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hours required per treatment per acre&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labor</td>
</tr>
<tr>
<td>Site preparation</td>
<td></td>
</tr>
<tr>
<td>Disking</td>
<td>2</td>
</tr>
<tr>
<td>Leveling</td>
<td>1</td>
</tr>
<tr>
<td>Fertilizing</td>
<td>3</td>
</tr>
<tr>
<td>Planting</td>
<td></td>
</tr>
<tr>
<td>Layout and planting</td>
<td>24</td>
</tr>
<tr>
<td>Weed control</td>
<td></td>
</tr>
<tr>
<td>Pre-emergent herbicide</td>
<td>1</td>
</tr>
<tr>
<td>Post-emergent herbicide</td>
<td>2</td>
</tr>
<tr>
<td>Mowing</td>
<td>2</td>
</tr>
<tr>
<td>Pruning</td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>7</td>
</tr>
<tr>
<td>Shearing</td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>7</td>
</tr>
<tr>
<td>Year 2</td>
<td></td>
</tr>
<tr>
<td>Spring&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10</td>
</tr>
<tr>
<td>Summer&lt;sup&gt;c&lt;/sup&gt;</td>
<td>10</td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
</tr>
<tr>
<td>Spring&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10</td>
</tr>
<tr>
<td>Summer&lt;sup&gt;c&lt;/sup&gt;</td>
<td>17</td>
</tr>
<tr>
<td>Fall&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Year 4</td>
<td></td>
</tr>
<tr>
<td>Spring&lt;sup&gt;e&lt;/sup&gt;</td>
<td>7</td>
</tr>
<tr>
<td>Summer&lt;sup&gt;f&lt;/sup&gt;</td>
<td>8</td>
</tr>
<tr>
<td>Fall&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Fertilization</td>
<td></td>
</tr>
<tr>
<td>Years 2 and 3</td>
<td>2</td>
</tr>
<tr>
<td>Year 4</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 2. Continued

<table>
<thead>
<tr>
<th>Insect and disease control</th>
<th>Years 1 and 2</th>
<th>2</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Year 4</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorant&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cutting&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Tagging&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td>Baling&lt;sup&gt;j&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> All hours rounded to the nearest whole hour.
<sup>b</sup> 85 trees/hour.
<sup>c</sup> 50 trees/hour.
<sup>d</sup> Trees to be marketed, 130 trees/hour.
<sup>e</sup> 60 trees/hour.
<sup>f</sup> 50 trees/hour.
<sup>g</sup> 39 trees/hour.
<sup>h</sup> 65 trees/hour.
<sup>i</sup> 130 trees/hour.
<sup>j</sup> 11 trees/hour.
Table 3. Christmas tree plantation costs--base example.

<table>
<thead>
<tr>
<th>Items</th>
<th>Annual per acre costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Site preparation</td>
<td></td>
</tr>
<tr>
<td>Disking (twice)</td>
<td>60</td>
</tr>
<tr>
<td>Leveling</td>
<td>15</td>
</tr>
<tr>
<td>Liming (1000 lb/acre)</td>
<td>20</td>
</tr>
<tr>
<td>Fertilizing (300 lb/acre, 8-24-24)</td>
<td>44</td>
</tr>
<tr>
<td>Planting</td>
<td></td>
</tr>
<tr>
<td>Seedlings (Virginia pine, improved)</td>
<td>40</td>
</tr>
<tr>
<td>Layout and planting</td>
<td>84</td>
</tr>
<tr>
<td>Weed control</td>
<td></td>
</tr>
<tr>
<td>Pre-emergent (2 times)</td>
<td>44</td>
</tr>
<tr>
<td>Post-emergent</td>
<td>40</td>
</tr>
<tr>
<td>Mowing (7 times)</td>
<td>140</td>
</tr>
<tr>
<td>Shearing</td>
<td>25</td>
</tr>
<tr>
<td>Pruning</td>
<td>25</td>
</tr>
<tr>
<td>Fertilization</td>
<td></td>
</tr>
<tr>
<td>Insect and disease control</td>
<td>34</td>
</tr>
<tr>
<td>Harvesting</td>
<td></td>
</tr>
<tr>
<td>Land</td>
<td>200</td>
</tr>
<tr>
<td>Overhead</td>
<td>100</td>
</tr>
</tbody>
</table>
Orthene and Bravo, the first for pine tip moth and the second for needle cast, are applied seven times in each of the third and fourth years. The two chemicals are applied together, the Orthene costing $6.40 per acre per treatment and the Bravo costing $13.70 per acre per treatment. Labor and equipment costs per treatment are $10 per acre.

Overhead Costs

Property taxes are highly variable, as are annual administration costs (insurance, accounting fees, legal fees, licenses, etc.). As a result, property taxes and administrative costs are lumped together and are assumed to be $100.00 per acre per year.

Revenues

At the end of three years approximately 865 trees are expected to still be living. Of these, 85 are cull trees, leaving 780 marketable trees. Half of these are sold in each of the 3rd and 4th years on a wholesale basis at an average expected price of $12 per tree. As a result, the income received in each of these two years is expected to be $4680 (Table 4), for a total of $9360 per acre over the 4-year period.

Results

The PNW's and IRR that would be earned with a Christmas tree investment having the treatments and associated cash flows discussed above are presented in Table 5. PNW was calculated using four interest rates: 5, 10, 15, and 20 percent. The "base" costs and returns are those presented above. The PNW for this investment ranges from $2640 to $4655, and the IRR is 112 percent. This means, for example, that at an alternative rate of return of 20 percent, the grower would earn his required 20 percent rate of return and, in addition, an extra $2640 per acre in present-value terms. A grower who expected a rate of return of only 10 percent would earn that as well as an additional $3835.

A number of implicit assumptions were made about the treatments used and their associated costs and returns. In effect, PNW's and IRR are earned only if operations and treatments presented above are performed, if the costs associated with them are correct, if mortality is only 3 percent and only 85 trees are cull trees, if half the trees are sold in year 3 and the other half in year 4, and if the average wholesale price received is $12 per tree sold. Any deviation from these assumptions would change the PNW's and the IRR, either up or down.

Assumption Changes

At this point changes in the assumptions can be made and sensitivity analyses, or "what if" games, can be conducted. For example, what if wages paid were higher than $3.50 per hour? Or, what if costs were generally higher
Table 4. Christmas tree plantation revenues--base example.

<table>
<thead>
<tr>
<th>Item</th>
<th>Annual per acre revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Harvest sales(^1)</td>
<td>4680</td>
</tr>
</tbody>
</table>

\(^1\) 97 percent survival, 85 cull trees, 390 trees sold per year, $12 per tree.

Table 5. Present new worths (PNW) and internal rates of return (IRR) per acre for the base costs and returns and various changes in assumptions.

<table>
<thead>
<tr>
<th>Analysis</th>
<th>PNW 5%</th>
<th>PNW 10%</th>
<th>PNW 15%</th>
<th>PNW 20%</th>
<th>IRR %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base costs and returns</td>
<td>4655</td>
<td>3835</td>
<td>3175</td>
<td>2640</td>
<td>112</td>
</tr>
<tr>
<td>$ 5 wages</td>
<td>4250</td>
<td>3477</td>
<td>2857</td>
<td>2355</td>
<td>98</td>
</tr>
<tr>
<td>$10 wages</td>
<td>2888</td>
<td>2277</td>
<td>1790</td>
<td>1399</td>
<td>60</td>
</tr>
<tr>
<td>10% cost increase</td>
<td>4438</td>
<td>3643</td>
<td>3004</td>
<td>2486</td>
<td>104</td>
</tr>
<tr>
<td>25% cost increase</td>
<td>4138</td>
<td>3379</td>
<td>2770</td>
<td>2277</td>
<td>94</td>
</tr>
<tr>
<td>90% survival, 100 cull trees</td>
<td>3846</td>
<td>3146</td>
<td>2585</td>
<td>2131</td>
<td>98</td>
</tr>
<tr>
<td>Tree glut</td>
<td>709</td>
<td>479</td>
<td>299</td>
<td>157</td>
<td>27</td>
</tr>
</tbody>
</table>
than those assumed in the financial analysis? What if fewer trees were marketable or sold than assumed? Or the price received was less than the $12 initially expected? Analyses of situations like these can be performed using the steps followed above. Different scenarios are developed below.

Although $3.50 is the prevailing wage in the local area, some growers may pay more, either because the prevailing wages are higher in their area or because they want to more easily attract good labor. An analysis was conducted using a labor cost of $5 per hour. The PNW's ranged from $2355 to $4250, and the IRR fell to 98 percent. Thus, at a rate of 20 percent, the PNW fell only $285 from that of the base run, and at 10 percent fell only $358.

Many growers and their families perform some of the operations required in managing a tree farm including, for example, mowing, fertilizing, and insect and disease control. They often do this without giving themselves a direct wage, instead implicitly paying themselves at the time of tree sales. Another analysis was conducted using a wage rate of $10 per hour, the implied assumption being that the grower does most of the work himself and believes his time is worth that much. Again, the PNW's were quite high, ranging from $1399 to $2888, and the IRR was 60 percent—and this after the grower has paid himself and his family for all labor hours required.

Some growers manage less efficiently than others, taking longer to mow, shear, fertilize, harvest, and so on. Further, some manage their plantations more intensively than others, possibly shearing sooner and more often; applying insect and disease control measures sooner, more often, or at greater rates; or conducting inspections more often. In both cases, the expected costs are likely to be higher than those of a more efficient or of a less intensive operation. In light of this, analyses were conducted with expected costs 10 percent and 25 percent greater than those used in the base run. The PNW's under the 10 percent higher cost assumption ranged from $2486 to $4438, while the IRR was 104 percent. The PNW's under the 25 percent higher cost assumption ranged from $2277 to $4138, while the IRR was 94 percent. In the latter case, only $363 of PNW was lost when using an interest rate of 20 percent, and only $517 was lost using an interest rate of 10 percent.

So far, "what if" questions have been applied to only the cost assumptions employed in the example. In all cases, the Christmas tree investment appeared highly profitable. The PNW's were all higher than $1300 and the IRR's were all higher than 60 percent, this in a period of time when the rates of return on most money funds, money market certificates, treasury bills, and other related investment alternatives have ranged anywhere from 8 to 17 percent. The next step is to question the assumptions on the revenue side.

The base example assumed 3 percent seedling mortality and 85 cull trees at the time of marketing, leaving a total of 780 marketable trees. The mortality rate in particular may seem somewhat low. Consequently, an analysis was conducted that assumed a 10 percent mortality rate and 100 cull trees at the
time of marketing, leaving only 700 saleable trees or about 78 percent of the original 890 trees planted. The PNW's ranged from $2131 to $3846, and the IRR was 98 percent. This situation can be viewed in different ways while still maintaining these results. For example, a mortality rate of 12 percent and 82 cull trees could be assumed, or a mortality rate of 15 percent and 56 cull trees could be assumed, both giving the same PNW's and IRR.

The final scenario focuses on the possible consequences of a Christmas tree glut should it occur. Whatever the seriousness of the problem, its effect will be felt on the revenue side, through reductions in sales, reductions in prices, or both. If this happens, the profitability of investing in Christmas tree plantations may be jeopardized. An analysis was conducted with gross revenues cut in half. This could represent selling all 780 trees at half the price, ($6 per tree), selling only half the trees at $12, selling only 75 percent of the trees at $8 per tree, or some other combination of price and number of trees sold. The PNW's ranged from $157 to $709, a substantial drop from the base example. However, the rate of return was still fairly high at 27 percent. Again, the same results would occur if instead of a glut revenues were cut in half by an ice storm, a bug infestation, a drought, or whatever.

Only a limited number of "what if" questions were asked. In fact, many more changes in the original assumptions could have been made and analyzed. For example, what if the recommended rotation age was 5 or 6 years instead of 4? Or, what if the assumed treatments were scheduled differently? Or applied at different rates of application? The analytical framework and procedures used for the example and subsequent assumption changes could be used to analyze any question of this kind.

Finally, no two growers are likely to have the same treatment schedules, application rates, number of marketable trees, etc. Consequently, no two growers should expect the same financial results. Although the example used to illustrate the procedures for conducting financial analyses was realistic, it was used for illustration only.

**Discussion**

**Question:** Would you comment on taxes on Christmas trees as an investment?

**Answer:** I believe that another speaker is supposed to talk about taxes. I think I can safely say that if you don't keep a tree for six years or more from time of seeding you can't take capital gains, so you are going to have to calculate your tax on an ordinary income tax basis. One reason that I didn't do the analysis on an after-tax basis is because the tax rates for individuals are highly variable. So this is clearly a before-tax example.

**Question:** You assumed in your example an inflation rate of zero?
Answer: Right, which means that realistically these returns are being underestimated. If the relative increases in prices of trees to the costs of growing them are similar to price and cost increases in traditional forestry, you are probably underestimating net returns by excluding inflation, because the returns to forestry have gone up at a faster rate than has the cost of operations. It might also be remembered that since I excluded inflation, the interest rates I used are real interest rates rather than market interest rates. By excluding inflation therefore you probably should be looking at the present net worths under the 5 to 10% and not under the 15 to 20% rates. If you look at the present net worths under 5-10% interest rates, the present worths are quite high.

Question: I understand that if you qualify for capital gains, only 40% of your income from Christmas tree sales is taxable.

Answer: That is correct.
In discussing legal problems relating the Christmas tree production, I would like to address five of the primary areas of potential legal problems facing the Christmas tree grower. The first is the form of organization of the legal entity which will undertake the operation. The second area of consideration is taxation and the effect of tax rules on business planning. The third is the contractual obligation entered into by a Christmas tree grower in terms of land leasing, the purchase or sale of services, and contracts for the sale of the ultimate product. The fourth area to be discussed is areas of potential liability arising primarily from alleged negligence, and the fifth area is problems arising from regulations.

Form of Organization

Historically, Christmas tree operations have begun as family operated hobbies which in some cases grew into full-fledged businesses. The entry of many of the older companies now in the Christmas tree business could probably best be described as accidental, but with the advent of the plantation concept of Christmas trees in which trees are grown in a row group attitude and intensively managed, the business concept of the initial formation becomes much more important.

One of the most popular forms of business organization at this time is the limited partnership. The limited partnership allows the raising of capital with less control from state and federal government than a corresponding effort involving the sale of stock or other registered securities. The limited partner in a typical undertaking has the advantages of direct ownership and direct flow-through of tax benefits while escaping personal liability for the indebtedness of the business. There must, of course, be a general partner who is personally liable. However, this general partner in many cases is a closely held corporation which again allows the individuals who actually make the business decisions to avoid personal liability. A usual limitation, however, on limited partners is provided by most state laws in that a limited partner who undertakes to be active in the business no longer retains his shield as a limited partner but may become personally liable by his actions. There are also, in many states, very technical requirements for filing amendments to the partnership agreement to prevent a new limited partner from becoming personally liable.

The Sub-Chapter S corporation, as it was previously known, has been changed by the most recent tax law, and many of the objections of this form of business as related to capital gains have now been lessened. The Sub-Chapter S or small corporation reports its profits and losses in a manner very similar to
a partnership, allowing the individual stockholder to directly claim the
profits and losses while maintaining the protection of the corporation form.

The standard corporation or ordinary corporation generally assures a
double taxation, and the best that can be hoped for is to approach the same tax
liability and bookkeeping cost that an individual would pay in a direct
proprietorship. This is rarely accomplished because of the increased number of
filings necessary to retain the corporation form of business in a proper state
of compliance with the various corporation laws.

Of course, an individual may still undertake his operation as a
proprietorship if he has the capital available and has sufficiently considered
the potential liabilities of the business.

Taxation

The Christmas tree industry is controlled by Section 631A and Section 631B
of the Internal Revenue Code. At its simplest form Section 631A provides for a
Christmas tree grower to treat his own cutting and selling of trees as timber,
which would allow capital gains on the increase in values between the
capitalized establishment cost and the value of the cut trees on the first day
of the fiscal year in which they are cut.

One of the first challenges by the Internal Revenue Service relates to the
disallowing of shearing cost as a maintenance expense. The Internal Revenue
Service attempted to require a Christmas tree grower to capitalize the cost of
shearing rather than treat it as a current operating cost. The case of
Ransbure v. United States, 281 F. Supp. 324 (1967) is a United States District
Court case in which the Court held that shearing was necessary to maintain the
trees in a Christmas tree configuration and was therefore a maintenance cost
and not a cost of establishment.

A more serious challenge to the commercial Christmas tree industry was
presented in 1977 when the Internal Revenue Service took the position that a
grower, who had cut some trees from a field, had cut all of the number-one
quality trees and that the only thing that was left for a second year's cutting
was small number-two quality trees. With a January 1 fiscal year beginning,
the value increased from a small number two to a one-foot-taller number one
within the period after the beginning of the fiscal year. This, of course,
would have meant that approximately 50% of the value of the trees from a second
cutting would have been ordinary income. The Trial Court in this case ruled
with the Internal Revenue Service on each issue. However, the case was
appealed to the 9th Circuit Court of Appeals, and the Court of Appeals held
that the Trial Court's interpretation of Section 631A was incorrect and that
the first day of the fiscal year was simply a date of convenience, and that
since Christmas trees had value only one time during the year, that that value
was the market value at the time they were actually offered for sale. The
Appellate Court actually went much farther than anything the Christmas tree
industry had hoped for, and the Internal Revenue Service found themselves with an Appellate Court ruling which may have substantially expanded the capital gains rights of a Christmas tree grower beyond what they had previously been considered to be. The Internal Revenue Service did not appeal. The reason for the lack of appeal could be debated. However, under the present ruling in the 9th Circuit there is no difference between the value of a Christmas tree on the first day of the fiscal year than the date it is actually harvested. It had been the generally accepted rule that the increase in value arising from growth occurring after the first day of the fiscal year should be treated as ordinary income and, in fact, this was not the real issue submitted to the Court in the Schudel case. However, that case now stands for the proposition that the Internal Revenue Service may not treat trees which have not been harvested within the first year of cutting as "number two's," and it is a good probability that the value on the first day of the fiscal year may be treated the same as the value on the stump at the time the tree is cut less any allowances for risk factor between the two dates. Schudel v. Commissioner, 563 F2d 1300 (1977).

In 1977 a revenue ruling was requested to determine the right of a choose-and-cut operator to qualify for timber election. Under Revenue Ruling 77-247, the Commissioner has ruled that choose-and-cut sales of Christmas trees qualify for timber election and that under 631B there would be no retained economic interest. While I believe that it would be technically possible for a choose-and-cut operator to qualify under 631A or in some cases 631B, the technical requirements of paper work and explanation of the obligations to the customer who wants to purchase an individual tree will probably make the use of capital gains in choose-and-cut operations impractical. I am not aware of any choose-and-cut operation which has sufficient records.

Contractual Obligations

While many Christmas tree growers are planting land which they own, there is a current trend that major operators are operating on leased land. These leases, of course, must preserve certain rights for the landlord but must also grant the grower an opportunity to raise and harvest his crop. Generally, it is best to include some standard provisions in any Christmas tree lease obligating the grower to use good agricultural and forestry practices and providing also for at least two one-year extensions of the lease in the event the crop does not mature as quickly as the grower had originally hoped. I would recommend including the right on the part of the grower to make any lease payments to a secured third party in the event the land owner defaults on any obligation for which the land is security. This could mean either mortgages or taxes.

Some of the leases which I have seen in recent years provided for a percentage of the crop to be paid to the land owner or otherwise tie the success of the crop to the amount which the land owner will receive. While I am not aware of any cases directly in point in the South, several growers in
the northwestern United States have harvested their crop only to be faced with a law suit by an angry land owner who claimed that the grower had not used good cultural practices or had utilized cultural practices which had lowered the value of the crop. These "bad management" cases are a guaranteed source of loss for the grower whether he wins the law suit or not, because he must go to the expense of defending it even if he defends successfully.

A fairly recent North Carolina trial case in which a land owner grower had turned the management of his farm over to a manager who was to retail the trees resulted in a large verdict against the land owner for the improper dismissal of the contract manager. In that particular case the trial court allowed the manager to recover for lost retail profits. Both the North Carolina case and the cases arising in the Northwest are trial cases and, since there is no appellate review, do not really constitute a precedent. However, they do serve as warning points in areas of potential conflicts.

Sales contracts vary from grower to grower and generally refer to some description of quality as well as size. While very few trees in the United States are sold under U. S. grades, in fact almost none, the U.S. grades do constitute a standard from which one can begin to understand the description of the Christmas tree as a product. The U.S. grades have in effect become the rule of the trade even though the individual sales are not made under the grade. Most states apply the generally accepted rules of the trade to any contract concerning that particular product. As a result Christmas trees are graded from butt to tip but generally, in sheared trees, a maximum twelve-inch leader and approximately 3/4 of an inch sheared handle per foot of tree. While I have seen some contracts which describe the species of trees in trade manner, such as "Lake States Spruce," I feel it is best to write contracts in terms of the proper name of the species.

Limitations on sales contracts relating to the type and form of notices of defects and the proper handling of shortages are absolutely essential. These limitations when accepted at the time of the contract are generally enforced by the courts. Our own practice is to send out a letter approximately ten days prior to the shipment of the trees emphasizing the correct procedure in the event of any problems.

Potential Liability

The problems of liability are often overlooked by the grower who is entering the sales cycle of rotation. However, there are some horror stories which make product liability insurance a worthwhile investment. Perhaps one of the worst cases arose in Texas when the producer of Christmas trees and the company which furnished the colorant for the trees found themselves being sued by an insurance company under a subrogation right for the loss of an entire apartment house complex. Again, as in some of the earlier cases which I have noted, the defense resulted in a successful defendant's verdict, but there was no appeal and no precedent upon which to establish a defense as a matter of
law. The particular case determined on proof, developed before a jury, that the paint was not a flammable material and that a freshly cut Scotch pine would not sustain combustion in the absence of some mishandling after its delivery. Needless to say the cost of tests and expert witnesses was substantial even though the grower and paint manufacturer were successful in their defense.

Many large merchandisers require evidence of product liability insurance before purchasing a product from any supplier. People who intend to sell to such companies as Sears, J. C. Penney, A & P, and other major marketers should be prepared to have their certificate of insurance available.

One other area of potential problems arises from the failure of many Christmas tree growers to obtain workmen's compensation insurance on their employees. While the rules for workmen's compensation vary from state to state, I would strongly recommend that the Christmas tree growers insist on the issuance of workmen's compensation insurance even if there is an assigned risk pool; and if the rating agency refuses to order a carrier to cover the risk, the grower should ask the rating agency to submit its refusal in writing. As a practical matter, rating agencies generally will reverse themselves and write the insurance when faced with the fact that they are going to guarantee the grower's insurance status without a premium. In any event, such a letter could be used as a defense if a workmen's compensation prosecution was later brought.

Many choose-and-cut operators attempt to avoid liability for insurance to visitors on their farms by printing disclaimers on tickets and putting up warning signs. While the law of negligence varies from state to state, as a general rule these disclaimers are largely, if not totally, ineffective. A more reasonable approach is to warn potential customers by signs or other appropriate means of any known hazards, such as holes, streams, and existence of any known pesticides which might cause danger to a customer. Generally, a land owner is not an absolute insurer of his customers' safety, but does have an obligation to warn him of any known hazards or defects. Disclaimers are not only ineffective but quite often put a defendant land owner in a bad light before a jury by seeming insensitive and indifferent to the problems of the consumer.

Problems Arising from Regulations

Certainly, no discussion of the legal problems in Christmas trees would be complete without an examination of the various regulations which control, and in some cases plague, Christmas tree producers. Of course, most growers are well aware of the restrictions on various pesticides and the problems of obtaining a label authorization for minor products. In Tennessee, as an example, atrazine is applied on thousands of acres of corn at a rate of four pounds per acre, while Christmas tree growers growing a non-edible crop still do not have a label allowing them to apply one-third that rate of application. The reasoning behind much of the restrictions of pesticides may be varied, but
in practical application many minor crops and small market products are simply ignored because of the bureaucratic hassle of licensing.

Regulation of the shipment of Christmas trees can also become a problem. In some cases, for example gypsy moth and sclerredosis canker, quarantines serve to protect the industry. However, some other state restrictions do not seem to make much sense or may in fact simply be methods of applying a tariff. Florida's cereal leaf beetle requiring the fumigation of all Christmas trees and California's inspection for Nantucket tip moth are two such cases. The Florida restriction failed to explain why Christmas trees were thought to be a carrier of the particular beetle when none had ever been reported on Christmas trees, and California required inspection of trees only from certain states, totally overlooking the fact that other states from which California received trees were equally infested with the same pest. Admittedly, such regulations have been used for protection of native industries in the past, and I certainly hope that pattern will not develop in the movement of Christmas trees.

Another area which continually arises is the rules of various fire marshals against natural trees in public places or multi-family dwellings. These regulations generally are based on myth rather than any scientific data. Some of the regulations require treatment of Christmas trees by an "approved fire retardant." To my knowledge no "approved fire retardant" exists, and the National Christmas Tree Association's efforts to locate such a product have met with failure. These so-called fire-marshal regulations are a classic example of the ability of a myth to continue without any real basis in fact. An examination of the causes of fires in one state found that a home was many times more likely to be burned from an effort to thaw frozen pipes than from any fire involving Christmas trees. One of the most interesting facts was that cigarettes were nine hundred times more likely to be involved in a fire. Since lighted candles on the trees do not constitute any part of the American Christmas tree tradition as it exists at the present time, I am amazed at the continued ability of local fire marshals to make rules and enforce them without being able to explain why they made the rule or being able to prove any danger in fact.

In summary, I would recommend to any tree grower that he undertake an occasional legal check-up much as people have an annual physical to determine their medical status. Many of the problems which have resulted in litigation could have been avoided by competent advice prior to the events which cause the problems.
CHRISTMAS TREE GRADING

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Introduction

I suppose some of you are wondering why I am here, a fruit and vegetable inspector, talking to you about grading Christmas trees, but I will discuss the reason our division became involved with Christmas tree grading a little later.

Historical Background of USDA Grading

The purpose of the grading service of the USDA is to provide the industry with common trading practices. I will be talking more in terms of fruits and vegetables, but the same principles apply to grading and selling Christmas trees. There are U.S. Standards for Christmas trees as there are for other agricultural products. We have written, published standards for agricultural products. The grading standards for Christmas trees are contained in a 12-page pamphlet, "United States Standards for Grades of Christmas Trees," published by the U.S. Department of Agriculture, Agricultural Marketing Service. The latest revision became effective April 1, 1973. (Editor's note: Copies of the pamphlet may be obtained through the Extension Forester's office in each state.)

This pamphlet describes the grades (U.S. Premium, U.S. No. 1 or U.S. Choice, U.S. No. 2 or U.S. Standard, and Cull. Our service is to provide the industry with a common trade language, more or less. Also, we provide an impartial judgment as to the quality of a particular product that has a U.S. grade.

We have no regulatory powers whatsoever in fruits and vegetables nor in our grading services. We are merely a service for the industry—a service which is provided by our agency on a fee basis, upon request. We do have a fee for our services. But whoever wants us, especially the fruit and vegetable industry, uses us extensively in trade practices.

The USDA grading service started at the request of the industry as an effort to combat unfair trade practices. For instance, if you ship a load of Christmas trees from the Northwest to the Southeast, the two people who are buying and selling don't even know one another, usually, except over the telephone; so we play the role of certifying the quality of this particular product.
Our services started in 1917; the first standards were issued on Irish potatoes. The services were offered at terminal markets only. In 1921 the service was extended to what we call the shipping point; that is, the point of origin, where the products are grown and shipped. There, the USDA had to obtain agreements with all the states. The state has to furnish the personnel. The USDA trains the personnel and issues them a USDA license. In each state there is a supervisor like me to oversee all the licensed state personnel—to see that they abide by the USDA rules and regulations according to the grade standards. I supervise Louisiana and Mississippi at this time.

Starting in 1917 with one standard, we now have 150 grades covering 80 different commodities of fruits and vegetables, peanuts, pecans, and Christmas trees.

The reason Christmas trees came under the fruit and vegetable division for inspection and grading was that the USDA forestry people had no provisions for, nor had staff already familiar with, grading of any products. The Forestry Division voluntarily said, "Let's get the fruit and vegetable people to grade our Christmas trees." So when the Christmas tree industry became interested in grading trees, we had systems and facilities. Since we had this structure already set up, we became the inspection people for the Christmas tree industry. I happened to be supervisor of Wisconsin and Illinois at the time. I helped our standardization section research and promulgate the first grade standards for Christmas trees, written in 1957. The standards were revised in 1962 and again in 1973. I have made the most recent copy of the standards available to you here at this meeting.

USDA grading is done at the request of the industry. The first thing we do in an inspection job is to contact the industry after it requests a grading or grade change. We discuss with the shippers, growers, buyers, and all the industry personnel involved just what they need in the way of standards. Information is compiled, and preliminary U.S. standards are written. Many times, standardization inspectors have had to go back again to an industry and try to get industry members together as to what they all would agree on. When all parties agree, then the standard is written and it is settled. Then after 60 days without any comments the standards become effective.

The same procedure applies when an industry feels the need to revise the standards. If the industry wants the revision, it requests it through our Washington office. If enough people are interested in a change then they go through the same process. Thus we have had several changes of Christmas tree grading standards. Hopefully these standards are now what everyone wants.

We have very few requests in the United States for inspection on Christmas trees. I believe last year we had ten throughout the nation, which was a very small number in comparison to the number of Christmas trees sold.
Grading Inspection Services

The gentlemen spoke just before me about your contracts with your buyers. That is a very good idea. I would go a little further and specify a particular grade that you are selling. If there are complaints at the other end from the buyer, we have help in the form of federal inspectors in almost all of your major terminal markets. All it takes is a request for that office to inspect a load of Christmas trees. If the trees are inspected and certified as the best grade, you stand a much better chance of winning your case and collecting your money, if you have to go to court. You have proof there, a federal certification, that you have the grade that you agreed to sell.

As I said, inspection is available at most terminal markets. It is also available at the point of origin. The shipping point, depending on the particular state you are in, has state inspection services. If you feel the need for such a service, you can request inspection. You can send a copy of the certificate along with your load of Christmas trees, showing the buyer that you have had them federally inspected and that the load does meet the contract that you agreed on.

Grading service fees at the point of origin are established by the state. States differ in their fees. Fees at the terminal markets are uniform. They are established by the USDA. The fee would be the same in New York City as it would be in New Orleans or Los Angeles. For example, a grading inspection at a terminal market for a complete load of Christmas trees would cost you $35. I believe that is a reasonable cost to establish that you do have the quality of trees which you have promised to deliver.

The way we inspect Christmas trees is on a "count" basis. The inspector selects 50 or 100 trees depending on the size of the lot, selecting these at random throughout the load. Normally, we pick a random sample of 50 trees out of each 500 trees. We determine the percentage of defective trees in that 50 trees, and that percentage applies to the 500 trees. If we have 10% defective trees out of that 50, that applies to the 500 trees. Then it is determined whether the tolerance is exceeded as to what is allowed in that particular grade.

There is a second way that we grade trees. We certify the percentages of U.S. Premium, U.S. No. 1, U.S. No. 2, and whether there are any Culls (trees which fail to meet the requirements of the U.S. No. 2 grade) in that particular lot. For instance, in a lot of 1,000 trees we could certify that 40% are Premium, 30% U.S. No. 1, 20% U.S. No. 2, and 10% Culls. That is normally the way we do it at the terminal market. That's the way receivers want it. We can certify the entire load at one particular grade, for example, all U.S. Premium. This grade certification is more apt to be applied at the point of origin where you sold a load of U.S. Premium trees. You would determine whether that load meets U.S. Premium standards. If you have some bad trees in there, since you are at the point of origin, before you load the trees you can take the bad ones
out and have a straight load of U.S. Premium or a load of U.S. No. 1. Or, we
can certify the entire load with the percentages of these USDA grades in the
whole lot. We will perform the certification whichever way it is requested.

**Major Defects of Christmas Trees**

I will go over common Christmas tree defects briefly. Not all of them.
When you read the standards you will see many of them that I did not cover.

"Defect" means something that is wrong with the tree that keeps it from
making a certain grade. A defect of U.S. Premium may not be a defect for U.S.
No. 1, because Premium is the top grade. It has more stringent requirements
than U.S. No. 1. Density of a tree, for example, is one of the main concerns,
as I am sure all of you know. The U.S. Premium and the U.S. No.1 grades
require that the tree have at least a medium density, meaning that the branches
are relatively close together and the needles are adequate to cover the
branches. The stem may be visible but not distinctly visible throughout the
length of the tree. We have photographs to train our inspectors—to show what
medium density is (Figure 1).

U.S. Premium and U.S. No. 1 require a "normal" taper. Normal taper means
that the tree forms a cone, and the base of this cone is from 40% to 90% of the
height of the tree. You divide the height into the width and you have your
taper. If the tree has more than 90% taper, it has a "flaring" taper. If it
has less than 40% taper, it is referred to as a "candlestick." Both trees
would grade as a U.S. No. 2, the lowest grade, and few people would want to buy
U.S. No. 2 trees.

The U.S. Premium grade requires that there be four faces which are free of
damage. A face is one-fourth of the surface area of the tree. U.S. No. 1
requires that there be three good faces. U.S. No. 2 requires that there be two
or more adjacent good faces. What that means is that a Premium tree is one
that looks good in the middle of the floor in the living room. A No. 1 you can
put against the wall; a No. 2 you have to put in the corner.

Some of the other defects considered in the standards are:

- Decided gaps (abnormal spaces between whorls of branches; Figure 2).
- Unduly long branches.
- Weak or broken branches.
- Curved stems that are visible (Figure 2). If a curved stem is not visible
  through the foliage, that is all right, provided that the tree will sit in
  a stand without tilting.
- Holes in the tree (lack of branches or foliage; Figure 2).
Figure 1. Light and medium density in Christmas trees. Source: United States Standards for Grades of Christmas Trees.
Figure 2. Defects in Christmas trees. Source: United States Standards for Grades of Christmas Trees.
Excessively long leader. If the leader is more than four inches above the apex of the cone, the tree is down-graded to the next lower grade. It would be easy to cut this defect out, but if it is present we have to down-grade the tree.

Incomplete whorls of branches.

Handle length not proportionate to the height of the tree. The handle cannot be less than 6 inches long nor more than 1.75 inches per foot of tree height.

There are many other defects that we could discuss, but I am not trying to teach you the entire standards.

I hope you will take the time to read and go over the standards, and that you will consider using our services. You know what you have when you cut a load of trees to sell, but if you have a problem on the receiving end, call us. If you have some bad trees, require that the buyer let you know within a certain period of time (48 hours is fine), and if he says you have some bad trees, order a federal inspection on them. Have him call the federal inspection office in the city where the trees are and request that he furnish you a federal certificate showing that these trees are bad. If he doesn't want to call the inspector, then it would be worth your while to call. Our fee would be only $35, and you would have a federal certificate to back up your claim. You can call the inspection office yourself; that's all it takes to request an inspection. I would urge you rather than taking someone's word to use our service. And if you are interested in this in your home state, contact the federal-state inspection service. In most states the office is located at the state capital, like Baton Rouge in Louisiana.

Discussion

Question: What kind of response time do you have, before the inspector would go out?

Answer: If you call the office in the morning, the inspector would be there that afternoon or at the latest the next morning, unless your trees are located a considerable distance from the inspection office, in which case it would be the next day. Normally, if the trees are within a large city where we have an office, the inspector would be there that day. If the trees are some distance away, say 100 miles from the closest inspection office, there is a travel fee of 20¢ a mile.

Question: Are inspections made before or after loading on the trunk?

Answer: We much prefer to inspect before the loading; then we can see the trees loaded on the truck and record its license number.
MARKETING METHODS FOR CHRISTMAS TREES

C. Bruce Murphy
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Coolidge, Georgia

The marketing methods for Christmas trees are generally considered to be in two categories:

Wholesale - The selling of goods in relatively large quantities at a lesser price to retailers for resale.

Retail - The selling of goods individually or in small quantities.

Each of these can be broken down into various methods.

Wholesale

The largest number of wholesale Christmas trees are sold as cut trees. A few are sold as live trees (Balled and Burlapped or B&B). Some B&B trees are brought into the home, decorated, and then planted in the yard after Christmas. Others are used on landscaping projects.

Anyone having large quantities of trees in sparsely populated areas must depend mostly on wholesaling as a means of selling trees. A wholesaler must be known over a larger area than someone in the retail business. This can be accomplished by attending state and national association meetings along with attending association meetings in other states.

Growers that can sell their trees on a retail level generally have a larger profit margin. Unfortunately a lot of us can not sell all we grow on a retail level.

Wholesalers must become familiar with contractual obligations and dealing with the trucking industry. A few trees are shipped by rail, but the majority are shipped by truck.

Retail Lot Sales

At the present time most trees are sold on retail lots in town; however, choose-and-cut farms are growing in numbers.

Retail lot operators are faced with some serious decisions prior to opening up a lot, such as location, permits needed, proper lighting, security, and most of all how many trees and what varieties should be purchased. Trees that sell well in one area of the country may not sell well in another. This can even vary within cities. People can be changed from what they are
acclimated to, but in order to do so the tree must be attractive in appearance to them and generally at a savings.

Some growers are able to retail all their trees either by choose-and-cut or setting up lots in town which they own or control. Grower-operated tree lots usually face the same hazards the ordinary lot operators face. A grower can usually flex with the number of trees sold on a lot and not wind up with a large number of trees left over. However, some of the other hazards can be harder to overcome, such as security and control of the lot.

Flocking trees may increase your tree sales. Flocking is the spraying on a tree of a mixture of special powder and water which resembles snow. This powder (flocking material) can be dyed to give various colors such as red, white, and blue.

Live trees (B&B) can be sold on retail lots but are generally sold in nursery-type operations.

The selling of related items such as tree stands, wreaths, etc. usually increases your income. Care should be given not to heavily invest in items that can be purchased elsewhere at a savings.

Choose-and-Cut Sales

Choose-and-cut is the most profitable means for a grower but is time consuming, and sometimes dealing with the public can be difficult.

In general the operating of a choose-and-cut operation consists of meeting customers at the entrance, providing them with proper instructions on how your business is operated, giving them a saw to use, and letting them go to the field alone. You receive your money for the tree when they exit.

Pricing methods can include setting one price for any tree in the field, charging so much a foot, or placing a price tag on each tree in the field you wish to sell.

Offering additional services and related merchandising usually is good for business and generates extra income. This can consist of things like shaking the trash out of the tree, wrapping the tree for better handling, and selling of related items such as tree stands, wreaths, etc. Again, do not invest heavily in items that your customer can purchase in other places at a savings.

The "layaway" method of sales can be used but is not recommended. This method allows the customer to come out early to pick out his tree and return later to get it. This technique requires that you deal with the customer twice, and sometimes his tree is not there when he returns.
Allowing the customer to dig his own tree is practiced by a few but not generally recommended. This leaves holes in the field, which are safety hazards for other customers. If selling B&B trees appeals to you, we recommend that you select a field that your customers cannot see and one that you are not planning to use for choose-and-cut in the future. B&B the trees yourself or hire a professional to do so. These trees can then be placed at the entrance and exit of your choose-and-cut operation to be sold to anyone desiring a live tree.

General Comments

In order to continue to be successful you must strive to provide your customers something that they are not finding in other places—fair pricing, friendly atmosphere, dependability, related items, etc.

In the Christmas tree industry a general means of determining potential sales in a given area can be used. People usually shop within a 25-mile radius. Larger cities may extend to a 50-mile radius, some even farther, but not in large numbers. An average household consists of 3.5 people. Using the population within the above areas an estimated number of households can be determined. It is estimated that one-third of the homes do not put up a tree, one-third put up an artificial tree, and one-third put up a real tree. Using the one-third of households for an estimated number of real trees sold in a given area, you should then survey the area to determine how many real trees are going to be available in a given area on tree lots or choose-and-cut farms. This will give you an estimate of what your potential market is.

Discussion

Question: After you cut your trees, what do you do with your stumps?

Answer: We clear-cut our fields. We have a large machine that goes in; it's a large rotograder which grinds up stump, ground, and everything. We can harvest trees and then be planting a week later; we just grind it all up and leave it right there in the ground. We planted about 50 acres this year and were through planting on the 15th of January. About 20 of those acres contained trees which we harvested this year.

Question: What do you do about providing light for after-dark sales?

Answer: In our choose-and-cut sales, our gates are shut at 6:00 p.m. We have people that go out with flashlights, but we don't try to provide any lighting out in the fields for our trees. We really would prefer that people not come around our area at night. It is a very bad feeling, people coming in on you after dark.

Question: How do you go about pricing your trees?
Answer: We individually price our trees by putting a tag on the tree and securing it very well so buyers can't swap it. We look at the tree—its size, density, and uniformity—and a big nice tree gets a big nice price. Prices stay abreast with what the market is. This last year a six-foot to seven-foot tree was $15-$17 in the field. Seven-foot to eight-foot trees were on up to $20 or $22. We just try to stay aware of what the market price is; we don't want to overprice our trees or to underprice them.

Question: How far is your place from a major city?

Answer: We have about 100,000 population within a 25-mile radius of us, in small towns. We have two big towns: Tallahassee, which is a very large town about 50 miles away, and Albany, which is also about 50 miles away. But we don't have any large cities near us.

Question: What is the volume of your choose-and-cut sales?

Answer: Two or three thousand trees. We have reduced the number of retail lots in the area in the last few years.
To look ahead we often need to look back. We need to ask certain questions .... Where are we? How did we get here? And the obvious question that is most important is .... Where are we going? Here in the South we are a new part of a larger industry that has existed for 50 years or more as we know it. Since World War II there has been a dramatic increase in plantation grown trees and a matching decrease in natural stand production. The marketing of Christmas trees has been irregular at best. In the mid-1950's we had an overproduction of Christmas trees, which was centered in the state of Pennsylvania. This was at that time the plantation-grown Christmas tree center of North America. The center of this production has gradually spread out across the nation, and by the mid-60's there was a large production area in the Lake States. Between 1965 and 1968 there was an over-supply period that caused great repercussions throughout the industry. Many people abandoned Christmas tree production then as they did in the 50's. Over-supply and depression in the industry only lasted a few years as it did the first time, and the industry came out of the over-supply period in much better shape as far as the opportunity to profit in the production of Christmas trees.

During this time cultural techniques and the quality of production have constantly improved. After the second over-supply period production seemed to spread more throughout the nation, and with the advent of the Virginia pine Christmas tree in the South during the early 70's we have had a longer than normal period of prosperity in the industry. This prosperity still exists today, but how much longer it will be with us is the question today.

There are storm clouds gathering and it appears evident that there will be a recession in our industry, the third since World War II. The success of recent years has bred a surplus in our industry as it has in all other agricultural industries. At the present time it appears that we are planting three to four times as many trees as we are selling. Most of us know this. However, the element of complacency is with us, or what we might call "wishful thinking;" many people throughout this room and our industry will tell you that no surplus actually exists and that the potential of a surplus is quite remote.

Examine the facts and decide whether there really is a surplus. After World War II the industry, according to the best statistics available, was selling over 40 million Christmas trees a year. With the advent of the artificial tree in the mid-50's natural tree sales started into a decline. The decline was not entirely caused by the artificial tree, but there were fewer trees used per capita than in previous years for several reason. The consumption appeared to drop to around 25 to 27 million trees. It stayed this
way for a number of years. In the early 70's it began to increase again. It
is our collective opinion today that we are selling somewhere around 30 to 32
million trees. In the early 70's our record-keeping indicated that we were
planting fewer than 20 million seedlings a year. The planting of seedlings has
increased quite dramatically since that time up to the present; our surveys
indicate that more than 80 million trees were planted in the winter of 1983
(Figure 1). Growers in some areas report planting as many as four trees for
every one that they are selling. You will find great variations throughout the
nation, and you have many factors that tend to bring production down into some
similarity to sales. You have the natural phenomena that pull down production,
as well as abandonment of plantations for one reason or another. As I have
traveled over the nation in the last two years I find the large growers
planting more trees than they have ever planted before. I found the medium and
small growers planting more than they have planted before. I find the new
growers planting trees. All of these groups are the ones that are doing it.
The question that comes next is, "Why are they doing it?", "What causes this
explosion in planting?" Part of the answer involves the "success story" of the
past decade. In part it involves two human characteristics—greed and
ignorance.

The "success story" has been told far and wide by the growers themselves
and especially by extension foresters and extension agents throughout the
nation. Many states have unleashed intensive programs to increase production
in their areas. This is their job as they see it and in areas where there was
little or no production such as much of the South, we took on the job of
improving and increasing production with the goal in mind of supplying our
local needs. Every extension agent needs to remember that we have an
obligation to the growers and to the industry to try not only to encourage
production where there is a need, but to produce a reasonable quantity of trees
and not encourage overproduction such as has been the case in the past of
overpromoting production of corn, soybeans, peanuts, hogs, cows or whatever.
We have a bad record in these areas of preaching production, production,
production—without enough consideration applied to marketing and supply and
demand.

I want to say that extension agents throughout the nation have done an
unbelievable job of encouraging people to grow Christmas trees. This only
reflects how effective this group is. They are a fine group. They have taught
the people how to grow trees and encouraged them to do so. Now it is time to
tell the story of marketing and the problems of overproduction. Extension
services can help us solve the problem, and I think they will if we can
convince them of the facts. Figure 1 predicts the oversupply period will occur
in about 1989.

Now I want to talk to you, the producer, for a moment. I think we need to
ask ourselves—"What are we trying to do and what are we trying to prove?" Are
we not deceiving ourselves when the current market outlook and production
indicate that only one out of three of the trees that are being planted now
Figure 1. Trends of U.S. Christmas-tree consumption, seedlings planted, and sales of plantation-grown Christmas trees. Assuming 50% of seedlings become merchantable in a 7-year production period, saturation point should occur in 1989 marketing season.
will find a buyer when they mature? This situation reminds me of another strange human characteristic—The "It can't happen to me" syndrome. It is definitely very prevalent in our industry. Ask yourself this question— "Am I planning to sell only one-half or less of the trees that I am planting?" Very few of you are thinking in those terms. I am sure what I am telling you is coming at a time when it is hard to believe me, but time will bear me out. I hope I am wrong. Some growers are not going to survive in the Christmas tree business. There are just too many of us. In Georgia alone there are over 500 Christmas tree growers. If you will look at the enclosed graph (Figure 2) you will see how the planting of trees in the state of Georgia has increased rapidly in the past few years. Even though sales have not caught up with the consumption in Georgia at this time, the planting of the seedlings is well over two and one-half times total sales at the present. We have better figures on the success stories of growers in Georgia than in any other state in the South. At the present time I am ashamed to tell you that three out of four of the people who have entered the Christmas tree industry in Georgia in the last 15 years have failed, either by producing inferior quality or abandoning the operation entirely or for one reason or another.

Recession in agriculture throughout the South has caused many people to turn to Christmas trees as an alternate crop. This is to get away from crops that are currently in surplus. We do not want these people to jump out of the frying pan into the fire.

Let's look at the southern producer's Christmas tree marketing outlook. In 1983 it is estimated that the South, which is the Virginia pine growing area of the nation, consumed 6 million trees in the 1982 season. Based on figures I have been able to accumulate around the South, it is a good guess that we planted at least 10 million Virginia pine seedlings alone in the South this year. This does not count the over 1 million Fraser fir planted in the mountains of North Carolina and the millions of white pine planted in the northern half of Georgia, South Carolina, Alabama, and North Carolina as well as Tennessee. All in all we are planting more trees than the current market can absorb. Fortunately all of these trees will not reach the market or will not even be marketable trees. Let's assume that only one-fourth of the trees planted will reach the market. Let's also assume that at best we can only take 50 percent of the market away from those who are presently supplying the market and have supplied this market for many years. The question you might ask is "Why can't we get all the market?"

Let's look at the big picture and think about the position of the typical Lakes States grower that has been supplying markets in the South for decades; he finds himself with more quality trees than he has ever had before. He finds that he has great competition in his other market areas of the North. What will he do? He will stick in there and try to keep his southern market. He will keep it at all costs. And he is well healed financially and probably can stay in there with the best of us. I can see this grower in the North being willing to sell his trees at harvesting and shipping costs just to protect his
Figure 2. Trends in Georgia of Christmas-tree consumption, seedlings planted, and sales of Georgia-grown trees.
market. Even though he couldn't make a profit he will be protecting his market for that better day down the road. The grower knows that the glut will not last long—three to five years at a maximum.

Therefore my assumption is valid that you can only take half of the existing market with the Virginia pine or whatever you grow in the South. Let's apply that to the data that is available to us. Let's look at Figure 3.

This is based on a rather intensive survey of Georgia production and marketing. We can assume that this is typical of other southern states. Some states may be a year or two behind Georgia but probably no more than that. Based on the planting in the last few years and assuming one-fourth of them will be mature trees four years from now, and assuming that if we can get one-half of the market in our state, we will hit the point of saturation in the 1986 marketing season.

The year 1986 is by no means "doomsday" as I see it. It is a date that we will long remember and it is a date that we should prepare for. What can we in Georgia and other southern states do? From a standpoint of the Georgia grower we will look south at the nearly 2-million-tree market that he finds in Florida. He says "I will move my trees into that market." And yes, he will. To give you a little insight, approximately one-half of Georgia's wholesale production goes to Florida or at least leaves the state at present. So maybe "doomsday" will not come quite so soon. But guess what ... Alabama, Louisiana, Mississippi, South Carolina, North Carolina, and many other places are looking at Florida as the "Big Apple" or even looking at markets in your state to send their extra trees. I think if you couple the 1986 situation that we will be facing in Georgia and the rest of the South and the 1989 projections that I have made earlier in Figure 1, I do believe we have some hard times ahead. What direct effect it will have on the individual grower can be summed up in this manner. It is predicted that 20% of the growers will do very well, in spite of this situation. Another 30% will do well as long as the oversupply does not last too long and the depression in prices does not fall too far. About 50% of the total number of growers in the South are probably going to leave the industry if my projections come true. If we do not reach this state of depression that I predict, maybe more of this 50% will stay in the industry. In three to five years after this oversupply period comes on I feel that there will be enough reduction in Christmas tree production to bring things back into a favorable position for the grower. If I am right the grower of today must decide that he will produce high-quality Christmas trees very efficiently and do a good job of marketing to be able to ride out the storm and be a part of the future industry.

As I gaze into my crystal ball I find one segment of the southern Christmas tree production and marketing system that will be the least hurt by all that will be going on. That is the "choose-and-cut" operation that is run efficiently. The choose-and-cut customers are the most loyal customers that I
Figure 3. Projections for Georgia: Christmas tree consumption, seedlings planted, and sales of Georgia-grown trees. Assuming growers will market 1/4 of the trees they plant and can capture 1/2 of the state's market, the saturation point will be reached in the 1986 marketing season.
What can the Christmas tree producer do to minimize the projected oversupply and survive? First of all he must grow top quality trees as economically as he possibly can and do a superb job of marketing. That's what he can do by himself on his own as part of his own business. Secondly, we have another opportunity. We can band together as producers and try to expand the market. The question often asked is, "Can we expand this market?" The answer is we can and we must, for at the present time only around 33 to 38 percent of the homes have a real live Christmas tree in them at Christmas time. There will be a four to five percent increase in families each year in the next decade, which will add to the opportunity.

The best way to expand our markets and soften the blow of this overproduction, is through promotion of the real live Christmas tree through a collective system. There is only one system—the National Christmas Tree Association. I contend that any grower that can afford the price of the seedlings to plant one acre of Christmas trees cannot afford not to join and support the commodity industry through its state and national associations. The cost is only $40 plus 1¢ per tree that you sell. If every Christmas tree grower in the United States, and there are over 7,000 of you, fully supported the National Christmas Tree Association, we could adequately finance a trade promotion that would benefit each of us. But as it stands today we are poorly supported. Of the over 7,000 Christmas tree growers that we know of, only 2,500 support a national program and they do not all contribute their fair share under the 1¢-per-tree volunteer program. In 1982 we spent only $50,000 to promote the real live Christmas tree, which is a $300 million industry. Yet what can we expect when we look around at other commodity groups such as the apple growers of Washington State? They have a $400 million industry, they have spent $5 million in the last year to promote their industry, and they are calling for more funds because there is going to be a 25 to 50% increase in the next few years in apple production nation-wide. We must get the support of all Christmas tree growers and up our promotional efforts. It can be done. We can increase consumption. We can even get people to put more than one tree in a home. I go in many homes where there is a family tree in the living room, and the children have a tree in their room. Why not have one in the den for those Christmas parties also?

The National Christmas Tree Association cannot do the job adequately because of lack of funds. Give it the funds and your support. Let's increase Christmas tree consumption to 40 or 50 million trees a year; this will wipe out my prediction of overproduction. I would like to be wrong. Please help me to be wrong.