Christmas Trees: An Economic Assessment of the Feasibility of Providing Multiple-Peril Crop Insurance

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Executive Summary

Christmas trees are produced in all 50 states, but the bulk of production is located in the northern half of the country. The top producing states include Oregon, Michigan, North Carolina, Washington, Wisconsin, California, and Pennsylvania. U.S. producers have harvested 34 to 36 million live Christmas trees annually since 1988, up from 29 million during 1977-79. The value of the 1994 crop is estimated at $360-$540 million.

Pine, fir, and spruce trees are the three major Christmas tree species. The top selling trees are balsam fir, Douglas fir, Fraser fir, noble fir, Scotch pine, Virginia pine, and white pine. In recent years, fir trees have been growing in popularity because they are a short-needle species that retain their needles and hold their green color for a longer time following cutting than do other types.

Although the Census of Agriculture does not report any Christmas tree statistics, industry estimates suggest that as many as 1 million acres may be planted to trees and that 100,000 people are employed either full or part-time in producing Christmas trees. Many Christmas tree producers grow trees on a part-time basis as a supplement to other types of farm-related enterprises or non-farm income.

Although different species of Christmas trees are native to specific regions of the United States, cultivation practices and the breeding of new varieties have enabled species to be grown beyond their native habitats. Pine trees are noted for surviving on poor soil, often where other agricultural crops would not do well. Spruces and fir are more specific as to soil and climate requirements, with the fir varieties being the most demanding.

Christmas trees are usually planted for the exclusive purpose of being harvested for Christmas trees or, to a limited extent, for nursery stock. Wild trees are not cultivated for Christmas trees and are rarely sold as Christmas trees in today's market. Wild trees are estimated to make up no more than 1 to 2 percent of Christmas tree sales.

Seedlings are started from seed in a nursery seedbed. Seedlings may be transplanted to nursery field beds at two years of age to allow more room for both shoot and root development. In the South, seedlings may be set into the field right from the seedbed. Even in the North, pines may be transplanted directly to the field from the seedbed.

On average, about 2,000 to 2,100 trees are planted per acre. Spacing within and between rows, however, varies by species, the size to which the tree will be grown, and the equipment to be used. The within-row spacing at planting averages 4 feet to 6 feet. After the initial loss of trees, an average of 1,000 to 1,500 trees per acre will remain for harvest as Christmas trees. In more northern regions, about 750 trees per acre remain.

Most varieties require shearing to obtain the desired density (number of lateral branches) and taper (shape). The ideal tree is thick (has many branches with few open spaces) and has a taper of about 66 percent. Pine trees require more shearing to achieve the desired shape and compactness than do the other species.

A Christmas tree is considered mature and ready for harvest when it reaches 6 to 7 feet, the most popular height desired by consumers. It usually takes 5-12 years from planting until trees reach the 6-7 foot height. The actual number of years depends on geographic location, species, size at harvest, age of seedlings when planted in the field, soil fertility, cultural practices, and other variables.

The major production perils affecting Christmas trees include drought, excessive rain, excessive wind, hail, and fire. Some of the perils may kill the tree, but more typically, the tree's appearance is altered to the extent it is no longer saleable as a Christmas tree.

For several reasons, many of the individuals contacted for this study implied that crop insurance would be mostly an issue for mature Christmas trees. First, costs during the early stages of production are minimal compared with the costs of producing the adult tree. Third, younger trees can sometimes outgrow damage, such as needle or branch loss, by the time the tree is ready to be marketed.

Our assessment is that there is likely to be a substantial amount of interest in purchasing insurance, particularly among the larger producers in the Pacific Northwest and northern states. Smaller, part-time producers may be less interested. However, moral hazard and adverse selection are potential problems; these insurance issues, along with others, are discussed in the text.

Two contacts mentioned that insurance had been offered about 20 years ago by a private company. It covered natural

disasters such as fire, hail, and winds. However, the insurance was too costly for most producers and the company felt it was too risky.

In recent years, the National Christmas Tree Association (NCTA) Insurance Representative has written 3 policies on growing trees. These policies cover fire, lightening, wind, and hail damage, and were required before growers could obtain financing from lenders.

Introduction

Christmas trees are produced in all 50 states, but the bulk of production is located in the northern half of the country. The top producing states are Oregon, Michigan, North Carolina, Washington, Wisconsin, California, and Pennsylvania (Table 1). U.S. producers have harvested 34 to 36 million live Christmas trees annually since 1988, up from 29 million during 1977-79.

Pine, fir, and spruce trees are the three major Christmas tree species. Cedar are widely grown in the South, where pine, fir and spruce grow poorly because of the extreme summer heat. Consumer preferences for the various species vary by region, tree availability, family tradition, and aesthetics, and can change over time (NCTA Fact Sheet). The top selling trees are balsam fir, Douglas fir, Fraser fir, noble fir, Scotch pine, Virginia pine, and white pine (NCTA Fact Sheet). In recent years, however, fir trees have been growing in popularity because they are a short-needle species that retain their needles and hold their green color for a longer time following cutting than do other types.

This report examines those aspects of the U.S. Christmas tree industry that relate to the demand for crop insurance and the feasibility of developing a Christmas tree crop insurance policy.

The Christmas Tree Market

Supply

The different species of Christmas trees have different climate requirements, and their availability, therefore, varies from one region to another. Trees, however, can be shipped across state lines making a wide number of varieties available to consumers nationwide. An estimated 90 percent of the trees produced in the Pacific Northwest and 75 percent of the trees produced in Michigan are exported out of those states (Pacific Northwest Christmas Tree Association, Dornbush).

Demand

In the late 1980's, real trees and artificial trees each held about 50 percent of the total Christmas tree market. Sales of real trees, however, dropped to about 48 percent of the market during the 1990's. One reason for the drop in demand for real trees may be due to the perception among some consumers that Christmas trees are cut from the nation's forests and that

this is bad for the environment. In response to the decline in real-tree sales, the National Christmas Tree Association began promotional programs to explain the farming of Christmas trees and their benefits to the environment (Geiger). Other issues

Table 1--1994 Christmas tree harvest by state

State	Percent of total U.S. trees harvested
Oregon	22-24
Michigan	14-15
North Carolina	11
Wisconsin	10
California	3-4
Other states	36-40
Total U.S.	100

Source: Pacific Northwest Christmas Tree Association's *1994 Facts at a Glance*.

believed to affect demand for real Christmas trees are the economy, ease of disposal of the trees, geographic location, consumer age, and family status.

Industry Characteristics

Although the Census of Agriculture does not report any Christmas tree statistics, industry estimates suggest that as many as 1 million acres may be planted to trees and that 100,000 people are employed either full or part-time in producing Christmas trees. The value of the 1994 crop is estimated at $360-$540 million--based on a $10-$15 average price for 36 million tree (Pacific Northwest Christmas Tree Association).

Many Christmas tree producers grow trees on a part-time basis as a supplement to other types of farm-related enterprises or non-farm income (Ward). Christmas tree farming is often viewed as a family business, with all members of the family participating (Jacob). Large Christmas tree farms, however, exist in all of the major-producing states.

Cultivation and Management Practices

Climate and Soil Requirements

Although different species of Christmas trees are native to specific regions of the United States, cultivation practices and the breeding of new varieties have enabled species to be grown beyond their native habitats. Pine trees are noted for surviving on poor soil, often where other agricultural crops would not do well. Spruces and fir are more specific as to soil and climate requirements, with the fir varieties being the most demanding. The major species of Christmas trees and their climate and soil requirements are shown in Table 2.

Varieties

The major species of Christmas trees are the firs, spruces, pines, and cedar. Within each of these species there are several varieties. The most popular varieties grown for Christmas trees include:

True Firs (*Abies* spp.)

The principle true fir varieties include the Noble fir, Shasta Red fir, Grand fir, Fraser fir, and Balsam fir. Needles of the true firs are borne singly along the twigs and are usually

fairly short and rounded at the tips. Needle retention on cut trees is excellent. The basic conical form of the trees is good, but irregular growth rates and limbs of uneven length usually require

Table 2--The most popular Christmas tree species, climate and soil requirements, and production regions

Species	Climate or native growing area, and soil type	Location
Norway spruce	Prefers a humid, cool climate with moist soil.	In the East as far south as North Carolina, Tennessee, and Missouri, and west to Minnesota and Iowa. In the West, in Washington, Oregon, Idaho, and Utah.
Colorado blue spruce	Native to the western U.S. Tolerant of most climates, but not very hot climates. Prefers moist, well-drained soil.	Throughout the United States, except the deep coastal South or hot desert Southwest.
Red cedar	Adapted to a wide variety of climatic conditions. Prefers limestone regions, but grows well in poor, dry soil.	Throughout the eastern United States, but used as a Christmas tree mostly in the South.
Eastern white pine	Native to southern Canada, the Lake States, and the eastern U.S. Can take cold, but not dry, cold winters. Prefers moist, sandy soil.	Northeastern United States, west to Minnesota and Iowa, and the Appalachian Mountains.
Virginia pine	Prefers warmer temperatures, where winters are brief. Can grow on poor soil.	Southeastern United States, up to southern Pennsylvania and west to eastern Texas.

Scotch pine	Prefers moist, cool climates and sandy soil; likes plenty of moisture.	Canada, and the east coast of the United States to North Carolina, Michigan, Minnesota, and the Dakotas.

Table 2--Christmas tree species, climate and soil requirements, and production regions, continued

Species	Climate or native growing area, and soil type	Location
Monterey pine	Native to the California coast. Will not grow in cold climates. Likes coarse, sandy loams on slopes.	Southern California.
Douglas fir	Prefers mild, humid climates with dry summers and cool, moist, well-drained sites with moderate-to-high fertility.	Pacific Northwest.
Noble fir	Prefers a humid climate, with a cool, short growing season; likes rain, but not in summer. Requires well-drained soil.	High elevations in the Pacific Northwest.
Balsam fir	Likes cold winters and warm summers. Prefers moist, well-drained soil near lakes and streams.	Canada, New England, the lake areas of Michigan and Wisconsin.
Fraser fir	Native to the Appalachian Mountains with elevations above 4,000 feet. Prefers moist, well-drained soil.	North Carolina, small pockets in Virginia and Tennessee. It is commercially planted extending beyond its native range.

Sources: *The Messenger of Life*, National Christmas Tree Association informational packet; Webb; Brown, Cowen, and Heiligmann; and Lungren and Douglass.

some shearing in order to produce high-quality trees. True firs are the most environmentally-sensitive species of Christmas tree and require more careful site selection and management practices than the other species. True firs are particularly susceptible to injury due to late spring frosts (Brown, Cowen, and Heiligmann).

Noble Fir (*Abies procera*) and
Shasta Red Fir (*Abies magnifica*)

The noble and Shasta red firs grow naturally at 2,500-5,500 feet elevations. Branch and needle structure is stiff and strong enough to withstand heavy snows in their natural habitat. They are non-shedding. Where one species grows well the other is likely to succeed. Noble fir grows faster than Shasta red, but Shasta red fir is more tolerant of dry soil conditions. Noble fir needles are considered more durable, darker green, stiffer, and more densely arranged on a twig than the Shasta red. Shasta red, however, develop a narrower, more "self-shaped" crown than noble fir (Langren and Douglass).

The noble fir is a native of high-elevation sites in the Cascades and coast ranges of Washington and Oregon, where it blends and hybridizes with Shasta red fir at its southern-most limit (Langren and Douglass).

Shasta red fir is native to high elevations in the Cascades and Siskiyou Mountains of southern Oregon and northern California. It forms a transition species between the noble fir and California red fir, and it hybridizes with each where their ranges overlap (Langren and Douglass).

Grand Fir

The grand fir grows naturally in western and eastern Washington, northern Idaho, and on many elevations in western and northeastern Oregon. It is also found in southern British Columbia, northwestern California, and western Montana. The regional strains of grand fir can differ in growth rates, disease resistance, needle retention, needle form, and needle color. Grand firs are usually priced between noble fir and sheared Douglas fir (Langren and Douglass).

Fraser Fir (*Abies fraseri*)

The Fraser fir, also called southern balsam fir, is native to the southern Appalachian Mountains. Its limbs are sturdy and the tree has a "balsam" smell. It is quite similar to balsam fir except that its needles are darker green and it has

prominent white bands on the underside of the needles (Brown, Cowen, and Heiligmann). North Carolina is the major producer of Fraser fir. However, new varieties have been bred to delay the growth of new buds until later in the spring, making it less susceptible to late frost injury, and enabling it to be grown successfully further north.

Balsam Fir (*Abies balsamea*)

Balsam fir is native to Canada and the northern United States, southward through the Appalachian Mountains to West Virginia. Growth begins early in the spring in the Midwest and Northeast and is therefore vulnerable to injury by late spring frosts. Because of irregular growth rates, partly related to frost injury, balsam fir requires more years to reach maturity than does Fraser fir (Brown, Cowen, and Heiligmann).

Other True Firs

Other true fir varieties include Nordmann fir, Cilician fir, Nikko fir, white or concolor fir, silver fir, and Turkish fir.

Douglas Fir (*Pseudotsuga Menziesii*)

Douglas fir is not a true fir. It is native to a wide area in the West and to Canada. Considerable genetic variation exists in the species. Seedlings from the West are generally not winter-hardy in the Northeast and Midwest. Those from high elevations in the northern Rocky Mountains grow very slowly and are often damaged by late spring frosts if growth begins in early spring. Seedlings from seeds collected in southern Colorado, Arizona, and New Mexico are more hardy for northern climates because they break bud somewhat later in the spring than the other species and therefore, are less subject to late spring frost damage. These sources produce trees with good growth rates and relatively long needles born singly along the twigs and usually having a bluish or blue-green foliage. Douglas fir do not tolerate excessive moisture or drought. The basic conical form of the species is good, but shearing is usually necessary to produce high quality Christmas trees. Needle retention on cut trees is excellent (Brown, Cowen, and Heiligmann).

The Pines (*Pinus* ssp.)

The principle pine varieties used for Christmas trees are the Scotch pine, white pine, Virginia pine, and Monterey pine. Needles of the pines are borne in bundles of two or more along the twigs and are relatively long in comparison to those of spruces, true firs, and Douglas fir. Nutrient and water

requirements are generally somewhat less exacting than those of most spruces, true firs, and Douglas firs. Because of their less-exacting requirements, pines are usually adapted to a wider variety of sites than other species. Needle retention on cut trees is excellent. Pines, especially the Scotch pine, are still widely grown for Christmas trees, despite the increase in consumer preference for fir trees.

Scotch Pine (*Pinus syvestris*)

Scotch pine is a two-needled pine native to Europe and Asia. There is considerable genetic variability in the species, and foliage color, needle length, stem straightness, and growth rate vary greatly depending on the area from which seed is collected. Scotch pine require considerable shearing to produce high quality trees (Brown, Cowen, and Heiligmann).

White Pine (*Pinus strobus*)

The white pines' needles are in bundles of five. Eastern white pines have needles 2 to 5 inches long. Western white pine needles are shorter and stouter than the eastern variety. Branches are slender and flexible, and trees usually require fairly extensive shearing to produce high quality trees.

White pines appears to be somewhat more tolerant of wet soils than are Scotch pines, although trees on wet sites may suffer from white pine root decline. Fertilizer requirements are higher than for Scotch pines, but less than for spruces, true firs, and Douglas fir. White pines seem to be more susceptible to damage from air pollution than other pines.

Virginia Pine (*Pinus virginiana*)

The Virginia pine is native to the southern part of the United States. Its needles are 1-1/4 to 3 inches long, in bundles of three. The needles, which are slender and stiff, resemble the Scotch pine. Because the Virginia pine grows in warmer climates that other pines, it requires less time to reach maturity than either the Scotch or white pines.

Monterey Pine (*Pinus radiata*)

The Monterey pine is a three-needled pine, with needles that are 4 to 6 inches long and dark green. The tree grows in a very limited area of California. Like the Virginia pine, the Monterey pine grows in a warm climate and matures more quickly than the Scotch or white pine.

Other Pines

Other varieties of pines used for Christmas trees include the Austrian or black pine (*Pinus nigra*) and red pine (*Pinus resinosa*), both of which used to be popular varieties in the Midwest. Because these varieties are difficult to shape into quality Christmas trees, growers have shifted to the Scotch and white pines. The moisture requirements of Austrian pine are similar to those of Scotch pine. However, its nutrient requirements are considerably higher. It grows well on soils with high pH and is resistant to salt and air pollution injury.

Southwestern white or border pine (*Pinus strobiformis*) is also planted in the Midwest in limited quantities. It is a five-needled pine, similar to eastern white pine, but the needles are shorter and are retained for two or more years. Limbs are stiffer than eastern white pine.

The Spruces (*Picea* spp.)

Spruce needles are borne singly along the twigs and are usually relatively short and sharp-pointed. Needle retention on cut trees varies somewhat, but in general, is not as good as on pines or firs. Spruces are probably the least popular variety of Christmas tree sold today. However, industry leaders indicate that spruces are beginning to show signs of regaining the popularity they once had (Jacob).

Although most species of spruce prefer moist, well-drained soils with moderate to good fertility, they will grow on rather sandy soils if there is a favorable water table throughout the growing season. Most species do not grow well on poorly-drained, fine- textured clay soils. Spruces often grow slowly during the establishment period, after which growth is usually relatively rapid. Therefore, although the basic form of most trees is good, some shearing is needed to produce high quality Christmas trees. As a group, the spruces are subject to spring frost injury because they leaf-out early (Brown, Cowen, and Heiligmann).

Colorado Spruce (*Picea pungens*)

The Colorado spruce, also called blue spruce, is native to the western United States. Needles are generally longer than other spruces and are very sharp-pointed. Although foliage on some trees is a bright bluish color, most nursery-grown seedlings are green to blue-green. Needle retention on cut trees is generally better than it is on white and Norway spruces and is almost as good as that of pines. Colorado spruce growth is slower than that of white or Norway spruces. Colorado spruce is one of the more popular Christmas tree

varieties to be sold potted or balled because it survives transplanting better than some of the other varieties (Dornbush).

Norway Spruce (*Picea abies*)

The Norway spruce is native to Europe. It has short, stiff, prickly, sharp needles and strong branches. Because of its poor needle retention, however, Norway spruce's popularity as a Christmas tree has declined.

White Spruce (*Picea glauca*)

The white spruce is native to the northern United States and Canada. Its needles may be whitish or bluish green. Although not as good as on pines, needle retention on cut white spruce trees is better than on the Norway spruce.

Other Spruces

Other spruces used as Christmas trees include red spruce (*Picea rubens*) and black spruce (*Picea mariana*). These two varieties were more popular species in the past than today. Their site requirements are more demanding than those of the Norway, white, and Colorado spruce. There are also several European and Asiatic spruces that can be used for Christmas trees.

Red Cedar (*Juniperus virginiana*)

The red cedar is actually a juniper. It has four rows of very short, paired leaves along the sides of its twigs, and longer, three-sided, needle-like sharp leaves at the ends of the twigs. It bears small, hard berries which are white to blackish-green in color (NCTA).

Site Preparation

Before Christmas trees are planted in a field, the site needs to be cleared of big rocks, trees, shrubs, bushes, and weeds. Eliminating or minimizing weeds in a Christmas tree field is essential for healthy, well-formed trees. During the early stages of growth, grasses, shrubs, and other brush compete with the seedlings for water and nutrients, and may weaken and perhaps kill young trees. Weeds also harbor insects and diseases which can harm or kill the trees, and can be a fire hazard. While site preparation is suggested between each rotation in a field (a rotation is the full harvesting of the field), some growers wait two or more rotations before going through such a thorough clearing again.

Plantings

A Christmas tree planting is called a plantation. The trees are usually planted for the exclusive purpose of being harvested for Christmas trees or, to a limited extent, for nursery stock. Wild trees are not cultivated for Christmas trees and are rarely sold as Christmas trees in today's market. It was estimated wild trees make up no more than 1 to 2 percent of Christmas tree sales (Jacob). Wild trees do not meet the shape and branch density standards demanded by consumers.

Seedlings are started from seed in a nursery seedbed. Seedlings may be transplanted to nursery field beds at two years of age to allow more room for both shoot and root development. In the South, seedlings may be set into the field right from the seedbed. Even in the North, pines may be transplanted directly to the field from the seedbed.

A seedling's age is designated by two numbers connected with a hyphen. The first number designates the number of years the tree was raised in the original seedbed. The second number indicates the additional years in a transplant bed. A 2-2 seedling, for example, spent two years in the seedbed and two years in a nursery transplant bed.

In recent years, containerized seedlings have become available. These seedlings, however, are more expensive and still less popular than bare-rooted seedlings or transplants (Brown, Cowen, and Heiligmann).

For seedlings to survive, they should be planted during the dormant season after the shoots cease growth in the fall and before growth begins in the spring. The soil needs to have a high moisture content and should not be frozen or snow-covered.

On average, about 2,000 to 2,100 trees are planted per acre. Spacing within and between rows, however, varies by species, the size to which the tree will be grown, and the equipment to be used. The within-row spacing at planting averages 4 feet to 6 feet. After the initial loss of trees, an average of 1,000 to 1,500 trees per acre will remain for harvest as Christmas trees. In more northern regions, about 750 trees per acre remain (Dornbush).

Because pines generally have relatively broad crowns, a spacing of 5 to 6 feet between trees within rows is needed if trees are to be grown to 6 to 8 feet. Spruces, true firs, and Douglas fir usually have narrower crowns and a spacing of 4 to

5 feet within rows should be adequate for producing a 6- to 8-foot tree. Spacing between rows should be at least 2 to 3 feet wider than the widest piece of equipment that must travel between the rows (Brown, Cowen, and Heiligmann).

Fertilization

Fertilizer requirements vary by species. Pines have very low fertility requirements and may not require fertilization on many sites. Spruces, true firs, and Douglas fir are more demanding and benefit from fertilization at planting. Use of slow-release fertilizers in either pelleted or granular forms usually give the best results. Seedlings can be injured or killed if soluble fertilizers such as nitrogen and potassium come too close to the roots. Nitrogen is the major fertilizer compound used to improve tree growth and color. It should not be used on first-year plantings.

Shearing

Most varieties require some shearing to obtain the desired density (number of lateral branches) and taper (shape). The ideal tree is thick (has many branches with few open spaces) and has a taper of about 66 percent (Brown, Cowen, and Heiligmann). Taper is the relationship of the width of the tree at its lowest branches to the height of the tree, less the handle. Pine trees require more shearing to achieve the desired shape and compactness than do the other species.

Shaping usually begins the second or third year after the tree has been planted in the field. By this time, the root system has become well established and the tree is entering its rapid growth phase (Leuschner and Sellers).

The first shaping is usually limited to eliminating double leaders (removing the excess upward-growing branches on those trees in which more than one branch competes to be the terminal leader). By the 4th and 5th years, shearing to maintain a cone shape begins. The terminal leader is cut back to limit growth to about one foot per year and the lateral branches are cut back as needed to achieve the desired taper (Kreh, Finley).

Pines must be sheared during the active growing season (late June and July). Bud growth on pines occurs only at the end of the branches. By shearing in June or July, enough of the active growing season remains during August and September for vigorous new buds to form at the ends of the cut branches, which provide the basis for the following year's growth.

Spruces and firs require less shearing than pines, and shearing can be done at any time of the year. Internodal buds form throughout the branch on spruces and firs, and new growth can occur from these buds.

True firs require more knowledge to cultivate than either spruces or Douglas fir. Because they grow very slowly, shearing mistakes can distort the final tree shape and diminish the tree's value (Mangold). Also, it is more difficult to establish a true leader for true firs than for other varieties. Douglas firs are more forgiving of bad pruning because they grow rapidly and can outgrow mistakes. Spruces and firs usually require some vertical shearing to maintain the proper taper, but less than for the pines.

All varieties are pruned to remove branches between the bottom whorl and the ground, called basal pruning, to provide a

branch-free handle. Basal pruning is generally done after 3 or 4 years in the field.

Harvesting

A Christmas tree is considered mature and ready for harvesting when it reaches 6 to 7 feet, the most popular height desired by consumers. It usually takes 5-12 years from planting until trees reach the 6-7 foot height. The actual number of years depends on geographic location, species, size at harvest, age of seedlings when planted in the field, soil fertility, cultural practices, and other variables. In the Pacific Northwest, a Douglas fir takes 5-7 years from seed to mature tree; a grand fir, 6-8 years; a noble fir, 7-9 years; and a Shasta red fir, 8-10 years (Langren and Douglass). On the East Coast, firs and spruces are harvested 9 to 12 years after transplanting, and pines, 7 to 10 years. In southern states, pines may reach maturity after only 4 or 5 years.

The needles on some varieties of pines have a tendency to turn yellow during the late fall, which diminishes the tree's value as a Christmas tree. Some growers spray the trees in the field with a green colorant to act as a sun screen to prevent yellowing of the needles. Spraying needs to be done in August and September, before the days become too short and the trees begin to lose their color.

Growers sometimes choose to have their trees graded by USDA standards (see Appendix 1). Grading takes place in the field before harvesting by a USDA inspector.

Trees harvested for wholesale markets are cut with a chain saw and dragged to a protected area. In the more mountainous areas in North Carolina and the Pacific Northwest, helicopters are used to bring the cut trees to lower areas for processing and loading onto trucks.

Trees are harvested as close to Christmas as possible to maintain their freshness. However, trees that are to be shipped long distances may be harvested as early as mid-November. Some Pacific Northwest trees that are shipped overseas may be harvested in October. Trees grown for the choose and cut (or "U-Cut") market are cut down by the purchaser and carried away.

Packing and Shipping Fresh Christmas Trees

Once a tree has been cut, it is put through a baler which wraps netting or twine around the tree, making it more compact and easier to store and ship. Baling machines are either taken into the field where the tree is baled right after cutting or are located at a central processing point. The

trees are then taken to a storage area for protection from the sun. They can be stored in sheds, under shade cloth, or under a tall stand of trees.

Trees are generally shipped by truck. Those to be sold locally may be hauled by flatbed trucks or semi-trailers. Trees shipped long distances may be put into van-like trailers and in some cases, especially when being shipped to warmer climates, in refrigerated trucks. Rail is not a common way of shipping Christmas trees in most parts of the country. Smaller growers may take their trees to larger growers, where they are put into semi-trailers and shipped to market (Rogers).

Marketing

Most Christmas trees are sold either wholesale or direct-marketed through choose and cut operations. The majority of the trees are sold wholesale. Only about 25 percent are sold by choose and cut (Jacob). Choose and cut marketing means that the individual purchasing the tree goes into the field, selects the tree that he or she wants, and saws (cuts) it down.

The majority of Christmas trees that are sold wholesale are sold through buyers to retail chains, charitable organizations, garden nurseries, or to retail Christmas-tree lots. Sometimes, growers find their own markets, establish their niche, and build up their own clientele (Dornbush).

The various state Christmas tree associations maintain lists of growers and their tree varieties to facilitate the grower-buyer relationship. Some also hold trade association meetings where growers and buyers can meet. Larger growers may have their own sellers.

Some growers retail their own Christmas trees by renting lots near urban areas. They transport their trees to these lots and sell them themselves.

Choose and cut operations make up a small portion of the market in the major producing states. In many of the other states, especially in the South and Northeast, choose and cut accounts for a large portion of growers' Christmas tree sales (Jacob). Some growers sell both wholesale and choose and cut.

Flocking Christmas trees--spraying them to look like snow is on the tree--is done at the retail level. Flocking has become less popular in recent years.

The selling of live (potted or balled) Christmas trees makes up only a small portion of Christmas tree sales. In most areas of the country, survivability of live trees after being removed from the house is poor, which reduces the appeal of this practice.

Costs of Production

Unlike many agricultural commodities, Christmas trees require several years from planting to marketing, and a tree planted one year because of its popularity may no longer be popular when it is ready for harvest. The market value of such a tree can be considerably less than the expected return when planted. Thus, the cost of harvest can be an important factor in whether or not a tree will be harvested when it reaches marketable size. Cost of production information may also be useful in offering crop insurance because it can be used to assign values to Christmas trees at various points in the production cycle.

The variable harvest cost for Christmas trees accounts for about 25 to 34 percent of total costs (Table 3). These costs may be so high that the grower in some cases abandons the trees and does not harvest them. In some cases, these trees could be used for lumber or pulp wood.

Production Perils

The major production perils affecting Christmas trees include drought, excessive rain, excessive wind, hail, and fire. Some of the perils may kill the tree, but more typically, the tree's appearance is altered to the extent it is no longer saleable as a Christmas tree.

Excessive Rain and Flooding

Excessive rain and flooding can kill fir trees, whether they are adult trees or seedlings. Other species are more tolerant of excessive moisture conditions, and adult trees can usually survive extended periods of excessive wetness.

Flooding just prior to harvest can muddy the trees, making them unmarketable that season. It is not practical to clean muddy Christmas trees (Ostlund).

Late Spring Frost

Frost is mostly a problem for spruce and fir trees. Frost damage is most likely to occur following a period of early-spring warming that initiates new bud growth. If this warm period is followed by a late frost, the new growth may die. Spruce and fir trees begin new growth earlier in the spring than other Christmas tree species.

Frost is mostly a problem if it occurs during the harvest year. The final growth is sheared slightly differently than previous years' shearings to give the tree a finished look. If the buds die, that year's growth will not occur, and a premium tree will

Table 3--Christmas trees: Variable harvesting costs, selected states

State/Area	Yield	Variable harvest cost	Total cost	Variable harvest, percent of total
	Trees per acre	$/acre	$/acre	Percent
Michigan:				
Scotch pine	750	1025	4030	25
Oregon-Willamette Valley:				
Douglas fir	1350	2098	6249	34

Sources: Cross, Langren, Turner, and Lisec; and Dornbush.

not result that year. The final shearing helps eliminate any holes in the shape of the tree and hides any brown needles in the center of the tree. Holes on the side of a tree reduce the grade of the tree. Although damaged trees cannot be marketed the year of the frost, they usually outgrow the damage and can be marketed in a following year, providing they have not grown beyond saleable height.

In Michigan, growers use irrigation to help protect their fir trees from frost damage. New strains of firs that begin growth later in the spring are now available, diminishing the risk of frost damage.

Heavy frost and extreme cold can kill off young transplants which have been in the field for up to 3 years. Irrigation can be used to protect seedlings from damage, but this is not generally a common practice among Christmas tree growers in most states.

Excessive Winds

Excessive winds, such as accompanying hurricanes and tornadoes, can destroy a stand of mature trees by breaking branches and distorting the trees' symmetrical shapes (Hesslink). Excessive winds may also be a problem after heavy rains for trees that are planted in light soils. The rains loosen the soil and then the winds may cause the trees to slant, or even blow over. Slanting trees and those that have been blown over can be tied up or braced to return them to the upright position. These trees, however, may fail to develop the desired symmetrical, conical shape.

Drought

Newly-planted seedlings are particularly susceptible to drought because they lack an established root system. Extremely dry conditions following planting reduce survivability of the seedlings and may require that the planting be replanted the following year. Trees that have been in the ground for several years have had time to establish more extensive root systems and can, therefore, withstand drought conditions better than newly planted trees. Irrigating the planting diminishes the risks from drought, but most areas of the U.S. do not irrigate Christmas trees.

Drought can stress established trees, slowing their growth and increasing their susceptibility to attack by insects and diseases. Dry conditions also reduce the tree's ability to retain its needles following cutting, and may cause trees to lose their rich green color.

Mature pines and spruces are more tolerant of drought conditions than fir trees. Extremely dry conditions may even kill mature fir trees.

Hail or Freezing Rain

Freezing rain can accumulate on branches, breaking them from the tree. Loss of branches makes a tree less dense, reducing its value as a Christmas tree. Ice on the branches can make a tree unmarketable that season. Icy branches cannot get through a baler, and it is unpractical to de-ice the tree.

Heavy Snow

Heavy snow at harvest-time, like ice, also reduces harvesting efficiency and increases costs. If the snow is high, it is difficult to get the chain saws at the proper level to cut the trees. Snow on the branches must be removed before the tree is baled, which is often unpractical. Also, heavy snows may make roads at higher elevations impassable for trucks to get the trees out of the fields. Some of the larger growers in North Carolina, Oregon, and Washington use helicopters to bring the cut trees out of mountainous areas.

Pollution

Air pollution, particularly sulfur dioxide, ozone, and gaseous fluorides, may injure Christmas trees. Air pollution damage ranges from extreme stunting of growth and death of all or parts of the needles ("chlorotic dwarf") to mild yellowing of the foliage. Air pollution affects all the species of Christmas trees, but is especially a problem for white pines (Brown, Cowen, and Heligmann).

Fire

By nature, conifers are more flame retardant than other trees, and fires usually spread slowly through conifer stands. However, fires still are a great fear to many growers (Scott).

The extent of fire damage to a plantation depends on when a fire occurs. If a fire breaks out after a dry spell it can spread quickly, destroying a field. A large accumulation of dry needles on the ground helps fuel a fire. As a result, fire is more of a problem in the Midwest where dry spells are common than in the Pacific Northwest and eastern states, which have moister climates. Fires that happen after a wet spring are much more containable and not a real threat to a plantation (Scott).

Fires tend to be less common today than they were 15 to 20 years ago. Better management techniques, including the elimination of vegetation and debris around the trees, help keep fires to a minimum. Also, most plantations, except those in very mountainous areas, are broken up with roads to enable trucks to pass. These roads help prevent fire from spreading from field to field and they also allow fire equipment to get to the fire more easily. However, when a fire does happen, it is either fatal to the tree or ruins the needles and kills the buds, making it unmarketable.

Animal Pests

Animals, both domesticated and wild, may damage Christmas trees. Larger animals, such as deer or cattle, eat the tips, trample seedlings, and damage the branches by rubbing. Broken branches can disfigure a tree, making it less marketable. Fencing helps reduce losses caused by large animals.

Smaller animals, such as mice and gophers, eat the stems and roots of young trees. Control of weeds and grasses is essential for reducing small animal populations.

Insects

Insects and mites are the most common Christmas tree pests. When abundant, insects may cause costly injury at various times in a tree's life cycle. Seedlings and young trees are especially susceptible because it takes only a few insects to injure or kill them. Insects damage Christmas trees in many ways. They may chew on or inside the needles or tunnel inside the shoots and trunk. They may suck sap from the needles, buds, or stems, which can weaken or kill the tree. They can also cause galls (swellings) to form, and can spread diseases directly or indirectly by feeding (USDA, Forest Service).

Balsam Wooly Adelgid (*adelges piceae*) forms as white cottony tufts on the undersides of branches or on trunks about the time new growth begins in the spring. The adelgid causes swollen knobs on the tree and distorts the tops and branches. Insecticidal sprays can be used to control the insect. It affects mostly Fraser, grand, and noble firs, with Fraser firs the most susceptible.

Balsam Twig Aphids is a small greenish aphid located on the tops or along the branches of a tree. The aphid secretes a honeydew- type substance and causes twisting, stunting, or matting of new growth. Spraying insecticides can help control the aphids. Grand firs are especially susceptible to the balsam twig aphid.

Bow-legged Fir Aphid is a large, shiny, black aphid that forms in colonies on the main stem of the tree in early spring. The honeydew secreted by this aphid causes a black sooty mold to form, but it generally does not cause serious damage. The aphid can be controlled with insecticidal sprays. The bow-legged fir aphid attacks all varieties of fir.

True Fir Aphids tend to concentrate on the interior of the lower crowns. The honeydew secreted by this aphid causes a black sooty mold, which diminishes the tree's value if present within 2 to 3 years of harvest. Grand, noble, and Fraser fir are most susceptible to this aphid.

Root Weevil

Root weevil damage becomes noticeable in early spring. The adult weevil emerges during May and June, and feeds at night. The feeding damage caused by the adult weevil, however, is minor. The greater damage is caused by the larvae, which are in the soil and feed on the roots, causing trees to yellow. Root weevil attacks all species of firs.

Pales Weevil (*Hylobius pales*)

Pales weevil affects young pine plantations. Adult weevils are attracted by the odor of fresh resin, which is found in recently cut-over areas that have been newly planted. They feed on the living inner bark of residual stumps and newly-planted seedlings. Feeding wounds may girdle the seedlings, causing wilting and eventually killing the tree (Webb).

Silver Spotted Tiger Moth

Silver spotted tiger moth damage occurs when clusters of caterpillar larvae feed on branches in scattered individual trees. The damage begins in the late fall, but does not become noticeable until early the next spring. Damage is minor, mostly affecting the appearance of the tree. Spot spraying eliminates the pest. All species of fir are susceptible to this moth.

Pine Tip Moth (*Rhyacionia* spp.)

Pine tip moths deposit their eggs on the needles and buds of trees. The eggs hatch in the spring, and the larvae bore into the base of developing needles and into the terminal growth or buds, causing the tips of the branches to die. Spraying can control the moth. Pine tip moths affect Virginia, sand, and spruce pines, especially the young trees (Webb).

Mite

Mite damage is usually characterized by a chlorotic or "blond" appearance of the tree's foliage. Mite populations may increase rapidly during the cool, moist conditions of early spring (Webb). Spraying and natural predators are used to control mites.

Spider Mites

Spider mites first appear in early spring and are present throughout the summer. They damage the tree's leader and upper whorls. The damage becomes evident in late summer. Spider mites are mostly a problem for fir and spruce trees.

Eriophyid Mites

Eriophyid mites may make branch tips appear "fuzzy" before bud break if the population is high. The mites feed on the buds and needles of the tree, causing the foliage to discolor and become distorted. Heavy attacks degrade Christmas trees. They can be controlled by natural predators. The mites affect Scotch, Austrian, red and white pines, and most fir species.

Bagworms (*Thyridopteryx ephemeraeformis*)

Bagworm larvae strip the needles and form cocoons, which hang from infected branches. Even minor infestations may result in spotty defoliation. Bagworm cocoons need to be removed and burned. Spraying with an appropriate insecticide helps control this insect. Bagworms are mainly a problem with pines and red cedar, but also attack other species (Webb).

Pine Webworm (*Tetralopha robustella*)

Pine webworm larvae form brownish webs in the late spring, which encase the twigs, including the base of adjacent needles. Localized defoliation may occur, and although small seedlings do not usually die, early growth may be retarded (Webb).

Scales

Scales, especially the pine tortoise scale, secrete sugary excretions which promote sooty mold development. They are a problem mainly with southern pines (Webb).

Balsam Gall Midge

The balsam gall midge larvae cause small galls, or globe-like swellings, to form on needles. These needles then drop prematurely, decreasing the value of the tree. Injured trees, however, can recover if they are not infested again for 3 or 4 years. The midges are a problem for balsam and Fraser firs.

Pine Shoot Beetle

The pine shoot beetle bores into the stems of pine trees, killing branches. The larvae feed inside the stem and kill the leader. There is no effective spray for pine shoot beetles. Infected trees must be burned for control.

Diseases

Foliage blights are fungal diseases which may result in death and premature shedding of the needles (blighting), often referred to as needle cast diseases. Other symptoms include abnormal swellings, galls or leaf curls, discoloration, crooks, wilting, and cankers. These diseases can render the infected tree unfit for sale or may kill the tree. Root rot diseases, also caused by fungi, infect the roots of Christmas trees and can kill the tree.

Needle Necrosis

Needle necrosis creates tan-colored bands across needles in June and July. The entire needle may turn coppery red later in the summer, and some needles may drop. The remaining discolored needles make the tree unsalable. The disease is more of a problem for certain seed sources of grand and noble firs than for others. Since the needles may grow back in subsequent years, the damage from the disease is mostly to trees that are ready for harvest (Langren and Douglass).

Grovesiella Canker

Grovesiella canker is found on the trunks and lower stems of young trees. It appears as small, black fruiting bodies which may be on the surface of cankers. The canker can girdle the tree branches or the entire tree, and may kill part or all of the tree. The stem diameter often is enlarged above the infection. There is no known cure. Although it affects all firs, the concolor (or white), Shasta, noble, and grand fir are the most susceptible.

Interior Needle Blight

Interior needle blight attacks all species of fir and causes the interior needles of the tree to turn brown. The damage is most evident in the fall, when it is time to harvest. The discolored needles remain firmly attached, diminishing the tree's attractiveness. On noble fir, the blight is associated with the fungus *Mycosphaerella*. Pruning to improve air circulation helps to control the fungus.

True Fir Rusts

True fir rusts are tube-like, fruiting bodies found on the lower sides of needles in late spring and early summer. If the infection is severe enough, it will cause needle drop. Grand and Shasta firs are especially susceptible to the rust. Bracken fern and huckleberry are alternate hosts to the rust.

Control involves removing alternate hosts within 1,000 feet of the trees. Fungicides also can partially control an infestation (Langren and Douglass).

Coleosporium Needle Rust

Coleosporium needle rust appears in the spring as small, pinkish-white ridges on pine needles. The ridges are reproductive structures of the *Coleosporium* fungi, which infect and kill developing needles. Most damage is temporary, however, because these needles are shed and replaced by new ones. Evidence of the disease is usually gone when trees are harvested for sale in the fall. It affects sand, spruce, and Virginia pine needles.

Brown Spot

Brown spot is caused by the fungus *Scirrhia aciciola*, and appears as small, yellowish-brown lesions on needles. If the infection is severe, diseased needle tissue may die and dead needles are cast, resulting in sparse foliage. Dead needles continue to produce spores, which sustain the disease on the same and nearby trees. Brown spot should be chemically controlled to avoid progressive losses of trees in the plantation. Brown spot is mostly a problem on Virginia pine (Webb).

Cercospora Needle Blight

Cercospora needle blight is caused by the fungus *Cercospora sequoiae*. The fungus infects and kills the oldest and youngest foliage first. It develops upwardly and results in a progressive shedding of the lower foliage. It affects the Eastern red cedar, and can ruin the tree for sale.

Phomopsis Needle Blight

Phomopsis needle blight is caused by the fungus *Phomopsis juniporova*. As the blight develops, young needles starting in the upper crown die and are shed. It affects the Eastern red cedar and the Arizona cypress, and may ruin the tree for sale (Webb).

Cronartium Rust

Cronartium rust is a fungus causing swellings on the stems and branches of sand, spruce, and Virginia pine. The fungus may eventually constrict host tissue and kill needles and twigs.

Pruning the affected portions as soon as the disease is recognized controls its spread.

Pitch Canker

Pitch canker is caused by *Fusarium subglutinans* fungus. If the infection starts at the trunk, it spreads rapidly and kills the tree. It can also attack branches, causing the needles to discolor and fall off. After the branches die, cankers weeping with resin appear (Storer, Gordon, Dallara, and Wood). Spores of the fungus are spread by wind to susceptible hosts and are very contagious. Careful pruning is the only current control as early infection must be removed to preserve acceptable tree shape. It affects many species of pine and Douglas fir.

Root Rot

Root rot diseases affect many species of pine, spruce, and fir. Root rot is caused by fungi which infect the roots of the tree, possibly killing the tree. The reproductive structures of these fungi resemble mushrooms and may appear at the base of the stem or occur on the surface of the surrounding soil. After the infected trees have died or are harvested, the root systems should be dug up and discarded to retard spread of the disease to surrounding trees (Webb).

Phytophthora Root Rot

The symptoms of Phytophthora root rot are obvious year round. Faded trees, dead and dying branches, and reduced growth are all evidence of the root rot. Cankers are generally visible only by peeling bark from the base of the trunk. Wet areas promote the disease. Infected trees need to be cut and destroyed. This disease attacks all true firs, but Shasta, white, noble, and Fraser are the most susceptible. Grand fir and Nordmann are the least susceptible to the rot (Langren and Douglass).

Physiological Disorders

Sunburn

Sunburn is a problem in the Pacific Northwest, where the sky can be overcast until early July. If the weather abruptly turns sunny, dry, and warm, needles may burn and drop off. This is especially a problem among the firs, which are very susceptible to climatic conditions. Sunburn is really only a problem for harvestable trees. Younger trees have time to replace dropped needles.

Weeds

Weed control is essential for growing premium Christmas trees. Weeds compete with young seedlings for nutrients and moisture. If not controlled, weeds can kill seedlings by competing for light and moisture. Weeds also harbor insects and pests which can disfigure and even kill adult trees as well as seedlings. Weeds can be controlled with a combination of mowing between the trees and by using herbicides.

Michigan

Michigan ranked second to Oregon in the number of Christmas trees harvested in 1994. The major varieties grown in Michigan include Scotch pine, Douglas fir, Fraser fir, concolor fir, blue spruce, white spruce, and balsam fir. Balsam fir is the only one of these varieties native to the area.

Christmas tree farms are located in every county in Michigan. The sizes of the farms average from 5 acres to about 3,000 acres. Farms often grow more than one species. Production is concentrated near the Great Lakes, because the Lake effects moderate temperatures during the spring and summer. Moderate temperatures are especially important for growing fir trees.

Most seedlings planted in Michigan are 2-2 seedlings, meaning that they are raised for 2 years in a seedbed and for 2 years in a transplant bed. Once planted in the field, it takes 7 to 10 years, on average, for the trees to reach maturity.

Scotch pine is the most widely grown species of Christmas tree in Michigan. However, the popularity of fir trees is growing quickly. A number of growers use irrigation to help provide suitable conditions for sensitive firs. Also, growers are planting varieties of fir bred to bud later in the spring. These late-budding trees are less susceptible to injury caused by late spring frosts.

Marketing

The majority of the trees harvested in Michigan are sold out of state. Of the 4.2 million trees harvested in 1994 in Michigan, only 1 million were estimated as sold in Michigan (Dornbush). The majority of the trees are sold wholesale. Most of the growers find their own market, building up a clientele over the years. Choose and cut operations are also popular in Michigan, with some growers selling their trees both wholesale and by choose and cut.

Some Christmas tree growers sell balled or potted trees to the nursery industry. Consumers can transplant these trees after the Christmas season is over. The blue spruce is the most popular variety sold for later transplanting by consumers. Locally, it has the best survivability rate of all the varieties. White pine, Fraser fir, and Austrian pine are also sold in this manner. Trees sold for later transplanting, however, account for a small portion of total sales.

Production Perils

For Scotch pines in Michigan, the major perils are diseases and insects. Mature Scotch pine are fairly tolerant of weather extremes, including droughts and excessive rain.

Fir trees are very susceptible to drought and heavy rains. Since many of the fir growers use irrigation, drought has become less of a problem in recent years. Rains, however, continue to cause problems for fir producers. Fir trees, especially the Fraser fir, are very moisture sensitive and too much rain can cause the quality of the tree to deteriorate. Also, very heavy rains that cause flood conditions can drown even adult fir trees.

Because growers are planting later-budding varieties, frost damage to firs has been less of a problem than in the past. Most fir growers irrigate their trees, and the irrigation can be used to protect the trees under heavy frost conditions.

Demand for Crop Insurance

Crop insurance would probably be less appealing to pine tree growers than to fir tree growers because pine trees are very tolerant of most extreme weather conditions. Also, because pines are not premium, high-value Christmas trees, growers tend to put less money into their production.

In contrast, fir tree growers may find crop insurance more appealing. While a number of fir tree growers use improved management practices to reduce the risks associated with harsh weather conditions, destruction to fields still occurs. For example, very heavy rains in June 1994 drowned mature as well as seedling firs in parts of the state (Dornbush). Fir growers also put more money and time into production than do pine tree growers. Losses due to natural disasters could provide them with greater financial hardship, especially if mature trees are affected.

North Carolina

North Carolina had the third-largest Christmas tree harvest in 1994. The major Christmas tree variety grown in North Carolina is the Fraser fir, which is indigenous to the North Carolina mountains. The Fraser fir needs an elevation of at least 3,000 feet to grow. At present, North Carolina is the number-one producer of Fraser fir, which accounts for about 90 percent of the state's Christmas tree harvest. Other varieties include white pine and blue spruce.

The majority of the state's producers are not full-time Christmas tree growers. The average size plantation ranges from 5 acres up to a couple of hundred acres. Full-time producers are more likely to have the larger plantations.

In North Carolina, it takes about 12 years from seed for the Fraser fir to reach maturity. Most growers plant 3-0 seedlings, which refers to 3-year-old nursery seedlings that are planted directly into the field, without going into a transplant bed first.

Marketing

The majority of Fraser firs are sold wholesale through brokers. Trees are shipped throughout the United States, with the majority destined for East Coast points, particularly the Southeast. Fraser firs ship well, unlike the pines which are sold locally. There was a strong demand for Fraser firs in 1994 and some growers cut trees intended for the 1995 harvest. This may create a shortage in the availability of 6-to-8 feet size Fraser fir trees in 1995. Choose and cut operations account for only a small share of the state's harvest.

Production Perils

The major perils to Christmas tree production in North Carolina are frost, drought, flood, *Phytophthora* root rot, and balsam wooly adelgid. Fire is not much of a problem in North Carolina, with the last fire occurring about 20 years ago (Thiel). Plantations are designed to allow trucks easy entry, enabling fires to be contained. Also conifers do not burn as easily as do deciduous trees.

Late spring frosts can damage transplants if the frost hits after buds have started to grow in the spring. Severe drought can kill seedlings and reduce market value by causing needles to turn yellow and drop off. Severe flooding, even at elevations over 3,000 feet, can kill the trees.

Phytophthora is especially a problem in wetter areas. Producers may be unaware that their trees are infected until the trees turn brown and die. The disease is very contagious.

Balsam wooly adelgid does not kill the trees, but disfigures them and make them less marketable.

Producer Associations

The North Carolina Christmas Tree Association maintains a buy-sell directory to help growers market their Christmas trees.

Demand for Crop Insurance

The director of the North Carolina Christmas Tree Association seemed very excited about the idea of crop insurance for Christmas trees. The state has experience periods of drought, flood, and frost conditions that have caused yield losses and reduced the marketability of its Christmas trees. With the state's dominance in the very popular Fraser fir market, some producers may see crop insurance as a means of protecting a high-value crop.

Pennsylvania

Pennsylvania ranks among the top-six Christmas tree producing states. The major producing counties are Columbia, Schuylkill, and Indiana. The most popular trees grown are Douglas fir, Fraser fir, Scotch pine, Colorado blue spruce, Norway spruce, white pine and Austrian pine.

Farms range in size from about 2 acres up to 500 acres. The average size is estimated to be between 50 and 100 acres. It was estimated that, in 1985, 15 percent of the growers produced 85 percent of the trees. Christmas tree production is the primary source of income for only about 10 percent of the growers. Many growers produce trees to supplement other employment or retirement income (Finley, Nelson).

Pine trees are planted as 1-0 or 2-0 seedlings, while Douglas fir are planted as 2-2 or 2-3 seedlings. It takes both the pine and the Douglas fir five to ten years from the time of planting in the field to reach harvestable age. Spruces, firs, and Douglas fir are planted at about a 5 feet spacing within rows, in rows that are 5 to 7 feet apart. Pines are planted with 6 feet spacings, in rows that are 6 to 7 feet apart.

All the varieties grown in Pennsylvania need at least moderately well-drained soil. Although Christmas trees do not need very much fertilization in Pennsylvania, fertilizers may enhance the tree's color, especially of the spruce and Douglas fir varieties. Fertilizers, however, also promote weed growth, a major competitor of seedlings for water and sunlight. Growers use herbicides and/or mowing to control weeds.

Growers typically start shearing pines beginning in the plant's second or third year in the field. Shearing begins in the fifth year for the other varieties.

Marketing

The majority of Pennsylvania's Christmas trees are marketed wholesale. Growers make contacts with buyers or brokers who purchase the trees and sell them to chain stores, garden centers,or on Christmas tree lots. The Pennsylvania Christmas Tree Growers Association often acts as a contact between growers and brokers. Choose and cut operations, while still in the minority in Pennsylvania, are growing in popularity. A few growers rent lots and retail their own trees.

Production Perils

The major perils for Christmas tree production in Pennsylvania include drought, ice storms, weeds, insects, and diseases. Droughts in 1988 and 1990 reportedly caused high losses among young Christmas trees in Pennsylvania. Pennsylvania occasionally has hail or ice storms that leave a layer of ice on tree branches, causing the branches to break off, and making them unsalable.

The major insect pests in Pennsylvania are adelgid, white pine weevil, and scales. Diseases include needle cast, root rot, tip blight, and sooty mildew fungi.

Producer Associations

The Pennsylvania Christmas Tree Association helps producers market their trees by maintaining a list of producers and the varieties of trees they produce, and circulates the listing to buyers.

Demand for Insurance

The director of the Pennsylvania Christmas Tree Growers Association felt there would be a good deal of demand for crop insurance. She mentioned the 1988 and 1990 droughts which killed off many seedlings, and felt that producers would benefit from insurance (Nelson).

The state forester, however, was more skeptical. He mentioned that producers do not like to spend a lot of money for Christmas tree production, especially those who do it as a secondary source of income. He did, however, mention that a few growers did apply for disaster assistance after the 1988 drought (Finley).

Pacific Northwest (Oregon and Washington)

Oregon is the number-one Christmas tree producer in the United States, accounting for an estimated 22 percent of the

Christmas trees harvested in 1994 (Pacific Northwest Christmas Tree Association). Washington ranked fifth in 1994, harvesting about 10 percent of the total number of trees. The major producing counties in Oregon are Benton, Clackamas, Marion, Polk, and Yamhill. In Washington, the top producers are Kitsap, Lewis, Mason, and Thurston counties. Farm sizes range from 1 to 6,000 acres.

In the Pacific Northwest, the most widely-grown variety of Christmas tree is Douglas fir. It accounts for over half of the production. Other widely-grown varieties include noble fir, grand fir, and pines.

Most planting is done in the spring, although a small number of trees are planted in the fall. Douglas fir, planted as 1-1 seedlings, typically reach marketable size in about 7 years (from seed). Pines and grand fir take about 8 years total, and noble firs, 9 years. Trees that exceed 8 feet in height may be abandoned, or they may be harvested for timber at a later date.

Douglas fir and Scotch pine are sheared by knife. Firs other than Douglas fir are shaped using hand clippers. Shaping is done annually, sometimes twice a year, to touch up the shape of the tree.

Both Oregon and Washington are net exporters of Christmas trees. Trees are shipped throughout the United States, and some are exported, mostly to Asia. Trees shipped within the continental U.S. are harvested around the middle of November. They may be shipped in open-bed trucks or in enclosed refrigerated containers. Trees destined for foreign markets may be harvested as early as October.

Marketing

The major growers may have their own sales staff, but smaller growers sell through brokers or the Pacific Northwest Christmas Tree Association. The Association provides a list of sellers and distributes the list nationally. Buyers and growers also make contacts at association trade shows and meetings. About 90 percent of the harvest is exported out of the Pacific Northwest (Pacific Northwest Christmas Tree Association). Locally, growers sell to retail stores, at local Christmas tree lots, and by choose and cut. Although choose and cut sales are increasing, this method accounts for a small share of total sales.

Production Perils

Major perils affecting Christmas tree production in the Pacific Northwest include snow at harvest, freezing rain, flooding, sunburn, insects, and diseases.

Snow is most serious at harvest-time. It slows down harvest operations and interferes with hauling trees from the plantation. Some large farms use helicopters to move cut trees from the fields to an assembly point.

Sunburn also can damage trees. If warm, dry air follows after long, cloudy periods, the needles, which are very sensitive to sun, can burn and drop off. Sunburn is mostly a problem for

trees that have reached harvestable size, since it makes them unmarketable. Sunburn is less of a problem with smaller trees because they have time to out-grow the sunburn damage before they are large enough to cut.

Major insect pests include the European pine shoot moth and pine shoot beetle.

Demand for Insurance

Growers in both Oregon and Washington are likely to be interested in purchasing multiple-peril crop insurance for their Christmas trees. A number of growers depend on Christmas trees for their principal livelihood, and the loss of production due to weather conditions at harvest-time has serious financial impacts. In addition, a disaster can diminish a grower's income for a several years because of the long time required for a tree to reach marketable size.

Virginia

The most commonly-grown Christmas trees in Virginia are white pine, Fraser fir, Scotch pine, Norway spruce, blue spruce, and Douglas fir. Pines are produced throughout Virginia, but grow the best in the piedmont and mountain areas. Spruces are adaptable and can grow well anywhere in the state. Firs can only grow well in the mountain areas, where the elevation is 2,000 feet or higher.

All of Virginia's Christmas trees are produced on plantations; wild-grown trees are not harvested commercially.

Land is prepared for planting by tilling or spraying herbicides to control weeds. Seedlings are planted in rows; the spacing varies by species. Seedlings are usually 2 to 3 years old for pines, and between 3 and 5 years old for spruces and firs. Some producers plant new trees next to the stumps of cut trees in order to utilize their land more fully. These producers may spray the stumps with a pesticides to eliminate any insects lingering from the cut tree. Other producers may not plant until all the trees have been harvested, or may even let the field stand idle for 2 or 3 years before replanting, especially if they have a serious insect problem. Harvesting may extend over several years, as all trees do not reach marketable size in the same year.

Scotch pines do not grow as well in Virginia as some other species, and have a lower survival rate. Fir trees require

more management than the others. They need more fertilization and require more stringent insect monitoring.

Christmas tree production is mostly a part-time activity in Virginia for producers who want to supplement non-farm or retirement income. Most operations are 20 acres or less. There are, however, a few larger Christmas tree operations.

Pines are usually harvested at 7 to 10 years of age, when they reach 6-to-7 feet in height. Firs and spruces grow more slowly and reach harvestable size in 9 to 12 years (Kreh). On average, 75 percent of the white pines will be marketable from a well-maintained stand that averages 1,000 trees to an acre. Marketability averages about 60 percent for Scotch pines, 75-80 percent for spruces, and 80 percent for firs (Kreh). Harvesting usually begins in early November and continues until near Christmas day.

Marketing

Choose-and-cut accounts for a large share of the Christmas tree sales in Virginia, but a number of trees also are marketed wholesale. Most of the wholesale producers are located in the mountain regions of Virginia. The choose-and-cut operations tend to be located within easy driving distance from population centers.

Some growers rent lots in more populated areas and retail their trees themselves. The Virginia Christmas Tree Association puts together a sellers list that details the availability of trees for potential buyers. Fraser fir producers have their own organization by which they identify sellers.

When there is a glut of trees on the market or if a particular species becomes unpopular, it is not uncommon for a grower to abandon these trees. Some may allow white pine trees to continue to grow for lumber. White pine trees are ready for use as lumber in about 30 years. The other Christmas tree species are not suitable lumber trees in Virginia. A very small number of trees may be sold to nurseries.

Production Perils

Late frosts and drought are the major production perils in Virginia. Both may damage or destroy trees. The major insect perils are aphids, adelgids, root rot, and weevils. White pine trees are especially susceptible to these problems.

Scotch pines are susceptible to eastern rust gall and needle cast diseases.

Producer Associations

The Virginia Christmas Tree Growers Association publishes an annual sellers list.

Demand for Crop Insurance

The demand for crop insurance for Christmas trees in Virginia is likely to be relative minimal. Christmas tree returns are supplemental income for most growers and losses may not represent a substantial part of total income. Most growers operate on a low-cost budget, and although they have put substantial amounts of labor into the enterprise, they may have invested a relatively small amount in direct expenses.

The Secretary-Treasurer of the Virginia Christmas Tree Growers Association indicated that not very many producers would be willing to spend the money for Christmas tree insurance. She also pointed out that she was not aware of many growers filling out the necessary forms to get disaster assistance after the 1988 drought, even though many would have qualified (Ward).

Christmas Tree Insurance Implementation Issues

Many of the individuals contacted for this study implied that crop insurance would be mostly an issue for mature Christmas trees. First, costs during the early stages of production are minimal compared with the costs of producing the adult tree. Second, younger trees can sometimes outgrow damage, such as needle or branch loss, by the time the tree is ready to be marketed.

Tree Assistance Program

Some disaster assistance has been available for Christmas tree producers. The Disaster Assistance Act of 1988 included forest crops under coverage for losses due to the 1988 drought. In response to the law, USDA established the Tree Assistance Program (TAP). TAP provides cost-share payments to commercial tree and nursery growers who incurred losses due to damaging weather conditions (USDA-Farm Service Agency, Farm Program Fact Sheet). Initially, the program provided relief only for losses due to drought, but in recent years has extended coverage to also include freezes, excessive rainfall, floods, tornado, and earthquakes. Under the 1994 Crop Insurance Reform Act, the Non-insured Assistance Program is expected to replace TAP.

The objective of the program was to reimburse part of the replanting or rehabilitation costs for small-and-medium-scale commercial tree growers. Once a region's losses exceed 35 percent above normal mortality, the program covers 65 percent

of the cost of replanting. TAP, however, only covered seedlings up to two years old. (For a complete description of the program and participation by Christmas tree producers, see Appendix 2.)

The data for the 1992 TAP program indicate that not many Christmas tree producers participated in the program in that year. While this may be an indication of willingness to participate in a similar program such as crop insurance, many producers may not have participated because they were unaware of the program.

Adverse Selection

The species and variety need to be adapted to the climate and soils of the production area in order to result in a premium-quality Christmas tree. Even different seed sources can make a difference in determining the marketability of a tree. Certain species of Christmas trees, such as the pines, are more hardy and can grow in most environments and soils. However, even among the pines, some varieties are more suitable for certain locations than others. Other species are more sensitive to environmental factors and poor selection of variety for a site can affect its survivability. This is especially important for fir trees, the most sensitive Christmas tree species.

The history of the field and surrounding area can also make the difference between success and failure in production. Pests that exist in the field where trees are to be planted or in nearby wooded areas can easily attack the Christmas trees. Also, certain shrubs and bushes act as alternate hosts to some pests, such as the fungus that causes true fir rust. The presence of these pests or their hosts in a Christmas tree field could predispose the trees to damage. Infested areas may need to be treated for pests, host plants removed, and varieties selected that can withstand injury or are resistant to existing pests.

With an insurance policy in place, a producer may be more likely to select a poorly-adapted species for a given field. Damage to a tree caused by adverse selection, however, would probably be most serious for seedlings, which would grow poorly or become infected early in the tree's life.

Setting Reference Prices

The reference price should probably represent the in-field value of the trees because expenses are incurred as the tree

progresses in the production cycle. The location of the plantation is a major factor determining the in-field value. Trees in the South can reach a salable size in as little as four years, while in northern states, it may take 10 to 12 years for a tree to grow to salable size. Producers in the northern states, therefore, incur higher costs to get their trees to harvest.

Variety also is a factor in determining the in-field value of a tree. Labor expenses, a major component of production costs,

differ considerably among varieties. Pines require more shearing to achieve the desired Christmas tree shape than do firs or spruces, increasing the cost of producing pine trees.

The method of sale may have an important effect on the value of the tree. Trees to be sold wholesale may have a lower value than ones to be sold retail, such as in a choose-and-cut operation (Scott).

In the few cases where private insurance coverage has been provided against Christmas tree losses, the value of the damaged trees has been based on the expenses invested in the tree at the time of loss by averaging the first 2 years of production, the last 2 years of production, and then those in the middle. Growers have been required to provide actual direct costs when filing (Hesslink). (For further discussion of private insurance, see "Demand for Insurance" section).

Market Prices and APH Distortions

Market price may affect the number of trees a producer harvests in a given year. Trees that are around the height of maturity may be kept in the field a year longer or harvested a year earlier, depending on the prevailing market price. If prices are low in a given year, less than perfect trees may be left unharvested. Fields of an unpopular species may be abandoned.

Estimating "Appraised Production"

Appraised production for Christmas trees (unharvested, but potential production at the time of the appraisal) could be estimated by counting the number of salvageable trees in a sample of plots and expanding the plot yields to an acre or plantation basis. For damaged trees which have not yet reached marketable size, a judgment would be needed about whether they could be reasonably expected to outgrow the damage by the time they reached harvestable size. In addition, a decision would have to be made about whether enough salvageable trees remained in the planting to justify maintaining the field rather than destroying all the trees and starting over with a new planting.

Insuring Price Risk

In response to the uncertainty and the long-term commitment needed for Christmas tree production, producers may be interested in an insurance plan to protect against revenue losses due to low market prices.

Many of the contacts identified low market prices as a considerable risk in Christmas tree production. Trees are planted anywhere from 4 to 12 years before they are ready to be harvested. During this period, the demand for a certain species may decline, causing prices to fall below the producer's expectations when the trees were planted. A producer may, in fact, decide to abandon all or part of the crop if prices are too low to cover harvesting and marketing expenses. Sometimes, abandoned Christmas trees may be grown out for timber, but most species are poorly adapted for timber production.

Market Prices and Moral Hazard

The presence of insurance could create a moral hazard if a grower plants the wrong species in the wrong location, knowing it will not survive or be marketable in that environment and then claiming losses (Mangold). Moral hazard would also be an issue if a producer knowingly neglects a crop because of low market prices.

Some part-time growers do not know much about producing and selling Christmas trees when they first enter the business and may become disenchanted once they see what is required to grow premium trees. After a couple of years, they may neglect the crop by not controlling weeds and other pests or neglecting proper pruning and shaping. The planting, consequently, slowly declines and many or all of the trees become unmarketable.

Availability of Individual Yield Data

We were unable to locate any records on the yields of individual growers. The number of trees ready for harvest in any given year depends on how rapidly the trees have grown and the demand for the trees. For example, the demand for Fraser fir is so high that producers in North Carolina were harvesting trees in 1994 that they expected to cut for the 1995 harvest (Thiel). Therefore, their yield for 1994 was higher than even the producers expected. In the future, their yields may decline as other states increase their production of Fraser firs and demand for the trees from North Carolina declines.

Another factor in determining yield is that not all trees planted in a field are harvested at the same time. Some trees may be harvested before they reach their prime height of 6 to 7 feet, while some may be left to grow taller to meet other market niches.

Demand for Insurance

Our assessment is that Christmas trees are a good candidate for crop insurance. There is likely to be a substantial amount of interest in purchasing insurance, particularly among the larger producers in the Pacific Northwest and northern states. Smaller, part-time producers, who typically grow Christmas trees for supplemental income, tend to operate on a low-cost budget, and may not want to pay the added cost of insurance. Such producers may not need insurance for risk management as much as full-time growers because of the presence of off-farm income.

Two contacts mentioned that insurance had been offered about 20 years ago by a private company. It covered natural disasters such as fire, hail, and winds. However, the insurance was too costly for most producers and the company felt it was too risky (Scott).

The National Christmas Tree Association (NCTA) Insurance Representative has written 3 policies on growing trees. The policies have a $1,000 deductible and cover $0.52 on every $100 of liability. They cover fire, lightening, wind, and hail. These policies were written to enable producers to meet bank demand for insurance before lending growers money to purchase the land for growing trees. Most of the other policies he has written for Christmas tree producers cover property--buildings and equipment, and liability--injury to workers and buyers in choose and cut operations.

Producers may also be interested in crop insurance because of the long-term investment in growing Christmas trees. Many things can happen between when trees are planted and when they are harvested and insurance can help alleviate some of the uncertainty.

Finally, the National Christmas Tree Association leaders and many of the state association leaders were very enthusiastic about the idea of crop insurance for their growers and believed their growers, especially the larger ones, would be interested in the new program.

Defining "Areas" for the Non-Insured Assistance Program

The Non-insured Assistance program (NAP) of the 1994 Crop Insurance Reform Act covers crops that are not currently insured by FCIC--including Christmas trees--until the development of an insurance policy. Under NAP, an "area" must incur at least a 35-percent yield loss in order to trigger

assistance payments. The definition of "areas" for purposes of calculating "area average yield" may determine whether or not growers with a qualifying yield loss (50 percent or greater of the individual average) are eligible for NAP payments.

Defining "area average yields" along county boundaries could create inequities in deciding whether growers qualify for disaster payments. Not all growers in a county may have the same damage due to disasters such as fire, excessive wind, late spring frosts, and flood. A fire may hit only one field or plantation, leaving others in the county unaffected. A tornado or hurricane may pull trees from the ground in one area of a county but not another. A late frost may hit a stand in the higher elevations, but not the low-lying areas in the same county. Flooding may affect lower elevations, but have less effect in higher elevations within the same county. Other major disasters, such as drought, hail, and snow would have similar effects throughout a county.

For Christmas tree production, "area average yields" may be better defined if elevation as well as county boundaries are taken into consideration. Fire damage needs to be based on an even more limited basis.

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