Crop Profile for
Christmas Trees Production Piedmont/Coastal Plain in
North Carolina

Prepared: January 1999
Revised: January 2015

www.southeastdiscovery.com/

General Production Information

Marketing Statistics (as of 2013 estimates):

✓ Choose-and-cut trees sold: 12,853
✓ Choose-and-cut acres in production: 240
✓ Value of choose-and-cut trees sold: $373,580
✓ Number of growers: 50 (basis for the estimates of all values)
✓ Total foot traffic at choose-and-cut operations: 116,024

Production Regions

The eastern growing area for Christmas trees starts as far west as Rowan and Forsythe counties and as far east as Hertford and Carteret counties. The primary eastern production areas are in Chatham, Harnett, Pitt, Wake, and Wayne where choose-and-cut operations are most common. Other counties that have a few producers are Cumberland, Duplin, Granville, Guilford, Johnston,
Lee, Moore, Onslow, Randolph, Rockingham, and Person. Species produced in the eastern part of North Carolina include the following:

*Abies balsamea* var. *phanerolepis*, Canaan fir
*Abies concolor*, white or concolor fir
*Callitropsis ×leylandii*, Leyland cypress, including Irish Mint™
*Chamaecyparis thyloides*, Atlantic white cedar
*Juniperus virginiana*, eastern redcedar
*Picea abies*, Norway spruce
*Picea pungens*, Colorado spruce
*Pinus strobus*, eastern white pine
*Pinus sylvestris*, Scotch pine
*Pinus virginiana*, Virginia pine
*Thuja plicata* ‘Green Giant’, Green Giant western arborvitae

Because the growing conditions in the mountains and eastern half of North Carolina are so different, there are two distinct profiles to address the different cultural requirements, pest problems, and environmental issues.

**Production Practices**

Christmas tree plantations east of the mountains are typically small and grow a mixture of tree species. Most growers tend to be part-time, and have often converted tobacco or soybean fields to Christmas tree production. Good site selection and proper preparation are critical to successful harvest of Christmas trees. Careful planning and layout of fields can help reduce pest pressure and harvesting costs.

Soil characteristics are the primary consideration when assessing a site’s appropriateness for growing Christmas trees. Taking soil samples is the first step in determining suitability. Growers should assess the physical and textural characteristics of the soil to ensure that the soil drains well and has sufficient fertility and water-holding capacity.

The microclimate of a site determines the risk of freeze damage to buds or new growth. Trees growing on warmer south- or southwest- facing slopes may break bud up to two weeks earlier than those grown on cooler north- facing slopes. Late hard freezes leading to early budbreak can cost an entire year’s growth. Because cold air “drains” poorly from flat land, the risk of frost damage can be compounded.
Choose species based primarily on regional climate. Many species grown in eastern North Carolina, such as Virginia pine and Arizona cypress, are primarily marketed through local choose-and-cut markets. The grower should consider the following prior to selecting species:

1. Is there a relatively stable market for these species?
2. Can I grow these species on the land available?
3. Are there special problems with growing these species?

Choosing the right species and implementing sound site preparation techniques can lead to a successful and economically viable Christmas tree plantation.

Once site preparation is complete and the species selected, planting can begin. Growers should select only the highest quality planting stock. Healthy seedlings have light-colored roots (tan, light brown, or reddish), no stripped roots, and a uniform, green foliage. Most growers purchase seedlings or transplants (also called liners) from the North Carolina Forest Service or privately owned nurseries. Some species take only 1 year to reach field size, while others may take 4 to 5 years.

Plant trees while dormant. In the piedmont, this is February through April, and in coastal areas, this is January through March. If planted within 4 weeks of when they are received, store them in shipping packaging in a cool, dark place (preferably under 50 °F). Do not allow roots to dry out while in storage or during planting. Trees are set by hand directly into the field, culling low quality or damaged seedlings. Some growers root-prune the seedlings to prevent “J” or “U” shaped roots. Only remove excessively long roots. Growers may choose to place some seedling species, such as white pine, in a line-out bed for a year or two, prior to planting in their final home site. Species type determines spacing in the field; it can be as little as 3 feet by 3 feet and as far as 10 feet by 10 feet. Most growers, however, set trees at 6 feet by 6 feet on center.

Machine planting trees, picture borrowed from www.maytreeenterprises.com/growersfinal.htm
Once trees have been growing in the field for two years (about waist high), growers should begin annual hand-shearing. Fast growing species, such as Virginia pine, may push two or more flushes per year; therefore, these require shearing twice per year. Shearing is a form of “heading” or “heading back” and removes currently growing and/or one-year old shoots. In response to heading young branches and leaders, new growth develops from buds just below the cut. If there is more than one terminal, remove one. A terminal controls overly vigorous growth of the lateral branches and therefore creates a fuller, denser tree and the typical conical shape.

Hand pruning with shearing knife, picture borrowed from www.realchristmastrees.org

Pruning with a rotary knife, picture borrowed from www.lincolntimesnews.com
Growers manage ground covers, weeds, and grass by mowing, string trimming, and herbicides. They apply pesticides (herbicides, insecticides, fungicides, and miticides) using hydraulic sprayers pulled by a tractor or similar machine, equipped with booms and nozzles that are driven between each row. Some of the newer pesticide chemistry can be applied as a drench.

Proper and safe hand spraying, picture borrowed from www.ipm.ucdavis.edu/GENERAL/pesticides_professional.html
Insect/Mite Pests

General pest control

Prior to using any chemical control measures, be sure to read the label carefully and follow instructions. READ THE ENTIRE LABEL. Always consider alternatives first. Make sure that chemical control is necessary and that it is the best management practice.

There has been considerable concern regarding the use of neonicotinoids, such as imidacloprid, due to their potential to kill foraging bees and other beneficial insects. Reading and following the label directions can ensure proper use and timing of applications to prevent killing non-target insects. Apply insecticides in late evening, night, or early morning when fewer bees are foraging, to minimize non-target applications. Do not spray when common foraging plants are in bloom. Applicators can also choose chemicals with reduced risks to non-target species.

Neonicotinoids are a class of insecticide chemically related to nicotine. They act on certain receptors in the nerve synapse of invertebrates; however, have a very low toxicity to mammals, birds, and other organisms. This is why they have become so popular. They are highly water-soluble, allowing them to be applied to soil and be taken up by the plant. This type of application can reduce risks of insecticide drift. Because these chemicals are systemic, they work very well
on sap-feeding pests, leaf-eating pests, certain woodborers, and many others. Neonicotinoids pose low-level contamination of nectar and pollen. Although these low levels may not expose bees directly to the chemical, they may affect bees’ ability to forage for nectar, learn, and remember where flowers are located, and possibly impair their ability to find their way home.

To reduce risk to non-target invertebrate species applicators can take the following steps: 1) follow label directions carefully, 2) restrict applications to soil or during times when bees are not foraging (e.g. evening), and 3) treat only individual plants that need treatment— those where an intolerable pest infestation exists.

There are many unmanaged areas around Christmas tree plantations such as pastures, riparian zones, hedgerows, and field borders. Growers should leave these areas unmanaged to provide habitat for natural predators, parasites, parasitoids, and other beneficial creatures. Natural enemies can help reduce pest pressure in the fields.

According to Dr. Jill Sidebottom, “Over the past dozen years, Fraser fir Christmas tree growers have reduced their pesticide use by almost 75%! They have also reduced fertilizer use and created more green-space for wildlife and pollinators including bees. IPM reduces costs and improves the environment — a win-win for everyone!” She believes that such a reduction is likely in the eastern part of NC, where growers are using IPM to manage pests in their Christmas tree plantations.

Bagworms
Bagworms (Thyridopteryx ephemeraeformis) are common pests of a wide variety of species. They prefer juniper, arborvitae, spruce, Leyland cypress, and pine but will also attack a variety of deciduous plants. A single bagworm is not much of a problem. However, because females do not fly, populations are often very dense on individual trees. In addition, because they make the bag from leaf materials from the host, they are often hard to spot before they get quite large and harder to treat. Defoliation caused by a large population of bagworms can kill conifers within one or two seasons. Adult males are black, clear-winged moths.
Eggs overwinter in the female’s bag. The adult female is a caterpillar that does not leave the bag. The eggs hatch May to June and the larvae crawl out of the bag. They spin silken threads that allow them to disperse with the wind. Once they land, they begin feeding on the foliage and create their bags, enlarging the bags as they grow in size. Bags range in size from ¼” to 2” long. Heavy infestations can lead to defoliation and possibly death of twigs and finally death of the plant if left unchecked. By mid-August, they are mature and pupate. Within four weeks, the male moths mature and fly in search of females. After mating and laying eggs (500 – 1,000), the female mummifies around the egg mass. Bagworms produce only one generation per year.

If left unchecked, bagworms can defoliate a plant causing branch dieback and eventual death. If during your monitoring you find more than 20 bagworms on a plant, it is time to consider treatment.

**Control**

*Cultural practices:*
If a light infestation, you can pick or clip them off the plant.

*Biological control:*
It is important to treat bagworms when they are small, as chemicals will be more effective. There are very low impact insecticides that target only caterpillars, such as *B.t.* (*Bacillus thuringiensis*). Time applications when larvae have just finished ballooning.

*Chemical control:*
Careful scouting and use of degree-days (around 900 DD base 50 °F) can be used to better time pesticide applications. Early sprays are more effective than later ones.

---

**Cinara aphids**

*Cinara aphids* (*Cinara* spp.) are a group of several species. They feed on Virginia, eastern white pine, and other conifers. Each species in the group feeds on a particular host. Cinara aphids are some of the largest aphids in the world. They are typically dark.
brown or black. The young are similar to adults, simply smaller. Like most aphids, Cinara deliver live young, allowing for a quick build-up of populations. Some also lay eggs that are black and oblong and are found singly at the base of needles in fall. These aphids typically live in large colonies of up to several hundred. In spring, Cinara aphids tend to congregate on the terminal, trunk, and upper whorl of branches. In the fall, you will typically find them lower on the trunk and on lower branches, possibly, because it is cooler. Additionally, aphid populations may be much greater on trees sheltered along wooded edges.

Tree growth is reduced by heavy infestations. Sooty mold grows on the honeydew that the aphids produce, reducing marketability. This aphid can produce colonies on just a few to a hundred trees in the field. There is no pattern of infestation, making it much harder to find the aphids.

**Control**

*Cultural practices:*

Implement good scouting practices. Train field workers to recognize these insects. Mark trees with flagging when you find a population. Check adjacent trees as well. If aphids are found in spring and summer, they will most likely be gone by fall, making an insecticide application unnecessary. Continue to check these trees throughout the growing season to determine if they are expanding. Cinara aphids will typically disappear from a field in a few weeks or months and never be found again. If the aphids inhabit a field for a year or more, then insecticide treatment may be warranted. Scout field in September and October for aphids. Look for aphids on terminals and trunks, and look for wasp or yellow jacket activity. These insects are attracted to the plants by the honeydew the aphids excrete. The final opportunity to spot them is during the harvest. Cinara aphids exude a purple stain when squashed, so during the cutting and handling this would be one way to determine if there are aphids present. If not found, they can stay on the trees when they are moved inside for decorating.
Biological control:
Natural enemies are important in controlling aphids, particularly where broad-spectrum insecticides have not been used. As with many other insect pests, leaving natural habitats for predators is key to control of aphids. Parasitic wasps lay eggs inside aphids. A variety of predators voraciously eat aphids, including lacewing larvae, soldier beetles, syrphid fly larvae, and lady bird beetle larvae and adults.

Chemical control:
If a grower finds Cinara aphids in the fall on trees to be harvested, treat with an appropriate insecticide as soon as possible. Choose an insecticide that has a short residual to reduce problems with worker exposure or pesticide residues on the harvested tree. If you have already harvested trees, do not treat with an insecticide. You can use a strong water spray to remove the majority of aphids. Retailers and homeowners can treat trees with insecticidal soaps.

Nantucket pine tip moth
Nantucket pine tip moth (Rhyacionia frustrana) feeds on all pines with the exception of longleaf and eastern white pine. In the Southeast, loblolly and Virginia pine are preferred hosts. The larval stage bores into the base of needles or buds then into the shoot itself, killing the shoots. Heavily infested trees may appear reddish due to all the dead shoot tips. Repeated infestations retard height growth, causes crooking or forking of main stems, reduce cone crops, and occasionally lead to tree death. Damage to the terminal shoot is most important because growers will shear off damaged side shoots during normal maintenance operations. Damage reduces marketability of trees.
The Nantucket tip moth overwinters as pupae in injured tips of pines. Adult moths begin to fly on sunny days in late winter, as early as January or as late as March. They mate and lay eggs on needles, needle axils, developing tips and buds, and stems. Eggs hatch in about 30 days in cool spring weather, and in 5 – 10 days in hotter temperatures. After hatching, caterpillars may feed externally on new growth causing shallow injuries, or bore into the needle bundles. Later they migrate to shoot tips, construct a protective web at the base of buds and bore into bud and stem. Larvae mature in 3 – 4 weeks and pupation follows within the cavity formed by the larvae. In the Southeast, there are three generations per year.

**Control**

*Cultural practices:*
Inspect seedlings prior to planting. Cull those that have injured buds or twigs. In smaller plantations, destroy damaged terminals during dormancy to kill overwintering pupae. In larger plantations, pesticides may be needed.

Prune infested trees below the dead part to ensure removal of larvae feeding in green tissue. Where there is a history of heavy infestations, refrain from planting Virginia pines.

Select vigorous tree varieties and implement proper site preparation to ensure healthy seedlings and young trees. Practices that encourage rapid development can help reduce infestations.

Destroy trees growing in waste places, along roadsides or fence lines as these are likely to be heavily-infested and can serve as a source for young, nearby plantations.

*Biological control:*
Several species of parasites, predatory insects, and birds attack this pest.
Chemical control:
Large-scale use of insecticides is not usually recommended except in high value plantations where growers can use power sprayers, thereby reducing costs. It may be necessary for growers to spray each generation. Direct spray applications at the young larvae feeding on the exterior portions of the shoots. Pesticide timing can be difficult once caterpillars have bored into shoots, as they may be protected from certain chemistries.

Pine bark adelgid
Pine bark adelgids (Pineus strobi) mainly attacks eastern white pine, but can also infest Scotch pine. Heavy infestations on branches will cause stunted growth. Nymphs and adults produce honeydew, which serves as a host for sooty mold fungus. If severe enough, pine bark adelgid can cause tree death.

Adelgids differ from aphids in that they do not have long antennae and cornicles characteristic of most aphids. The life cycle of pine bark adelgids is not well known. It seems that immature females (nymphs) overwinter on the bark of pines.
In late winter, these nymphs become active and are covered with white, wooly wax. The nymphs mature, molting to become wingless adults. Adults lay 40 – 50 eggs in the white, fluffy secretion over a 20 – 30 day period. Eggs hatch over a two-week period and the larvae move to suitable places on bark to insert their mouthparts. Larvae hide under dead adults, bases of old needles, and under newly emerging needles. The larvae molt into the nymph stage, produce the white waxy coating, and become adults over a 20 – 30 day period. Adelgids can produce five generations per year, and during summer, you can find all life stages of this insect. Only nymphs that have molted twice and third instars can overwinter. Most develop into wingless females that lay fertile eggs without mating. Winged females can fly to other trees. All others die. Populations of pine bark adelgids increase dramatically during cool fall weather and in early spring. As weather warms up, predators become more active and help lower adelgids numbers.

**Control**
This insect is slow to spread, as crawlers must drop from adjacent trees, be blown in, or be moved by birds or other animals from other plantations.

*Cultural practices:*
This adelgid is more unsightly on older trees, but can cause serious damage on young trees. Remove any older white pine in areas adjacent to your plantation.

*Biological control:*
Encourage natural predators and parasites. Lady beetles, lacewings, and hover flies eat pine bark adelgids. However, if growers spray broad-spectrum insecticides they will kill these natural enemies. Some lady beetle larvae can be covered in the white wooly wax like the adelgids, so be sure in your IPM scouting to correctly identify the pests and predators.

*Chemical control:*
Growers can use dormant oil sprays (3 – 5%) in spring or fall to kill the overwintering nymphs. In spring, be sure to spray before the females begin to produce eggs in the waxy coatings. Thorough coverage of trunk and branches is key.

Insecticides labeled for adelgids applied in late March to early April will kill overwintering nymphs before they mature and lay eggs. Summer sprays are effective, but you will need three or more applications to kill new crawlers that emerge throughout the growing season. Thorough coverage is critical.

**Pine needle scale**
As the name implies pine needle scale (*Chionaspis pinifoliae*) attacks pines, but also attacks spruce, white (concolor) fir, and cedar. Pine needle scale causes yellowing and stippling of the foliage. In heavily infested plants, the needles become brownish and can result in premature defoliation. Pine needle scale can also reduce needle length and growth rate. Outbreaks are
typically confined to one portion of a tree. In a plantation, they can cause serious concern. Most often scale infestations are associated with factors, such as drought, that reduces the host tree’s vigor. Additionally, road dust and pesticide application can result in significant infestations.

Adult female pine needle scale insects are about 1/8” long, dark orange, and wingless and live under an armored scale. They are easily visible because the covering is pure white, and oval shaped with a yellow tip. Developing males are similar to developing females, just smaller. The immature, crawler stage is oval, reddish. The scale overwinters as females and eggs beneath their waxy coating. In late April to early May, the eggs hatch into crawlers that move around for a few days before settling and beginning to feed. It takes them about a month or so to reach maturity. Males emerge, mate and then die and a second generation is produced that matures in late summer.

Control

*Cultural practices:*
Proper tree care is important, keeping plants growing vigorously. Prune off heavily infested branches. Refrain from planting pines near dusty roads to help maintain predator populations.

*Biological control:*
Because they are quite apparent on needles many predatory and parasitic insects feed on these typically keeping populations low. There is a lady beetle species whose life cycle is synchronized with the scale and are therefore a very effective predator. Severe cold temperatures can help reduce populations as well.
Chemical control:
Growers can use horticultural oils and soaps that have a lower toxicity to non-target pests. Armored scales are more difficult to kill due to the waxy covering, so often you must plan to treat during the crawler stage or use systemic chemicals. Treating during the summer generation has been shown to be more effective than a spring treatment.

Pine tortoise scale
Pine tortoise scale (*Toumelella parvicornis*) is a challenging insect to control. It is found on many pines, but those grown as Christmas trees, Scotch and Virginia are highly susceptible. It does not typically cause death, but does reduce growth. Because this is a soft scale, it produces honeydew. Black sooty mold forms on the honeydew causing discoloration, making trees unattractive and often unmarketable.

In North Carolina, pine tortoise scale produces two to three generations, so growers may observe several stages of development at the same time. Scale overwinter on trees as immature females that are brown, circular in shape, and about ¼” long. In March to April, females mature and produce eggs. Crawlers hatch in April to May, move around a bit, settle, and begin feeding. At this point, they form a white, crystalline substance on their body. Shortly after, males emerge from the pupal stage, fertilize the immobile females, and soon die. The first generation usually reaches maturity in late June, early July and the second generation begins.

Control

Cultural practices:
Implementing sound IPM strategies is important, particularly monitoring for the various life stages of the scale. Proper tree care is also important, keeping plants growing vigorously. Prune off heavily infested branches. Refrain from planting pines near dusty roads to help maintain predator populations.
Infestations are often localized to a small portion of the field. Mark trees that have scales and treat when crawlers are observed. This tactic may prevent the need to treat an entire field. Honeydew is often a sign of scale infestation, but treatment should not be delayed until honeydew is noticed. Control ants in the Christmas tree fields as well. Ants are attracted to the honeydew and will often protect them from potential predators or parasites.

**Biological control:**
Encourage natural predators and parasites. A number of predators feed on pine tortoise scale. However, if growers spray broad-spectrum insecticides they will kill these natural enemies.

**Chemical control:**
Same insecticides as those used for pine needle scale.

### Pales weevil

*Pales weevil (Hylobius pales)* feeds on all pines and many other conifer species as well. They also feed on freshly dead pine material. They are attracted to the smell of fresh-cut stumps and recently damaged trees. Adults commonly “flag” branches of conifers or kill seedlings. They prefer to eat bark off the lower branches, often near a fork. The dead branch drips sap and then often dies during the next growing season. Weevils will quickly girdle seedlings planted adjacent to last season’s stumps, often just below the soil line. Examine seedlings that die suddenly and check for stripped bark. The larval stage does not damage living trees.

Pales weevil adults are tiny, dark reddish-brown with faint yellowish spots scattered over the wing covers. They have the typical snouts and bowed antennae found on all weevils. The grubs (larvae) are white, C-shaped, legless and have brown head capsules. Pales weevil can be confused with pine root-collar weevil, but it prefers to breed in living pines.

Most pale weevils overwinter as adults in the duff and soil near pines. As temperatures get above 50 °F, adults begin feeding on the bark of last year’s tree stumps or slash left after harvest. These adults may also feed on young trees and seedlings. During this time, the weevils are mating. Females eat holes in pine slash or stumps and deposit their eggs. Eggs hatch in 10 – 14 days and...
the grubs burrow into the cambium. Most grubs mature in June, chew into the sapwood, and make pupation cells, called “chip cocoons”. These are covered with fibrous sawdust. Pupae take about a month to mature into adults. Adults chew out through the bark and look for live conifers on which to feed; adults feed from July through September. As it gets colder, adults move into the soil or duff under slash for the winter.

**Control**

The most common tactic to control pales weevils is to eliminate the larval stage so adults do not develop to damage seedlings and young trees.

*Cultural practices*:
Remove, chip or burn stumps, slash, and unused trees from the previous season’s harvest. Some growers cover stumps with soil or plastic mulch to prevent adults from finding the food source.

Stumps that have weathered for a summer are unsuitable for weevil egg laying. Delaying planting new seedlings in that area for a year may help reduce populations. However, weevils will still be produced in this area and can travel in search of conifers for food.

Leave a whorl of live branches on the stump to keep stump alive, making unattractive to weevils.

**Biological control:**
Little is known about possible biological controls. There is evidence that naturally occurring white and green muscardine fungi, a gregarine protozoan, and neoaplectanid nematodes infect pales weevils.

**Chemical control:**
Growers can use insecticidal dips to protect seedlings, especially when planting in the fall. Seedlings planted in spring are better protected with foliar sprays.

One of the best ways to control these weevils is to treat last year’s stumps. Use registered pesticides mixed with kerosene or fuel oil. These act as carriers to help penetrate into the egg-

![Pales weevil damage on white pine, picture borrowed from www.msue.anr.msu.edu/](https://www.msue.anr.msu.edu/)

---

*Pales weevil damage on white pine, picture borrowed from www.msue.anr.msu.edu/*
laying holes and larvae already present. The pesticide will kill any late adults or larvae. Treat stumps in early spring when daytime temperatures are averaging 60 °F.

Apply foliar sprays to protect tree branches and new seedlings, if you did not treat stumps in early spring. Apply insecticide to living trees when the new adults are emerging, usually in July. You should check whether weevils are present or not. To do this, dig up around several stumps, peel off the bark, and look for chip cocoons. If there are several chip cocoons in each stump, a protectant spray is needed.

Spruce spider mite
Spruce spider mite (*Oligonychus ununguis*) is one of the most destructive spider mites in the U.S. It has a wide host range of coniferous species, including spruce, arborvitae, juniper, hemlock, and pines. For eastern Christmas tree growers it is a problem primarily on eastern spruce, and pines.

After hatching, young pale green mites emerge. These are the juveniles or larval stage and resemble adults except are smaller and have only three pairs of legs. As the mites mature they shed their skins three times, going from a larvae to a nymph, and then to an adult. The nymphs and adults have four pair of legs, are dark green to nearly black, with the body surface and legs covered with salmon pink-colored spines.

Spruce spider mites overwinter as brown eggs found in and around bud scales, and at the base of needles. They hatch in spring, typically before new growth starts. One generation from egg to adult typically takes between 15 and 20 days. Generations overlap and there are 7 – 10 generations per year, so you will find all stages of the mite on host plants.
Spruce spider mite sucks fluid from the needles of host plants. Needles have a speckled or stippled, yellowish appearance, lacking their typical green color. After prolonged feeding, needles turn rusty colored and may fall off. Mites typically feed on older needles located in the lower and inner parts of the branches. These mites also produce silken webs.

**Control**

*Cultural practices:*
Face fields north and east to help reduce mite problems. South and west facing sites tend to have higher populations due to increased temperatures and higher humidity, allowing mites to grow and reproduce at higher rates. Windier sites tend to have higher spruce spider mite populations, so locating plantations where woodlands can protect the Christmas trees helps reduce foliage drying. In addition, dust on the needles can kill the predatory mites, by causing them to dry out.

**Biological control:**
Maintain fallow areas, hedgerows, field edges, ground covers, and so forth as these provide habitat for natural predators, especially predatory mites. Other predators include, hover fly larvae, lacewing larvae, dusty wings, and lade beetles (especially the larval stage).

**Chemical control:**
Begin monitoring plants in early spring (April), and continue regularly throughout the entire growing season. Look for the needle stippling and webbing. If you suspect spruce spider mites, take a piece of white paper or tray and hold it under a branch. Shake the branch. If mites are
present, you should see the dark, oval mites. Examine 3 – 4 places on the plant. If you dislodge ten or more mites at each site, then it may be advisable to apply a registered miticide, according the label directions. Remember mites are not insects, so an insecticide will not work. In addition, mite populations may increase following the use of certain insecticides, such as imidacloprid, Thiodan, Sevin, and Asana. These chemicals are broad spectrum, last a long time in the environment, and will kill off the natural predators.

Spruce spider mite is a cool season pest. This means it is most active during spring and fall, when it is cooler. The best time to treat is in late March or April and again in August to September. Repeated applications may be necessary to keep populations under control. After every third application, switch to another class of miticide to prevent resistance to certain chemicals. Horticultural oils kill insects and mites by suffocating them. These may work against the spider mite egg, but requires reaplication within 10 – 14 days. Most horticultural oils are petroleum based, but some are vegetable based. These oils can burn (if agitation is incomplete) or discolor foliage.

### Insecticides/Miticides

<table>
<thead>
<tr>
<th>INSECTICIDE</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 1994</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 2000</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 2006</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>DI-SYSTON 15 G</td>
<td>64.6 %</td>
<td>49.6 %</td>
<td>31.9%</td>
<td>0.2%</td>
</tr>
<tr>
<td>LINDANE</td>
<td>21.7 %</td>
<td>23.8 %</td>
<td>1.9%</td>
<td>1.1%</td>
</tr>
<tr>
<td>DIMETHOATE</td>
<td>2.3 %</td>
<td>21.2 %</td>
<td>34.7%</td>
<td>46.6%</td>
</tr>
<tr>
<td>ASANA</td>
<td>11.8 %</td>
<td>16.6 %</td>
<td>13.3%</td>
<td>15.7%</td>
</tr>
<tr>
<td>LORSBAN</td>
<td>5.8 %</td>
<td>8.4%</td>
<td>4.6%</td>
<td>0.0%</td>
</tr>
<tr>
<td>SAVEY</td>
<td>—</td>
<td>5.4%</td>
<td>3.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>MORESTAN</td>
<td>14.3 %</td>
<td>3.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>TALSTAR/SNIPER</td>
<td>0.0%</td>
<td>0.3%</td>
<td>11.9%</td>
<td>48.4%</td>
</tr>
<tr>
<td>THIODAN</td>
<td>0.0%</td>
<td>2.2%</td>
<td>6.3%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Table from NCSU Extension, FAQ: Pesticides Used in Christmas Trees, written by Dr. Jill Sidebottom

### Diseases

**Botryosphaeria canker**

Symptoms of *Botryosphaeria* canker (*Botryosphaeria dothidea*) are very similar to those of *Seiridium* canker, and infect Leyland cypress. One exception- *Botryosphaeria* cankers do not
typically exude resin. This disease can lead to development of long, narrow cankers, often more than a foot long. Rainfall and overhead irrigation spread the disease spores from branch to branch and tree to tree, but wind can also spread spores.

**Control**

*Cultural practices:*
*Botryosphaeria* canker occurs on plants that are under severe stress. During drought periods, provide supplemental water, maintain good soil health, and do not over-fertilize. Prune out infected twigs and branches, cutting back to at least 1 inch below the canker. Disinfect pruners (dip in rubbing alcohol or spray with Lysol, wiping chemicals off before making the next cut) between cuts to minimize spread. Remove severely infected trees.

*Chemical practices:*
None known.

*Cedar/apple rust*
Cedar apple rust (*Gymnosporangium juniper-virginianae*) is a fungal disease that alternates between eastern redcedar (*Juniperus virginiana*) and apple or crabapple species. In most cases, the disease is a minor problem regarding the health of eastern redcedar. However, the large fungal structures (galls) produced are quite visible and highly unsightly. This fungus can cause serious problems in commercial apple production.

Growers can find the galls in winter or early spring. In spring when it is moist, a striking, bright orange mass of gelatinous horn-like structures form, called telial, develop on these galls. This causes the gall to swell to several sizes larger than the original gall. These telial hold the spores. As the horns continue to absorb water, they forcibly discharge the spores, which move through the air. If they land on an apple (*Malus* spp.) and water is present, an infection will develop. One to two weeks after infection, orange pustules form and will later produce more spores, continuing to infect the tree.

---

Close up of *Botryosphaeria* canker, picture borrowed from [www.extension.umd.edu/](http://www.extension.umd.edu/)
While the galls that form on eastern redcedar cause little damage to the tree, they are highly visible particularly during wet weather. After sporulating, a woody-like gall remains and can make Christmas trees less marketable.

Fungal galls on eastern redcedar; top shows a fully developed gall, while the next picture shows a gall just beginning to develop, picture credits- Barbara Fair

On apple and crabapple, bright orange-yellow spots develop on upper surface of leaves in late spring. Within a few weeks, light colored, fringed, cup-shaped structures form on lower leaf surfaces. Fruit can also be similarly infected making it unmarketable.

Control
There are few control measures available for treating junipers for cedar-apple rust because it does such little damage. Fungicide applications are used on commercially valuable crops of apple, which suffers greater damage from the disease.

Cultural practices:
Plant resistant varieties of juniper, such as Juniperus virginiana ‘Tripartita’ or Juniperus communis ‘Suecica’. Remove any crabapple or apples growing adjacent to Christmas tree plantations. Prune off galls from trees.

Biological control:
None known.
Chemical control:
None known.

Passalora needle blight
Passalora needle blight (*Passalora sequoia*, formerly known as *Cercospora sequoia*) is a fungus that infects junipers, such as eastern redcedar, Leyland cypress (*Callitropsis × leylandii*), and Arizona cypress (*Cupressus arizonica*). In addition, the fungus *C. sequoiae var. juniper* has been found to cause severe damage in plantation plantings.

The disease can cause only slight discoloration or complete defoliation and death of seedlings. Look for discolored needles, bronze to brown, on lower branches, adjacent to the main stem. On severely infected seedlings, only the top will remain green. This pattern of infection differs from *Phomopsis* tip blight, so they can easily be distinguished.

The fungus overwinters on infected needles of living trees. Warm, wet conditions allow disease to spread more quickly. Viable fungal spores are present in spring and summer. Spores are spread primarily by wind. Windbreak plantings of eastern redcedar can serve as a spore repository, so use a non-susceptible species.
Control

*Cultural practices:*  
Remove all infected trees in plantation and adjacent windbreak or other areas. Provide significant spacing between trees to allow sufficient sunlight and air circulation around trees. If there is heavy disease presence in your area consider growing species not susceptible to *Cercospora*.

*Chemical control:*  
In general, growers can use copper-containing fungicides. Kocide® (active ingredient-copper hydroxide) is registered for general use on ornamentals, and some formulations are labeled for fir, juniper, pine, spruce, and Leyland cypress and may be appropriate for plantation use. As always, check labels prior to use.

*Phomopsis tip blight*  
*Phomopsis tip blight* (*Phomopsis juniperovora*) can infect junipers, *Cryptomeria*, *Chamaecyparis*, and *Thuja* species. It seldom causes significant damage, unless weather conditions are favorable for disease development. During prolonged wet, cool periods in spring and fall, spores of *Phomopsis juniperovora* ooze from black fruiting bodies on the plant’s twig. Splashing rain or overhead irrigation spread the spores to other parts of the plant, or to other plants. Spores can potentially be produced throughout summer, but most infections occur in spring or fall. Fungal spores germinate and invade healthy, young twigs. Blight fungus penetrates young twigs quickly, potentially killing first-year seedlings. Older twigs are typically resistant to infection; but on highly susceptible hosts, the fungus can invade and girdle the larger stems.

Symptoms include browning and dieback of young needles and shoot tips. Gray lesions typically girdle the shoot at the base of dead tissue. In some cases, the black or grayish fungal fruiting bodies may be visible.
Growers can occasionally mistake tip blight diseases with damage from either the juniper midge or the juniper tip midge. Inspect affected shoot tips with a hand lens. The presence of small holes in the shoot indicates where one of these insects has exited.

Another tip blight fungus presents similar symptoms and can infect the same species. This species is *Kabatina juniperi*. The primary difference between the two is that Kabatina infects wounds caused by insects or mechanical damage, but does not infect healthy twigs. An infection caused by *Kabatina* must be treated differently than a *Phomopsis* infection.

**Control**

*Cultural practices:*
Growers can still find viable spores on branches infected two years prior. Therefore, it is important to prune all blighted twigs, remove, and burn or bury these to prevent further infection. Prune on a dry day to prevent transmitting the fungus to other parts of the plant or other plants.

If possible, do not use overhead irrigation.

There are a number of juniper species resistant to *Phomopsis*; if possible choose these species. Listed below are some that may work as Christmas trees.

*Juniperus chinensis* ‘Mountbatten’

*J. chinensis* ‘Robusta Green’

*J. chinensis* ‘Wintergreen’

*Chemical control:*
Treat *Phomopsis* tip blight in early spring and continue at 10 – 14 day intervals.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Rate</th>
<th>Method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>azoxystrobin (Heritage)</td>
<td>1 to 4 oz/100 gal</td>
<td>foliar spray</td>
<td>Do not make more than three sequential applications of Heritage before rotating</td>
</tr>
</tbody>
</table>
**Phytophthora** root rot

*Phytophthora* root rot (*Phytophthora cinnamomi*) is an oomycete, which is a fungus-like organism that is either soil or plant borne. This organism causes severe root rot, dieback and plant death in Fraser firs, shortleaf and loblolly pines, azaleas, rhododendrons, camellia, boxwood, and many other woody plant species.

*Phytophthora* root rot can kill Christmas trees when grown in wet, low-lying areas. Additionally, in wet years after extensive drought and plants are stressed, infection can readily occur. The fungal spores will have been lying dormant in the dry soil until conditions are right for infection.

The symptoms of *P. cinnamomi* include smaller than normal foliage, stunting, chlorosis, necrosis, wilting, leaf curl, reddish-brown discoloration of wood at soil line, greatly reduced root systems, dark streaks up stem, slightly sunken cankers just beneath bark, and death. Stem necrosis may take weeks to develop after wilting symptoms are seen. Belowground, young feeder roots develop necrosis and may eventually develop cankers. Roots of older plants may not develop cankers at base of stem and recover from the disease if wet conditions abate. In addition, older plants may be symptomless, or display only minor dieback despite severe root rot. The disease can survive in symptomless and tolerant plants, as well as in the soil. These symptomless plants are a major source of spread to previously clean areas, making control challenging.

*P. cinnamomi* overwinters primarily in infected roots, stems, and to a small extent in the soil surrounding the plant. The organism is spread by splashing during heavy rains and overhead irrigation. It is carried in run-off, or from plant-to-plant in the field. Do not plant susceptible plants in a field where *P. cinnamomi* has been found

**Control**

*Cultural practices:*
Thoughtful site selection can help reduce the incidence of disease. Find sites that drain well, or when preparing wetter sites install drainage tile. Sanitation measures are critical to disease prevention. Grow resistant cultivars if available and plant in areas known to harbor *Phytophthora*. Irrigate plants under drought stress, as plants previously disease resistant, may lose resistance and can be attacked. Avoid using run-off water for irrigation and minimize use of overhead irrigation.
Chemical control:
There are a number of fungicides labeled for use in Christmas tree plantations.

Seiridium canker

*Seiridium* canker (*Seiridium unicorne*) is likely the most serious disease of Leyland cypress. Plants of all sizes and ages are affected. Cankers form on stems, branches, and in branch axils. These cankers cause twig and branch dieback, and can lead to death of young trees. Cankers are dark brown to purple, sunken areas that often exude resin. Resin does flow from perfectly healthy Leylands, so look for the sunken cankers to be sure you have *Seiridium*. Scattered twigs and branches killed by the fungi turn reddish-brown, in stark contrast to healthy branches. Rainfall and overhead irrigation can spread the spores from branch to branch and tree to tree.

Cultural practices:
Avoid water stress and plant wounding. Prune out infected twigs and branches, cutting back to at least 1 inch below the canker. Disinfect pruners (dip in rubbing alcohol or spray with Lysol, wiping chemicals off before making the next cut) between cuts to minimize spread. Remove severely infected trees.

Chemical control:
None known.

Weeds

Weed control is an important part of field management, and helps improve tree growth. Competition from grasses and other vegetation can kill young trees or limit their growth by blocking sunlight and competing for water and nutrients. Vines such as poison ivy or porcelain berry, Virginia creeper, and so forth can reduce tree quality by growing around branches and trunks, and bending the tops. Some weeds, such as briars, thistles, and poison ivy can make it challenging for field workers managing the trees.

Managed ground covers, such as grass and forbs, can enhance Christmas tree production by promoting water penetration, mitigating soil temperatures, reducing soil erosion, and providing habitat for natural predators, parasites, and parasitoids.
Eastern Christmas tree growers rely heavily on mowing to keep weeds under control. Growers make use of both pre- and post-emergent herbicides.

### Herbicides

<table>
<thead>
<tr>
<th>HERBICIDE</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 1994</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 2000</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 2006</th>
<th>PERCENTAGE OF ACREAGE TREATED IN 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROUNDUP</td>
<td>93.7%</td>
<td>94.9%</td>
<td>89.6%</td>
<td>99.4%</td>
</tr>
<tr>
<td>SIMAZINE</td>
<td>72.2%</td>
<td>38.8%</td>
<td>16.8%</td>
<td>6.2%</td>
</tr>
<tr>
<td>GOAL</td>
<td>43.8%</td>
<td>20.7%</td>
<td>10.7%</td>
<td>0.4%</td>
</tr>
<tr>
<td>VANTAGE</td>
<td>23.9%</td>
<td>14.7%</td>
<td>10.7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>STINGER</td>
<td>22.8%</td>
<td>11.7%</td>
<td>5.8%</td>
<td>1.5%</td>
</tr>
<tr>
<td>GARLON</td>
<td>—</td>
<td>7.8%</td>
<td>6.1%</td>
<td>1.5%</td>
</tr>
<tr>
<td>CROSSBOW</td>
<td>0.9%</td>
<td>3.1%</td>
<td>5.0%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

### On-line Resources

- [http://www.cipm.info/](http://www.cipm.info/)
- [http://ecoipm.org/](http://ecoipm.org/)

Updated by

Barbara Fair, PhD, NCSU Landscape Extension Specialist, 2015

Originally Prepared by

Jill R. Sidebottom, PhD, NCSU Mountain Conifer IPM Extension Specialist, Mountain Horticultural Crops Research and Extension Center, 1999