United States
Department of
Agriculture

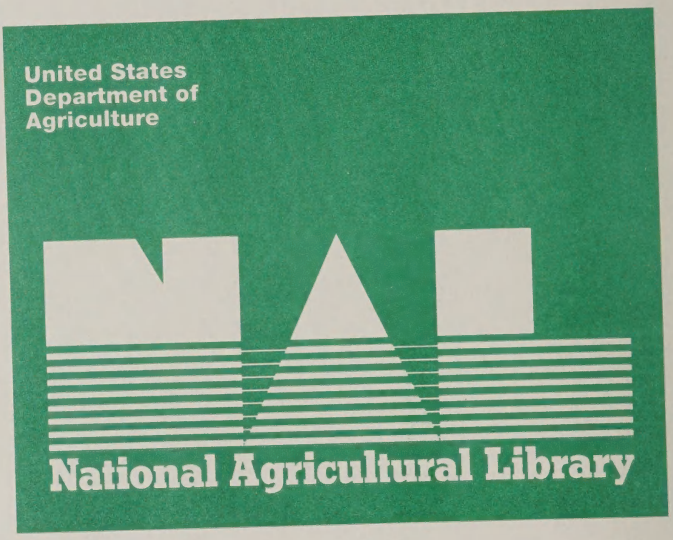
Forest
Service

Southwestern
Region

Conifer Pests in New Mexico

Prepared by:
Robert Cain, Jesus Cota, and Charles Ward*

New Mexico State University - Cooperative Extension Service



* Robert Cain is with New Mexico State University Cooperative Extension Service, Jesus Cota with USDA Forest Service, Southwestern Region, and Charles Ward with New Mexico State University Cooperative Extension Service.

This publication is a revision of Insects and Diseases of Evergreens in New Mexico prepared cooperatively by New Mexico Department of Agriculture, USDA Forest Service, New Mexico Division of State Forestry, and USDA Cooperative Extension Service in 1977. Special acknowledgement is given to Anthony Smith who prepared much of the original version.

Printed April 1990 on recycled paper.

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Introduction

This guide is intended to help homeowners and forest managers in identifying and controlling forest and ornamental tree pests. The guide focuses on insect and disease pests but also discusses natural and human-caused environmental problems.

Many pest problems can be prevented by keeping trees healthy and vigorous. Tree pests are usually attracted to and do more damage to stressed, weakened trees. In forests, environmental stresses can sometimes be alleviated by thinning stands to reduce competition among trees. In urban landscapes, trees are often planted in areas where they would not grow naturally and thus may suffer from too much or too little moisture, soil compaction, alkalinity, air pollution, and exposure to sun and wind. In urban areas throughout New Mexico, conifers need supplemental water during the windy spring and at other dry times during the year.

Transplanting wild grown conifers to urban areas poses other problems. Conifers growing in New Mexico's dry soils have extensive root systems. Generally, few of the roots remain intact when the trees are dug so many transplanted trees die. The larger the tree chosen to transplant, the less likely it will survive. Younger trees are more vigorous, have smaller root systems, are easier to dig, and will quickly grow to a size equal to that of larger, more costly transplants. You can double the survival rate by pruning roots 12 months or more before digging. Cut them with a narrow pointed shovel from 1 to 3 feet out from the tree to a depth of 12 to 18 inches. Prune roots in November, December, or January while the tree is dormant. Conifers must be moved with a ball of soil held firmly intact around the roots. Use tightly wrapped burlap to keep the soil from crumbling during transportation and handling. It 's important to remove burlap, chicken wire, or any other material used to wrap the root ball when resetting the plant in the ground. These materials often don't rust or rot away in dry Southwestern soils and the trees will remain root bound.

The following pages include descriptions of pests, pictures of damage, and pictures of the damage-causing organism wherever possible. Options for mechanical and biological control are provided where such alternatives are effective. At the end of this publication is a list of recommendations for specific chemical control. Remember that pesticide recommendations are subject to frequent changes in chemical registration and chemical-use regulations. For current recommended controls, contact your county agriculture extension agent or the Cooperative Extension Service at New Mexico State University. Or contact the New Mexico Energy, Minerals, and Natural Resource Department 's Forestry and Resources Conservation Division in Santa Fe, New Mexico; New Mexico Department of Agriculture, Las Cruces, New Mexico; or USDA Forest Service, Region 3, Forest Insect and Disease Management, Albuquerque, New Mexico.

State law prohibits removing any plant within 300 feet of a public thoroughfare. The law also requires that before removing any plants, you first obtain a written permit from the landowner or land manager. If you plan to dig or sell plants, first apply for a Collected Plant Inspection Certificate and/or a Dealers License from the New Mexico Department of Agriculture.

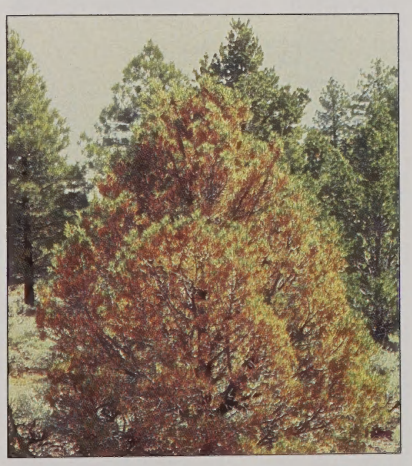
Pinyon Needle Scale

Matsucoccus acalyptus (Herbert)

Pinyon needle scales are small, black, bean-shaped bumps on the surface of one-year-old pinyon needles. These tiny, sap-sucking insects kill the needles and seriously weaken pinyon pines in forests and used as ornamentals. Reduced new growth and stunted needles are common on trees suffering repeated attacks. Heavy infestations frequently kill small trees and predispose weakened larger trees to attack by other insects, especially bark beetles, which can kill trees.

Scales infesting one-year-old needles.

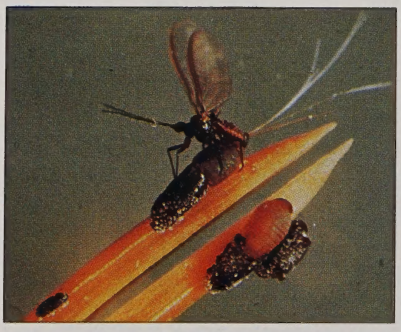
BIOLOGY: Adult, wingless females emerge from the scale coverings during mid-to late April and mate with winged males. Most males emerged the previous fall and spent the winter as prepupae in silk webs in litter beneath the tree. A few males don't enter the prepupal stage until early spring. Mated females lay yellow eggs in clusters held together by white, cottony webbing around the root collar, on undersides of large branches, in branch crotches, or in cracks of rough bark. Occasionally, egg masses are found several feet from the base of the tree on a rock or log. About four weeks after eggs are laid, tiny, red eye spots can be seen in the eggs with the aid of a hand lens. Nymphs, called crawlers, emerge about 7 to 10 days after eye spots appear. They climb to the ends of branches and settle on the previous year's new growth. After inserting tubelike mouth parts into the needle, they become immobile, cover the body with wax, and turn black. In New Mexico, this normally occurs by early June.



Heavily infested pinyon. Only the new growth remains green.

CONTROL: Potential damage from these pests can be drastically reduced by destroying eggs before they hatch. Dislodge egg masses from the tree with a strong stream of water from a garden hose. After washing down the tree, rake up all the material around the base of the tree and destroy or remove it. Chemical insecticides are registered to control the pinyon needle scale, but timing of the spray application is critical for success. Apply insecticides to the bark and branch crotches as soon as crawlers begin to emerge. Examine eggs with a hand lens and be ready to spray shortly after the crawler's red eye spots are visible. Once scales have established themselves on the needles, they become more difficult to control. Additional direct control information is provided on page 45.

Female scales migrating to egg-laying sites in the cracks of rough bark.



Female scale emerging from scale covering and being mated by winged male.

Cottony webbing and eggs laid at the base of the tree trunk.

Pine Needle Scale

Chionaspis pinifoliae (Fitch)

Pine needle scale is a common pest of most pine species, spruce, and Douglas-fir. Damage is especially noticeable on ornamental varieties of pine and trees growing along dusty roads. Insects feed by sucking sap from needles, causing the needles to yellow and eventually drop. Heavy infestations over several years can kill young trees and severely weaken larger trees, predisposing them to attack by other pests.

Pine needle scale on ponderosa pine needles.

BIOLOGY: The pine needle scale has two generations per year. The eighth-inch-long mature female scales are most conspicuous. They are almost pure white, slender at the front end, and wider at the rear end. Males are smaller, more slender, and rarely seen. Twenty to 30 eggs are laid in the fall and winter beneath the dead female scale. Eggs hatch in May and the nymphs or "crawlers" move to the new green needles to feed. Nymphs mature by early July, adults mate, and new clusters of eggs are laid. Scales of this second generation mature by fall and lay the overwintering eggs.

Enlarged view of female scale on a single needle.

CONTROL: Inspect trees for scales before digging or purchasing for transplant. On established trees, apply a foliar systemic insecticide (see page 45) in May and early June to provide some control of heavy infestations. Insecticides should be applied just before eggs hatch and then once or twice more at 7-10 day intervals to control nymphs hatching later. Adult insects are protected by a waxy covering and almost impossible to kill with insecticides. Summer or horticultural oils may improve effectiveness but they can discolor or burn plants if not applied correctly. Cutting or burning small infested trees is the only effective cultural control alternative to chemical insecticides. Ladybird beetles and a few species of parasitic wasps usually keep populations of this pest below seriously damaging levels.

Pinyon Spindle Gall Midge

Pinyonia edulicola Gagne'

Pinyon spindle gall midge produces a spindle-shaped swelling from the needle base that is about a half-inch long. The insect is a common forest pest that rarely causes serious damage. However, in urban settings heavy infestations can cause serious defoliation as galls dry and needles drop prematurely.

BIOLOGY: The pinyon spindle gall midge is a tiny fly about 1/16-inch (3-4 mm) long. Adults lay eggs on needles in late June and early July. Larvae hatch soon afterward and mine into the current year's needles, causing galls to form. Each gall contains from 5 to 40 small, orange, legless maggots. Larvae overwinter in the galls and pupate in the spring.

CONTROL: Controlling this pest usually isn't necessary. Landscape trees under stress that develop heavy infestations, may require treatment with a registered systemic insecticide (see page 45). Apply the insecticide when eggs are laid and hatching starts in late June and early July.

Needle gall.

Tiny, orange maggots inside gall.

Needle Miners

Pinyon Needle Miner

Coleotechnites edulicola Hodges and Stevens

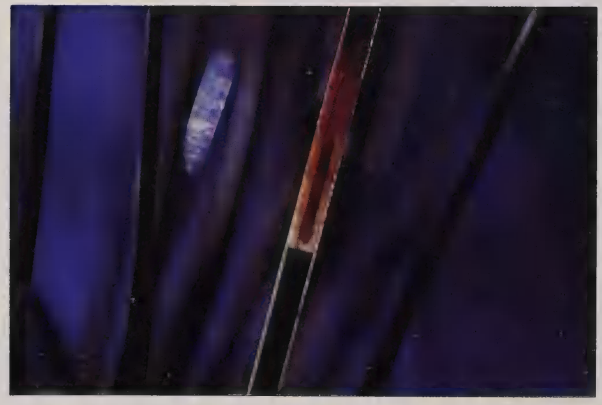
Ponderosa Pine Needle Miner

Coleotechnites ponderosae Hodges and Stevens

Needle miners are locally common on pinyon and ponderosa pine. Species resemble one another in appearance and damage but have different life cycles. Damage first becomes evident as foliage browns. Closer examination reveals hollowed-out needles. Early needle drop, reduced growth, and tree mortality can all result from needle miner infestations. The severity of the infestation varies significantly from tree to tree, suggesting that individual trees have some resistance to these pests.

BIOLOGY: Pinyon needle miners lay eggs from early June through mid-July. Larvae emerge soon after eggs are laid and bore into uninfested needles where they feed until fall. They overwinter inside the needles as dormant larvae. Feeding resumes in the spring and larvae grow to about 3/8-inch (5 mm) long. Pupation occurs in late May.

Pinyon needle miner exit hole.



Ponderosa pine needle miner inside needle.

Ponderosa pine needle miners lay eggs in late summer inside previously mined needles. The newly hatched larva bores into the tip of a green needle and mines slowly through the winter, developing more rapidly as the weather warms and then pupating in mid-summer.

CONTROL: Trees usually recover from needle miner damage without suffering serious injury. For direct control, use a foliar systemic insecticide after eggs have hatched (see page 45).

Pinyon needle miner damage.

Tiger Moth

Halisidota ingens (Edwards)

This insect can damage young ponderosa or pinyon pine but natural enemies prevent it from becoming a serious forest pest. Webbing and branch defoliation caused by tiger moths is unsightly on ornamentals.

Tiger moth tent.

BIOLOGY: Tiger moths produce one generation per year. Adult moths emerge from mid-July to late August. Females lay clusters of light green eggs on needles and twigs of host trees. Eggs hatch in 3-6 weeks. The small gregarious larvae are dark brown to black and quite hairy. Groups of young feed on current needles and form webs or tents enclosing a portion of the branch. Feeding continues through the fall and larvae overwinter in tents. Tents are usually located in the topmost branches or on the trees' south and west sides. Larvae will feed outside the webbing on warm sunny days throughout winter, returning to the tent before nightfall. By early spring, tents are large, conspicuous, and filled with masses of dead needles.

As caterpillars reach their full growth, they feed alone away from the tent, often migrating to another tree. Full-grown caterpillars are about 1-1/2 (3.5-4 cm) inches long and covered with yellow-brown to dark brown hairs that can cause a skin rash on people sensitive to them. In June, mature caterpillars spin brownish cocoons of silk and body hairs. These cocoons are attached to branches, limbs, and trunks of the host trees and occasionally to debris on the ground.

Tiger moth caterpillars.

CONTROL: Chemical insecticides and the bacterial insecticide, *B. t. (Bacillus thuringiensis)*, are available but not usually necessary. Remove tiger moth infestations by simply pruning and destroying branches with tents while larvae are resting inside.

Douglas-fir Tussock Moth

Orgyia pseudotsugata (McDunnough)

The Douglas-fir tussock moth is one of the most destructive pests on ornamental Douglas-fir, white fir, and blue spruce in New Mexico. Needles in the upper portion of infested trees may be completely removed after one or two years of feeding. In Southwestern forests, tussock moth outbreaks have generally been confined to overmature, multi-storied stands of white fir and Douglas-fir.

Wingless female laying eggs in frothy mass.

BIOLOGY: Eggs hatch in late May and early June and caterpillars feed on the current year's developing foliage. Young larvae are 1/8 to 1/4 inches (4-7 mm) long and covered with long, thin body hairs that later develop into tufts. Because the female moth is wingless, the primary means of dispersal from tree to tree is by windblown larvae. Young larvae congregate on the tops of defoliated trees and drop on silken threads that may be over 10 feet long. These threads eventually break from the tree and give a ballooning effect to the larvae. If caught by a strong wind, some larvae may be blown great distances. Many of the larvae will never find a suitable host and perish during dispersal.

Mature larva.

Mature larvae are up to 1-1/4 inches (31 mm) long and very colorful. Behind the head are two long, dark tufts of hair that resemble horns projecting forward. On the posterior is a longer tuft of hair projecting backward. In the middle of the back are four dense, buff-colored tussocks. Short hairs radiating from red, buttonlike centers cover the rest of the body except for the head and legs. Some people develop an itchy rash from exposure to the frequently airborne caterpillar hairs.

Older caterpillars do the most damage. After they are about half-grown, they feed on new and older foliage lower in the crown and farther back on the branches.

Cocoon on underside of branch.

Pupation occurs inside a thin, silk cocoon spun on the undersides of branches from late July to the end of August. Adults emerge within 10 to 18 days, depending on temperature.

The female moth has only rudimentary wings and cannot fly. She emits a chemical sex attractant and soon mates. If undisturbed, all of her eggs will be deposited in a single mass on top of the cocoon from which she emerged. From 150 to 300 eggs are laid in a dry, tough, frothy substance covered with hairs from the female's body. Overwintering occurs in the egg stage.

CONTROL: Without some form of control, ornamental trees can be completely stripped of all needles and die. Both chemical and biological insecticides are registered for use against the Douglas-fir tussock moth. The microbial insecticide, *B.t. (Bacillus thuringiensis)*, provides an effective alternative to chemical control. *B.t.* is a bacterium that produces a toxin lethal to many kinds of moth larvae. Spray it during dry weather on small larvae when the egg hatch is finished and leaf extension 40 to 50 percent complete. Chemical insecticides (see page 45) are also most effective when applied to the small larvae. Don't use these chemicals near water or bee hives; they're toxic to both fish and bees. Egg and larval parasites, a virus, general insect predators, and birds also help control outbreaks of this pest.

Defoliation by Douglas-fir tussock moth often kills the top of the tree.

Western Spruce Budworm

Choristoneura occidentalis Freeman

The western spruce budworm is a serious forest pest that damages ornamental and Christmas trees growing at higher elevations. The budworm attacks Douglas-fir, white fir, and spruce. Outbreaks are periodic and can last from several years to over a decade. Damage from budworm outbreaks includes tree mortality, top-killing, and growth loss. Defoliation in recreation areas is unsightly and camping and picnicking can be discouraged by large numbers of dispersing larvae.

BIOLOGY: Western spruce budworm moths are about an inch long (22 to 28 mm) and mottled gray to orange-brown in color. Eggs are laid on the undersides of needles throughout the crown of host trees from early July through mid-August. About 50 (range 15 - 120) pale green eggs are laid in two or three rows. Like fish scales, each egg overlaps the preceding one. Hatching usually occurs within seven to 10 days.

Newly hatched larvae are often dispersed by the wind to other branches. After a few days, they seek overwintering sites under bark or cone scales, between needles, or in other protected spots on the tree. They emerge the next May and chew paths through buds or feed at the base of new needles on expanding shoots. As they feed, they produce a silk webbing that catches uneaten needles. These needle remnants dry, turn red, and make the tree look scorched. The final two larval stages may be 25 to 32mm long and account for most of the defoliation. As new needles become scarce, larvae disperse on silk threads to the understory or adjacent trees.

Pupation occurs from late June to mid-July and lasts about 10 days. Adult moths emerge between late June and early August, depending on locality and weather conditions.

Larvae hatching from egg masses on needles.

CONTROL: At least 40 species of insect parasites attack the budworm; however, when weather and stand conditions are favorable, artificial controls may be necessary to keep budworm populations in check. Both chemical and biological insecticides are registered for use against the western spruce budworm. The microbial insecticide *Bacillus thuringiensis (B.t.)* provides an effective alternative to chemical control. *B.t.* is a bacterium that produces a toxin lethal to many kinds of moth larvae. Spray it on small larvae during dry weather. Chemical insecticides (see page 45) are also most effective when applied to early larvae. In forests, reduce budworm potential by thinning stands to remove Douglas-fir and white fir and by heavy regeneration cuts that favor the establishment of pine and aspen. Thinning to reduce stand density will also increase vigor and reduce stress on remaining trees.

Infested, expanding shoot.

Full-grown western spruce budworm larva.

Conifer Sawflies

Neodiprion spp., *Zadiprion* spp.

Conifer sawflies can be divided into two groups—the "spring" and "summer" sawflies. Spring species generally feed on old needles so the new foliage remains and trees are never completely defoliated. However, summer sawflies feed on new needles first and then attack older needles. Defoliation by summer sawflies results in greater growth loss and more frequent tree mortality.

Typical sawfly feeding damage.

Adult female sawfly and eggs laid in slits on needle.

CONTROL: Since the insects feed in colonies, simply wash the larvae off with a high pressure hose, prune infested branches, or pick the larvae off by hand. For larger outbreaks, you may need to use a registered insecticide (see page 45).

BIOLOGY: Adult sawflies are wasplike insects less than a half inch (11mm) long. The female uses a sawlike ovipositor to cut slits into needles where eggs are laid. Most sawfly larvae feed in groups of 50 or more. Young larvae skeletonize the needles. Older larvae consume needles entirely. Larvae resemble caterpillars but have six or more pairs of abdominal prolegs and one pair of eye spots on the head. There is wide variation in color; many species are dark green or black.

Gregarious sawfly larvae clustered around branch.

Conifer Aphids

Cinara spp.

There are many species of conifer aphids in New Mexico that attack pines, true firs, Douglas-fir, and spruces. Many of these are specific to a particular genus of tree, some even to a particular species. Conifer aphids are rarely a concern in the forest but often an annoying pest on ornamentals around homes. Heavy infestations cause foliage to yellow and stunt the growth of young trees. Needle growth is reduced, twigs dry, and heavy defoliation occurs with excessive feeding. Occasionally, even larger trees are so weakened that they die in a few seasons or are attacked by other insects.

Aphids feed by piercing the bark of branches and twigs and sucking out large amounts of sap. Because they can't use all of the liquid portion of the sap, they expel much water, sugar, and other compounds. This sweet, sticky substance is called honeydew and is often covered with a black fungus called sooty-mold. Ants, bees, and wasps are attracted to the honeydew. When aphid populations are high, honeydew rains down, covering lower branches and objects below the tree. Sometimes it appears as though the tree and adjacent area were sprayed with crude oil.

Aphid eggs on ponderosa pine needle.

Spruce aphid defoliation on Colorado blue spruce.

BIOLOGY: Most species are quite large for aphids, up to 1/4 inch (6mm), and are generally dark in color. In the fall, females lay shiny, black eggs that resemble very tiny jelly beans on the twigs and needles. Eggs hatch in the spring and the females soon begin producing live young without mating. There are a number of generations per year with both winged and wingless forms.

CONTROL: Several chemical pesticides (see page 45) and insecticidal soaps effectively control conifer aphids. The timing of spray application or other chemical control measure isn't as critical to successful control as with other insects. Damaging populations should be present before taking any control action. Low populations are effectively controlled by a host of natural enemies.

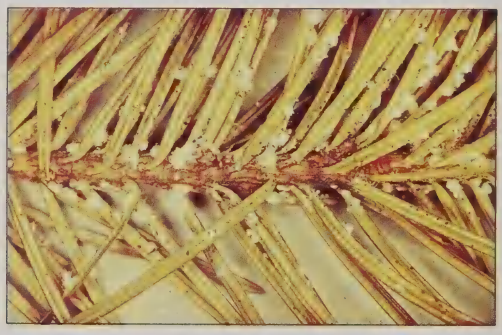
Aphid on spruce branch.

Cooley Spruce Gall Adelgid

Adelges cooleyi (Gillette)

Cooley spruce gall adelgid is the most common gall-forming adelgid on spruce in New Mexico. The galls are cone-shaped or pineapple-shaped. The insect is not usually considered a forest pest, but is often troublesome on ornamental spruce and in Christmas tree plantations where large numbers of galls are aesthetically damaging. Galls don't seriously affect overall tree health.

BIOLOGY: Generally, winged females fly from Douglas-fir to spruce where they lay eggs at the bases of newly expanding buds in early spring. Nymphs hatch from eggs and begin feeding at the bases of growing needles. In response to chemicals injected by feeding nymphs, the tree quickly envelops the insects in rapidly developing galls. Young galls are green to purple and become purplish or reddish brown with age. Galls contain 50 to 350 nymphs and are usually from 1 to 3 inches (25-75mm) long. In mid-July, galls begin to dry and open, allowing the full-grown nymphs to crawl out to the needles. Nymphs molt into winged adults and fly back to Douglas-fir to lay eggs. This generation of nymphs secretes a waxy, woolly covering over their bodies as they feed. The insects look like little balls of cotton clinging to needles. Occasionally, heavy infestations on Douglas-fir will look like snow on the tree. Feeding causes yellow spots on the needles and may cause distorted needles. Eventually, another winged form is produced that migrates back to spruce, completing the life cycle.



Alternate life-stage or "wolly aphid" on Douglas-Fir.

Galls on spruce.

CONTROL: There are insecticides (see page 45) to control the adelgid; however, timing of the spray is difficult to determine for effective control. Dormant oils applied before buds swell have effectively controlled the overwintering stages. However, there is a risk of injuring or discoloring foliage when using oils. On small ornamentals, prune off galls before adults emerge. It may also help to plant spruce or Douglas-fir exclusively, rather than planting the species together.

Spider Mites

Oligonychus spp., *Tetranychus* spp.

Although these tiny arthropods have six legs when they hatch from the egg, they're not insects. After molting once, they become eight-legged. There are a number of species that may be green, yellow, orange, or red, often with dark pigmented patterns. Spider mites feed on a variety of conifers but are most likely to be a problem on spruce and juniper. Feeding symptoms resemble those of aphids and scales — spotting, yellowing, and premature dropping of needles. Webbing and associated eggs, cast skins, and live mites are also characteristic. The webbing can become obvious if it becomes covered with dust.

BIOLOGY: Spider mites have piercing-sucking mouth parts and damage trees by sucking plant juices from needles. Numerous generations can be completed in a single year and the population can explode in hot, dry conditions in the absence of natural enemies.

The spruce spider mite, *Oligonychus ununguis* (Jacobi), and the two-spotted mite, *Tetranychus urticae* (Koch), appear to be the primary species found in New Mexico.

CONTROL: Wash the plants with a strong stream of water to remove many of the mites and help keep the population in check. For large plantings, there are a number of miticides registered as well as insecticidal soaps, and dormant and summer oils (see page 45).

Comparison of clean (left) and mite infested, dusty foliage.

Closeup of spider mite and eggs.

Pine Tip Moths

Rhyaciona spp.

There are at least eight different species of pine tip moths in New Mexico. All species mine in the buds and terminal shoots. Injury is most severe on trees under 12 feet tall that may be stunted or deformed by heavy infestations. Hosts include ponderosa, pinyon, eldarica (Afghanistan), and other pines.

Damage to pine shoot.

BIOLOGY: Most species have one generation per year; the Nantucket pine tip moth has two to four generations. Eggs are laid on new shoots or terminal buds from March through June depending on the species. Newly-hatched larvae feed for a short time at the bases of needles. They then bore into buds, laterals, and terminals, and mine out the pith from the tip down to the base of the shoot. The point of attack is marked by a small resin flow, but no pitch nodule is formed. The larvae are yellow to orange to brown and are 1/2 to 3/4 inches (10 to 20mm) long when full-grown. Tip moths, depending on the species, overwinter as pupae in the tips or shoots, in bark crevices, or in litter below the tree.

CONTROL: Heavily attacked ornamentals may require insecticidal control (see page 45). Timing of control is critical for success. Control the newly hatched larvae before they bore into the shoots. Use pheromone traps to monitor moth populations to determine times of peak egg-laying.

The southwestern pine tip moth, which is common in northern New Mexico, can be reduced by destroying the overwintering pupal stage. Pupae of this species are found attached to the root collar of the tree in plasterlike cocoons.

Severely damaged ponderosa pine.

Nantucket pine tip moth adult.

Pinyon Pitch Nodule Moth

Petrova arizonensis (Heinrich)

Pinyon pitch nodule moth attacks pinyon pines throughout New Mexico. Attacks are characterized by fading branch tips and nodules of pitch formed at the insect's feeding sites. The pitch nodules are hollow balls of pitch 1/2 to 1 inch (10-25mm) long, round, smooth, and often light purple or red. They're most often found at the crotch of two or more twigs. The fading twigs eventually lose their needles and fall off. Leaders are occasionally damaged and forked trees may result.

BIOLOGY: The pinyon pitch nodule moth has one generation per year. The small, rusty-brown moths emerge through holes in the pitch nodule in late June and early July. Eggs are laid on needle sheaths of the current year's growth. Newly hatched larvae feed on young needles before boring into the bark at nodes or whorls of twigs or branches. Full-grown larvae are about 1/2 inch (10mm) long, reddish yellow with a black head and a dark area behind the head.

Dead tips and crusty pitch nodule with adult exit hole.

Pupation occurs inside the pitch nodule in June. Pupae move just below the surface of the pitch before they emerge as adults.

Reddish-brown "pitch nodule" and fading needles characterize new attack.

CONTROL: There are no registered insecticides to control this insect. In the forest, top-killing of pinyon is rarely important. On valuable ornamental trees, control the insect by pruning and destroying the infested tips as they fade in May or early June before the adult moths emerge. On branches and stems, destroy larvae by crushing them within the pitch nodule.

Spittlebugs

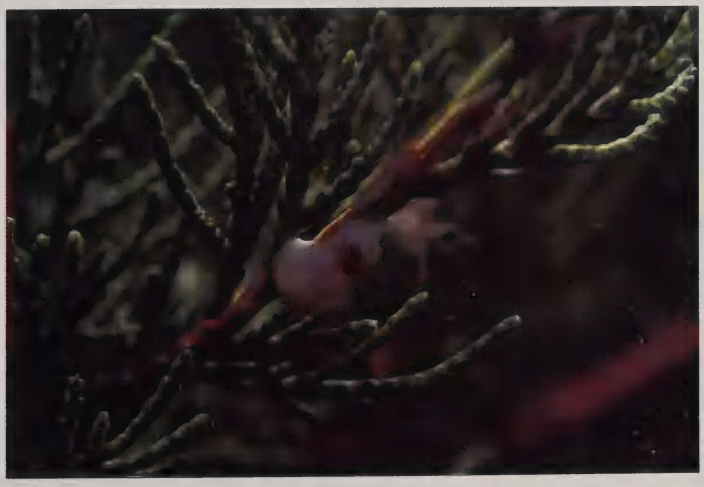
Aphrophora spp.
Clastoptera spp.

Spittlebugs feed on many conifer species in New Mexico but those found on juniper are most often noticed. The insects are characterized by spittlelike froth produced by feeding nymphs. The insect's feeding causes no significant damage to forest or ornamental trees. Scattered twig mortality may be seen in the crown of infested trees.

BIOLOGY: Adult spittlebugs (froghoppers) are very active and superficially resemble leafhoppers. Most species lay eggs in midsummer in rows on the foliage. Eggs hatch the following spring. Nymphs of some species drop from the trees and feed on understory shrubs while those of the juniper spittlebug remain on the trees.

Nymphs are soft-bodied and white to brown. As they feed, they produce masses of "spittle" by internally blowing air through a viscous sugar solution and releasing froth through the anus. The spittle serves both as a protective device and as a means of reducing evaporation. Nymphs shed their skin five times before molting into winged adults. Adults continue to feed all summer on sap from twigs but do not produce a spittlemass.

CONTROL: Spittlebug injury isn't serious in New Mexico and doesn't warrant control, but spittlemasses on ornamentals can be unsightly. Use a strong stream of water from a garden hose to dislodge nymphs and wash away the spittlemasses.



Juniper spittlebug spittle mass.

Bark Moths and Pitch Moths

Dioryctria spp. *and Vespamima* spp.

Bark moths and pitch moths have similar habits and effects on trees. Pinyon pine is the primary host in New Mexico, although ponderosa pine and occasionally Douglas-fir and the true firs are attacked. Larger branches, limbs, and trunks of young trees are attacked. Repeated attacks can seriously weaken trees and kill branches. The most severe damage is to trees under 20 feet, especially in urban areas. The insects are rarely a problem on larger trees or in the forest environment.

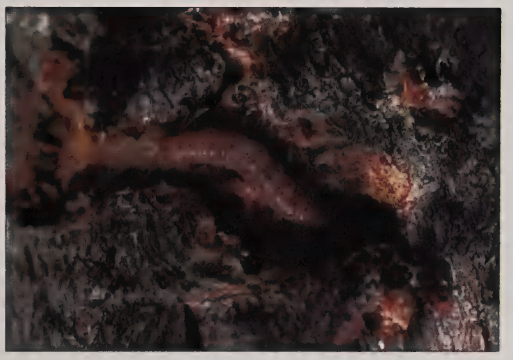
Pitch moth attacks appear as large, ugly masses of pitch that form at the wound site. Bark moth attacks typically produce less pitch.

Pitch moth attack on the underside of pinyon branch.

Fresh pitch moth attack on pinyon.

BIOLOGY: Pitch moths (*Vespamima* spp.) require two years for one generation and overwinter as larvae each winter. Bark moths (*Dioryctria* spp.) require only one year for a generation and overwinter as eggs or larvae. Eggs are laid in bark crevices or near mechanical wounds on the bark. Newly hatched larvae tunnel under the bark, forming irregular galleries or elongated gouges in the sapwood. Pitch moth larvae feed on pitch the tree produces in response to their tunneling. Oozing pitch masses 1 to 3 inches (25-75mm) in diameter cover entry holes and conceal larvae and their destructive tunneling. Full-grown larvae are 3/4 to 1 inch (15-25mm) long, dirty white, yellow, orange, light green, or light brown. Bark moth larvae feed on the inner bark and when full-grown, are marked with rows of dark spots.

CONTROL: No insecticides are registered for use on these insects. The only effective control is removing larvae from the pitch mass or from under the bark with a knife or similar tool.



Bark moth larva mining under ponderosa pine bark.

Twig Beetles

Pityophthorus spp., *Pityogenes* spp.

Twig beetles are frequent pests of pines and occasionally spruce and other conifers. In forests, they attack shaded-out and storm-damaged twigs and branches. Occasionally, high beetle populations develop in drought-stressed, injured, or recently felled trees. Generally, breeding is restricted to twigs and small branches, but larger branches and thin barked portions of the trunk of stressed trees may be attacked. In urban areas, recently transplanted pines may be killed by trunk infestations.

Twig beetle damage to pinyon tips.

Trees attacked by twig beetles can be identified by fading branches throughout the crown. Tan sawdust is produced around the attack site. On smaller twigs and branches, most of the cambium will have been mined beneath the bark. Small, star-shaped egg galleries can be seen under the bark on larger branches and small trunks.

Tiny exit holes on pine twigs and branches.

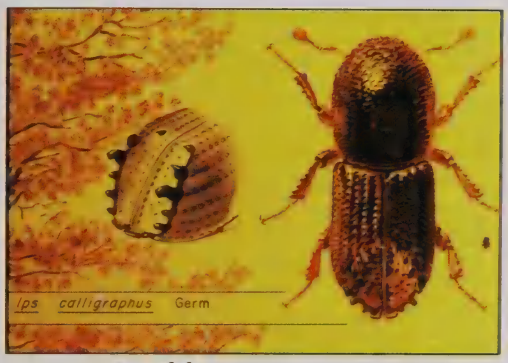
BIOLOGY: Adult twig beetles are 1/16 to 1/8 inch (1.5 to 3.0mm) long and dark brown. Most species have rounded rear ends but a few have a pair of short spines. The larvae are fat, white, "C"-shaped grubs with light brown heads. Most species have 2 to 4 generations per year, depending on local conditions.

CONTROL: Control infestations of twig beetles by hand-pruning infested twigs and branches and by keeping trees vigorous with supplemental food and water.

Bark Beetles

Ips spp.
Dendroctonus spp.

Ips beetles, also called engraver beetles, attack ponderosa and pinyon pines as well as other conifers. Dendroctonus beetles attack medium to large ponderosa pine, blue spruce, Engelmann spruce, and Douglas-fir trees in New Mexico. Different species within the genera are difficult to distinguish based on body shape alone. Host species attacked, location, and shape of tunnels (egg galleries) they excavate are all important clues in identifying the pest species.



Ips adult.

Dendroctonus adult.

Full-grown bark beetle larvae and pupae. Note blue stain to wood caused by introduced fungus.

BIOLOGY: Details of the life cycle vary with each species but some generalizations can be made. Initial attack on a tree is made by a few adult beetles. Once a tree is selected, the beetles produce an "aggregation" pheromone, drawing many beetles to the tree. The attack on the tree may be initiated by the male (ie. *Ips* spp.)

or by the female (ie. *Dendroctonus* spp.) beetle. The beetle chews through the bark and excavates a chamber in the moist tissue beneath the bark. The opposite sex then enters the chamber and mating occurs. The female beetles then excavate distinctive tunnels or egg galleries under the bark. Eggs are laid in niches along the lateral walls.

Ips gallery showing central mating chamber and radiating egg galleries.

Adult beetles may introduce a number of microorganisms to the tree when they attack. Some species have evolved specialized pockets for carrying such microorganisms as fungi, yeasts, and bacteria. Introduced blue-stain fungi are particularly important in killing the tree and may provide nutrition for the developing brood.

Boring dust at the base of a tree.

Pitch tubes from Dendroctonus beetles on ponderosa pine.

After hatching, larvae bore away from the egg gallery at right angles. They molt three or four times and then construct a pupal cell either in the phloem or in the bark.

Bark beetles usually attack severely weakened or damaged mature or overmature trees. Trees damaged by lightning or harsh weather and trees stressed from transplanting, logging slash, and recently cut firewood are prime candidates for bark beetle colonization. Vigorously growing trees have active resin systems that deter such colonization. When the beetle bores into a healthy tree, resin exudes through the wound and may prevent the beetle's entry. The resin may also inhibit spread of the fungus that aids the beetles in killing the tree. When populations of bark beetles are very high, particularly around an outbreak, trees may be attacked by so many beetles that even healthy trees succumb.

Time between generations varies considerably for different species of bark beetles. Some species of Ips can complete their life cycle in six to eight weeks during warm summer months. Others require two years for a single generation, such as the spruce beetle (*Dendroctonus rufipennis* Kirby), which lives at high elevations. Most species will have one or two generations per year.

Fading crowns of bark beetle infested trees.

SYMPTOMS: Foliage high in the tree begins to fade, turning from green to yellow or red after the tree has been attacked. Boring dust, a sawdust-like material pushed out of beetle galleries, can often be found around the base of the tree, in bark crevices beneath entrance holes, and on tops of branches where they intersect the trunk. Globules of resin called "pitch tubes", produced as the tree's defense, may or may not be present. Woodpecker activity on the trunk is also a good indication that the tree has been attacked.

PREVENTION AND CONTROL: Once a tree has been successfully colonized by bark beetles, it cannot be saved. Infested trees should be removed, burned, or buried as soon as possible to protect surrounding trees from attack by emerging beetles.

Check green firewood for bark beetles. Bark beetles emerging from infested firewood account for many tree losses near homes and in urban settings. If firewood has been stored for at least one season, the beetles won't be present. Green firewood collected or purchased in summer when temperatures are high should be stacked in direct sunlight and covered with clear plastic. Don't use black or other opaque plastic because it prevents sunlight from entering. Piles should be no larger than 4x4x4 ft. or 1/2 cord. The edges of the plastic should be buried in the ground. This creates a greenhouse effect, raising temperatures under the plastic up to 160 degrees (F). After two or three weeks of sunny weather, the beetles should all be dead. Bark beetles can also be prevented or controlled in firewood by peeling off the bark. This exposes the phloem, rendering it useless to the beetles. The method is difficult but effective.

Green firewood piles are often bark beetle breeding grounds.

Preventive control measures using chemicals are discussed on page 46.

Green firewood should be stacked in the sun and covered with clear plastic.

Roundheaded and Flatheaded Wood Borers

Family Cerambycidae
Family Buprestidae

Roundheaded and flatheaded wood borers attack recently dead and dying trees, often riddling them with tunnels. In the forest, they become especially numerous after fires. Roundheaded borers are often the most destructive, tunneling deep into the wood. Fresh-cut logs left in the forest or in storage for a year can be seriously damaged. These beetle larvae can often be heard chewing in infested firewood or vigas. Adults feed on cambium of twigs and small branches and on needle bases. Shoot tips occasionally flag above adult feeding sites. Adult feeding damage can be heavy along edges of recent clearcuts, in groups of seed trees left in clearcuts, or in residual blocks of timber left in harvested areas.

Adult roundheaded borer, a long-horned beetle.

BIOLOGY: Generally, the life cycle is complete in at least two years. Eggs are laid in slits in the bark throughout the summer. Young larvae feed on wood beneath the bark, creating tunnels filled with frass and wood chips. In late summer, they tunnel deeper into the wood and overwinter. The next year they continue tunneling through the wood. Full-grown roundheaded larvae are legless, with cylindrical, segmented bodies. Flatheaded larvae are similar but are broad and flat behind the head. They pupate at the end of a tunnel beneath the bark. Adults emerge through circular (roundheaded) or oval (flatheaded) holes cut in the bark and feed on needles and tender bark of twigs.

Cross-section of borer infested log.

CONTROL: Wood borer damage to logs cut for lumber or vigas can be prevented by using wood soon after cutting it. Other guidelines for preventing damage are as follows:

- Before spring, remove wood cut in the winter from the stand.
- When storing wood in the forest, piles should be as large as practical and a long distance from cutting areas.
- Wood cut in summer should be used immediately.
- Wood stored in the forest in summer should not be stored in the mill woodyard.
- Wood piles in the woodyard should be as large as possible.

Western Cedar Borer

Trachykele blondeli Marseul

Western cedar borer is an aggressive pest of juniper and Arizona cypress in New Mexico. It belongs to the buprestid beetle group also known as metallic or flatheaded wood borers. Unlike most other buprestids, the western cedar borer will attack and seriously injure or kill seemingly healthy trees. Considerable damage is found in some juniper stands; older, larger trees appear to be favored by the beetles. Larval galleries degrade lumber from logs, making them useless for products requiring sound wood, such as furniture.

BIOLOGY: Adults range from 1/4 to 1/2 inch (11 to 17mm) long and are bright emerald with several dark areas on the wing covers. Females lay eggs under bark scales on branches of living trees. Flatheaded larvae bore from branches into the main bole. They feed primarily in the heartwood for several years. Full-grown larvae move near the surface and pupate. Adults emerge in the spring, leaving oval or rectangular exit holes in the tree.

CONTROL: No practical controls or preventive measures have been developed for this insect pest.

Adult exit hole.

Cross-section of damage.

Juniper Twig Pruner

Styloxus bicolor (Champlain and Knull)

Juniper twig pruner causes twig dieback on junipers and Arizona cypress growing throughout New Mexico. The insect is a small cerambycid or long-horned beetle.

BIOLOGY: The juniper twig pruner adult is 1/4 to 1/2 inch (7 to 11mm) long and has a reddish-orange head and brownish to black body. Eggs are laid on branches, often near an intersection of twigs, one to two feet from the branch tip. Larvae are small, white, cylindrical, legless grubs that kill twigs by boring through the centers. The life cycle may take as long as two years to complete.

CONTROL: No chemicals are registered for control of this pest. Damage can be unsightly when populations are high but trees are rarely seriously injured by the juniper twig pruner.

Adult exit hole.

Cross section of injured twig.

Juniper twig pruner damage.

Mistletoes

Arceuthobium spp. *and Phoradendron* spp.

Mistletoes are parasitic plants that injure and may eventually kill their woody hosts by stealing water and essential nutrients. Both dwarf mistletoe and true mistletoes occur in New Mexico. Dwarf mistletoes live only on conifers, while true mistletoes occur on conifer and hardwood trees and shrubs. In New Mexico, dwarf mistletoes attack ponderosa pine, Southwestern white pine, pinyon, Douglas-fir, Englemann spruce, and blue spruce, while true mistletoes are found on several species of juniper, numerous species of oak, and other hardwoods.

Mistletoe plants vary in color from yellow to green to red-green. Dwarf mistletoe plants vary in size from an inconspicuous bud structure protruding through the tree bark as found on Douglas-fir to shoots nearly a foot long on ponderosa pine. True mistletoe plants vary in length from a few inches to several feet. Symptoms of mistletoe infection include swelling at infection sites and formation of witches' brooms.

BIOLOGY: Dwarf mistletoes spread by shooting seeds from explosive berries a distance of 20 to 30 feet. True mistletoes are spread by birds that eat mistletoe berries. Seeds pass through the birds unharmed and are spread in their feces.

CONTROL: Branch infections on trees attacked by mistletoe can be pruned out to reduce damage and to reduce further spread of the parasite. If the infection is on or close to the trunk of the tree, it cannot be removed. A chemical is registered (see page 46) to spray on mistletoe plants to cause abscission of the fruiting structures of the plant. This does not remove the mistletoe infection, but it can stop the plant from spreading within the tree or to other trees. Another suggested treatment of infections on trunk and large branches is clipping fruiting

Witches broom caused by dwarf mistletoe.

structures as close to the wood as possible. Next, remove some of the bark and wood where roots of the parasite have grown and paint it with a thick coat of asphalt tree dressing. The asphalt material is somewhat toxic to mistletoe and will prevent it from returning for a few years.

Infection on trunk.

True mistletoe on juniper.

Broom Rusts

Chrysomyxa spp.
Melampsorella caryophyllacearum

Broom rusts are primarily a forest problem. Infections cause growth loss, top-kill, and occasionally tree mortality. Trunk infections may provide entrance for decay fungi.

Two species of broom rust are important in New Mexico—spruce broom rust, which attacks Engelmann spruce and blue spruce, and fir broom rust, which attacks white fir and subalpine fir. Infections are characterized by conspicuous, dense masses of branches called witches' brooms. Witches' brooms are large and yellow.

BIOLOGY: Broom rust fungi require the presence of an alternate host to complete their life cycle and successfully spread. Kinnikinnick is the alternate host for spruce broom rust and chickweed the alternate host for fir broom rust. Needles on brooms are often stunted and drop off each fall. Other fungi and disease organisms may cause formation of witches' brooms, but only broom rust causes annual drop of needles.

CONTROL: On trees with only a few branch infections, witches' brooms can be pruned out if the infection is not too close to the trunk of the tree. Trunk infections are characterized by trunk swelling and cracks in the bark at infection sites. There are no chemical or biological controls available for broom rust.

Broom rust on white fir.

Branch and Shoot Dieback on Spruce

Cytospora Canker of Spruce
Cytospora kunzei Sacc.

Sirococcus Shoot Blight of Spruce
Sirococcus strobilinus

Cytospora canker and Sirococcus shoot blight are primarily fungal diseases of Colorado blue spruce, although other ornamental spruce and Douglas-fir may be attacked.

Cytospora canker causes death of lower branches followed by progressive dying of branches up the tree. Trees are occasionally killed, but more often damaged by loss of symmetry. Cytospora cankers are inconspicuous and may or may not cause bark deformation. Any part of the branch is susceptible to girdling except for very small twigs. Typically infected areas are marked by a heavy, clear amber pitch flow that later dries and covers the cankered area with a hard, crusty, white pitch coat. Pitch exuded will also drip down and cover branches below the infection. Needles on infected branches fade and eventually turn brown. Needles may stay on the branch for up to a year after infection.

Sirococcus shoot blight is indicated by fading, drying needles at the ends of branches. Needles eventually drop, leaving the last 2 to 12 inches of branches bare by summer's end. It is usually seen after heavy rainfall and high humidity.

BIOLOGY: Tiny black fruiting bodies of Cytospora canker can be seen by scraping away bark in the transition area of diseased and healthy tissue. Spores ooze from fruiting bodies in wet spring and summer weather and spread to the same or other trees by splashing rain, wind, insects, birds, and man. Spores must land on freshly wounded wood to infect the tree.

Small fruiting structures of Sirococcus shoot blight can be seen with a hand lens on bud scales and other parts of dying shoots. A canker also forms as the fungus grows within the succulent stem; it rarely invades older wood. Spores are produced by fruiting structures during wet periods and are spread by splashing rain and irrigation water.

CONTROL: Trees under environmental stress, especially during drought, appear most susceptible to infection. Fertilizing and watering during dry periods aids tree vigor, but will probably not control the disease.

Cytospora—Early detection and removal of infected branches can reduce continued development of the disease. Prune infected branches close to the trunk. Cankers will continue to produce spores even after pruning so promptly destroy (burn of bury) cut branches. Prune only in dry weather to avoid spreading spores to healthy branches. After pruning, watch for development of new cankers. No chemical sprays adequately control Cytospora on spruce.

Sirococcus—Remove diseased shoots to reduce sources of infection and improve the tree's appearance. Fungicide sprays may help reduce infection if applied before summer rains and periods of high humidity. See page 46 for specific recommendations.

Root Rots

Shoestring Root Rot
Armillaria mellea

Annosus Root Rot
Heterobasidion annosum

Root diseases are difficult to diagnose since symptoms above the ground can resemble symptoms caused by many other problems. In ornamental situations, root problems frequently develop in response to unfavorable soil conditions, such as an impenetrable hardpan or abnormally high or low moisture content. In forests, two frequently encountered root diseases are shoestring root rot and annosus root rot. Both of these diseases occur in expanding pockets, often with mortality at the center. The entire crown of infected saplings usually turns reddish brown all at once. Dieback, thinning foliage, or yellowing of the crown is characteristic in older trees. Forest trees are predisposed to root disease when stressed by fire, drought, poor sites, or insect injury.

Both diseases attack a wide range of conifers. Shoestring root rot infects both hardwoods and conifers, although conifers are more vulnerable to mortality. Young pines planted on old hardwood sites are often infected by this disease because the fungus remains active in stumps and old root systems for years.

BIOLOGY: Shoestring root rot often produces white, fan-shaped mats beneath the bark on the lower surface of infected boles and shoestring-like black rhizomorphs in the soil. Outer bark at the root collar is often covered with resin. The disease spreads over long distances by means of spores or locally by rhizomorphs. When the fungus contacts the tree's root or root collar, it penetrates the bark and enters the living tissue. It then spreads and penetrates the wood. Cellulose is consumed, leaving the root light-colored and causing the tree's butt to rot. In late summer or early fall, a honey-colored mushroom is produced, commonly at the base of the infected tree. As the mushroom matures, the surface of the cap breaks into dark brown scales. Whitish gills produce wind-borne spores.

Annosus root rot causes small silver flecks to form on the cambium of the roots and root collar. It produces long, shallow pockets of decay, often surrounded by spongy wood. Root rot may penetrate the heartwood and grow into the stem, resulting in butt rot. It's spread by airborne spores that often infect freshly cut stumps or locally from contact between healthy and infected roots in the soil. The fungus produces small (less than 1 in.), white to buff-colored conks under the bark or larger (6 - 8 in.) shelf-like conks flat against the soil or in litter.

CONTROL: Maintain trees in vigorous condition. Avoid planting pines on old hardwood sites that contain shoestring root rot infected stumps. In areas infected with annosus root rot, avoid thinning stands during cool, wet periods, that stimulate spore production.

Needle Diseases

In New Mexico, relatively dry conditions help limit the incidence of foliage diseases in conifers. Many non-insect foliage problems are due to environmental factors rather than disease. However, there are a few needle diseases that may occur.

Lophodermella concolor—This fungus is an occasional problem primarily for ponderosa pine in New Mexico at elevations above 7,000 feet. During outbreaks of the disease, nearly all of the second-year foliage in the lower half of the crown may be lost. If conditions allow for successive years of infection, only the current year's needles will be left on the tree. Airborne spores of the fungus settle and germinate on developing needles in spring. The following spring, infected needles turn reddish brown and small, fruiting structures develop that are difficult to detect. Needles dry and fall from the tree shortly after the fruiting structures mature.

Elytroderma deformans—Elytroderma needle cast is widespread and infects pinyon and ponderosa pine in New Mexico. It is particularly damaging because it invades twigs and branches and persists for several years. Symptoms occur in spring when all of the year-old needles on an infected twig simultaneously turn red brown 6 - 12mm from the needle bases. Infected needles persist on the tree until fall or winter. Fortunately, incidence of the disease is low because weather conditions favoring its development are rare. Local outbreaks generally start in sheltered humid places, such as bottoms of deep arroyos, sapling thickets, and on low branches on north sides of trees pole-sized and larger.

Dothistroma pini—Dothistroma needle cast (red band disease or red banded needle blight) may infect ponderosa, pinyon, and Austrian pines in New Mexico. Symptoms first appear as yellow or tan bands around the needles. Bands later turn red. Both old and new needles may be infected, but infection periods differ. Old needles are infected in spring and usually turn brown by fall. New needles are infected in mid-summer and turn brown in late summer the following year. Initial infection occurs on the lower portion of the tree and progresses upwards. Spores are released during rainy weather and spread by splashing rain.

Rhabdocline pseudotsugae—Rhabdocline needle cast on Douglas-fir is an occasional problem in New Mexico. The most recent outbreak was seen in 1989 in and around the Lincoln National Forest and on Mescalero Apache lands. This conspicuous fungus disease causes mottling and premature shedding of needles over a year old. It occurs during long, rainy periods while new needles are growing. The disease is not usually serious since conditions favoring infection rarely occur over successive years.

Other Problems

Numerous environmental stresses, both natural and human-caused, may injure or kill trees. Any factor interfering with the tree's physiology can injure it.

Natural Environmental Stresses

Cold Injury—Injury from cold temperatures can usually be categorized as frost damage or winter damage. Frost damage most often occurs in the spring after shoots have begun to grow. Trees most frequently injured are those growing at the northern limit of their species range. Young conifers are more susceptible to injury than are older trees. Frost damage to spring shoots may resemble damage from shoot borers such as pine tip moth. Winter injury generally occurs in midwinter to early spring. Most often, the entire tree above the snow line is affected. Cold winds dry the foliage but because the ground is frozen, the tree can't replace lost moisture so foliage dies and turns red. Protect ornamental conifers by covering them or buffering them from dry, cold winds.

Heat Injury—Tree tissues may be injured by unusually high temperatures. Sunscald results from overheating and drying of bark and is characterized by reddening bark, followed by canker formation. Leaf scorch or needle scorch, a heat injury found more frequently on hardwoods but also on young conifers, results when a tree loses more water through transpiration than it can absorb through the roots.

Water Injury—Lack of water can cause foliage to dry from the tips back and eventually foliage and twigs may die. Drought injury is indicated when foliage yellows or browns and needles are prematurely cast. Flooding or a dramatic increase in the water table can suffocate tree roots, resulting in above-ground symptoms of discolored foliage and spongy bark.

Soil Deficiencies—A shortage of available nutrients can injure or kill conifers. New Mexico soils are often deficient in iron and zinc and have a pH level that ties up many nutrients in compounds the tree can't use. Nutrient abnormalities are indicated by foliage discoloration and often by distorted needles and twigs. Heavy clays commonly encountered in New Mexico are difficult for roots to penetrate and can significantly limit tree growth.

Storm Injury—High winds can break branches, limbs, or trunks. Shallow rooted trees are often uprooted. Heavy snows may break limbs. Hailstorms can wound or kill buds, foliage, twigs, and branches. Damage varies with time of year, size of hailstones, and intensity of the storm. Younger stems with tender bark and trees with developing foliage are most seriously damaged.

Animal Injury—Mice and other small rodents seriously damage trees by feeding on bark at the root collar of young conifers, particularly in plantations. Damage usually occurs in winter when snows are deep, food scarce, and where there is plenty of grass or weed cover around the trees' base. Trees are often completely girdled although symptoms of injury may not appear until the following summer or fall. Sapsuckers also commonly injure and kill trees. These birds drill holes, often in a characteristic pattern, and drink the sap. Bark in heavily drilled areas may die. Occasionally, the tree or its top is completely girdled. Forest trees may be browsed on by deer and damaged by deer or elk rubbing antlers against tender bark. Small ornamental trees and shrubs around the home may be injured by dog urine and by cats sharpening their claws on thin bark.

Human-Caused Stresses

Soil Compaction—Soil trampled by confined animals or compacted by machine traffic is less aerated and resists water penetration and drainage. Injury to tree roots during soil compaction results in yellowing foliage, premature leaf drop, and often death of the tree.

Mechanical Injury—Frequent wounding of ornamental trees occurs from lawn mowers and trimmers hitting the base of the tree. Mechanical injuries can occur from anything scraping against the bark. Poor pruning jobs can seriously wound trees. Excavation around trees can hurt the root system.

Air Pollution—Trees can be injured or even killed by air pollutants. Symptoms of air pollution injury generally include discolored, spotted, or blotched foliage. Most damaging pollutants are produced from industrial emissions and vehicle exhausts. Oxidants produced by internal combustion engines are concentrated in urban areas but may be windborne to rural areas. Ozone injury may occur anywhere from ozone created by lightning. Industrial emissions such as sulfur dioxide and fluorides, usually only cause injury in areas immediately downwind of the pollution generator.

Salt Injury—De-icing salt applied to roads, walks, and driveways can seriously injure trees. Most of the damage occurs on foliage but eventually roots may be killed. Salt-injured trees may have yellow, red, or brown needles. Frequently, only the road side of the tree shows symptoms resulting from salt spray from passing vehicles. Calcium-based salts are less damaging than sodium salts; unfortunately these are infrequently used. Salt-injured trees also appear more susceptible to winter injury.

Herbicide Injury—Conifers are very susceptible to herbicides and herbicide drift. The concentration and type of herbicide reaching the tree, the type of tree, and weather conditions all affect severity of injury. Frequently, foliage and twigs will be distorted. Ornamental trees can be damaged by overapplication of lawn weed killers, which usually contain 2,4-D.

General Chemical Recommendations and Precautions

Mechanical and biological options have been provided for reducing pest damage wherever possible. Chemical insecticides are rarely necessary in forests where individual tree injury or loss is often insignificant. However pesticide use may be necessary to protect valuable ornamental trees, nursery stock, or forest trees in areas heavily traveled. Pesticides' poisonous nature mandates strict adherence to recommended dosages and precautions for handling and use as listed on the label. Follow these precautions whenever using pesticides:

1. Read the entire label before using product.

2. Observe all precautions each time you use a material.

3. Store chemicals under lock and key, out of the reach of children and pets, and away from food and feed.

4. Keep chemicals in their original containers.

5. Dispose of unused chemicals and containers in such a way that they are no longer hazardous.

6. Follow directions pertaining to residual tolerances on edible plants; allow the specified time interval between last application and harvest.

7. Use chemicals only on plants specified and at the correct rate and schedule.

8. Do not eat or smoke while applying pesticides.

9. Wear protective clothing and masks when directed on the label.

10. Bathe and change to clean clothing immediately after spraying or dusting. Wash clothing before reuse.

11. If chemicals are spilled on the skin or clothing, change clothing immediately and wash thoroughly.

12. If illness develops during or after spraying or dusting, call a physician immediately or take the patient to a hospital.

13. Avoid chemical injury to plants; use separate equipment for herbicides.

14. Rates of application have been carefully computed; don't use more than recommended.

15. Don't spray or dust on a windy day; avoid drift that would injure plants on adjacent property.

Specific chemical recommendations are given here with caution. Whether using chemical or microbial pesticides, always check the pesticide label to be certain its registered for use on the site to be treated. Chemical registrations and chemical use regulations frequently change. Contact manufacturers for the most current product information, including supplemental labeling and special local needs regulations. It is a violation of federal law to use any pesticide in a manner inconsistent with its labeling. County agricultural agents, state extension specialists, and state and federal pest management specialists can be consulted for current information on available insecticides.

Trade names listed in this publication are given solely to provide specific information and are not intended as a recommendation, guarantee, or warranty of the product.

Generalized Pesticide Control Strategies for Conifer Pests in New Mexico

Scales—Spray trees with "dormant" or "superior" oil before buds break to kill overwintering immature scales. Don't use dormant oils after buds begin expanding. **Improper use of oils can injure foliage.** Dormant oils can remove the waxy bloom on blue spruce, resulting in discolored foliage.

Insecticide sprays are only effective against the "crawler" stage of scale insects. Repeat applications are usually required at seven- to 10-day intervals to maintain coverage as eggs hatch. Insecticides with labeling for scale insects include acephate (Orthene®), dimethoate (Cygon®), carbaryl (Sevin®), diazinon, and malathion.

Needle Miners and Gall Formers—Under most circumstances, these pests should not be controlled. Damage can be unsightly but the tree is rarely injured seriously.

Insecticides capable of penetrating the foliage are most useful when needed. Acephate (Orthene) is recommended for needle miners and is effective against pinyon spindle gall midge but labeling for this purpose is limited. Carbaryl (Sevin) may be used against Cooley Spruce gall adelgid in spring when buds expand. Restricted-use soil applied insecticides that are taken up by the roots also effectively reduce spruce galls. Due to high toxicity, restricted use chemicals can only be applied by a licensed applicator.

Caterpillar and Sawfly Defoliators—Carbaryl (Sevin) and acephate (Orthene) will eliminate most caterpillar and sawfly problems. *Bacillus thuringiensis* (Dipel®, Thuricide®, etc.), a microbial insecticide is very safe to the environment, is effective on most caterpillars if applied properly. Insecticidal soaps are effective on young sawfly larvae if applied soon after eggs hatch.

Conifer Aphids—It's usually unnecessary to control aphids on conifers. If control is desired, spray trees with a dormant oil before buds break. (See "scales.") Insecticidal soap, acephate (Orthene), diazinon, dimethoate (Cygon), endosulfan, and malathion will adequately control aphids.

Spider Mites—Miticides such as dicofol (Kelthane®) and dienochlor (Pentac®) are effective against spider mites. Insecticides with some mite activity include acephate (Orthene), malathion, and diazinon. Insecticidal soaps are effective early in the season before populations are very high.

Pine Tip Moths—Chemical sprays for pine tip moths need to cover the branch tips at the time of egg laying and egg hatching. Pheromone traps are available to determine mating and egg-laying periods for most species. Insecticides available for controlling pine tip moth include acephate (Orthene), dimethoate (Cygon), *Bacillus thuringiensis* (Dipel, Thuricide, etc.), Carbaryl (Sevin), and diazinon. Several restricted use synthetic pyrethroids also are effective for pine tip moths, but can only be applied by a licensed applicator.

Bark Beetles—Once bark beetles have invaded a tree, it cannot be saved. Trees at high risk can be protected from attack by spraying the trunk and large branches with a 2% carbaryl (Sevin) suspension. This will kill the adult beetles as they chew through bark to enter the tree.

Some labeling for bark beetles (preventative) is present on the chlorpyrifos (Dursban®) label.

Borers—Insecticide treatments are ineffective against borers once they hatch and burrow under bark. Conifers infested with borers are usually dead or dying from other causes. Chlorpyrifos (Dursban) has some labeling for borer prevention.

Mistletoes—The chemical ethephon (Florel®) reduces spread of mistletoe within the infected tree and between trees if sprayed before the plants produce seeds. It does not remove mistletoe infection.

Sirococcus Shoot Blight—Fungicides that may help prevent Sirococcus shoot blight include Daconil® and mancozeb (Dithane® M-45, Pencozeb®, and Manzate® 200).

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