Red Pine Management Guide

A handbook to red pine management in the North Central Region

This guide is also available online at:

http://ncrs.fs.fed.us/fmg/nfgm/rp

A cooperative project of:

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Forest Health

Forest health

Past management guides have viewed red pine as a species with fewer insect and disease related concerns than other Lake States conifers. It does not have a major defoliator such as the jack pine budworm that damages older jack pine stands on a regular basis. Nor does it have a major pathogen such as blister rust in white pine that can kill large numbers of trees. Its more common disease problems tend to be subtle, such as periodic outbreaks of shoot blights that kill and deform seedlings and small trees. These epidemics occur infrequently and are often forgotten during the intervening non-epidemic years. Though red pine does not have what many would regard as a single major pest problem, it does have an array of insects and diseases that can, on occasion, cause significant damage.

Mammal caused damage is generally minimal in red pine. Pocket gophers can eat the roots of seedlings and young trees causing extensive damage in isolated plantations in some locations in the Lakes States. Deer browsing is rarely a significant problem on red pine.

Weather events can cause significant damage and can create conditions conducive to widespread disease epidemics. Drought and hail damage both favor outbreaks of Diplodia shoot blight and canker. Persistent wet weather, especially in the spring and early summer often results in Sirococcus shoot blight epidemics, especially in northern parts of Wisconsin and Minnesota, and Michigan's Upper Peninsula. Damage from heavy snow, ice, and wind is relatively common in dense plantations where trees have developed small crowns.

The most common damaging insects have been associated with seedlings and young stands. As long as older plantations are thinned on a regular cycle of 10-15 years, tree growth and vigor is generally maintained and tree mortality and/or growth loss is minimal.

Several diseases have become widespread because of inadvertent planting of infected nursery stock. The severity of some of these diseases has increased because of environmental and site factors that are favorable for pathogen development and spread.

In the Great Lakes region, red pine largely has been managed in monoculture plantations. Even natural stands are often relatively pure. Any tree species growing in largely pure stands is inherently at risk to outbreaks of insects or diseases. This concern is further compounded with red pine since the species has very limited genetic diversity. Fortunately, no major insect or disease threatens the existing resource at this time, though that could change with the introduction of an exotic species. Managers do have opportunities to develop diversity within existing plantations as well as when establishing new red pine stands. This process should reduce some of the risk associated with largely pure red pine stands.

It is often possible to manage red pine to reduce insect and disease risk and minimize losses. The emphasis should be on long-term strategies that prevent or reduce the risk of pest outbreaks. It is generally easier to prevent problems than it is to deal with an ongoing outbreak.

Detailed information on specific pest problems in red pine are described and discussed in the section titled Specific Pest Concerns. Pests are described based upon what part of a tree they damage. This section provides links to additional management guides and identification aides. Further pest information can also be obtained in a section on Pest Problems and Stand Development. This section details specific pest problems that are most likely to occur during various stages in the stand development of red pine.

Specific pest concerns

Red pine has an array of specific pest concerns that can influence management of the species. The most

commonly encountered concerns are highlighted below. The following discussion is organized by the part of the tree damaged. Specific insects, pathogens and mammals damage different parts of trees including needles, shoots and branches, roots and the root collar region, main stem, and seeds and cones. This is done to assist managers in identifying pest problems. Photographs are included for further assistance. A number of links are provided as well, where available these should provide more detailed information.

Red pine diseases are discussed in detail in a publication titled, Pocket guide to red pine diseases and their management. This is available electronically. Detailed pine pest insect guides for the Great Lakes region have also been developed. One of the best is " Insects of eastern pines". It is not available electronically. Complete references for all of the disease and insect guides are listed in the section, Sources of Technical Information."

It can be hard to generalize but damage to the roots and root collar region, and the main stem, is much more significant than damage elsewhere on a tree. Branch and twig damage can affect overall form but on larger trees this is rarely lethal. Needle loss can reduce growth rates but unless trees are defoliated completely, i.e. lose both old and new needles, tree mortality rarely occurs. Seed and cone insects are only a concern when regeneration from seed is an objective.

Needle damage

Needle diseases
Needle diseases such as Lophodermium needle cast and pine needle rust can be found on young trees but seldom cause significant damage.

Lophodermium needle cast, Lophodermium seditiosum, is primarily a problem in nurseries where it can defoliate and kill seedlings. On older trees it tends to affect needles in the lower crown. If not controlled in the nursery, infected trees can be inadvertently shipped and planted in the field. Spores are released from fruit bodies on killed needles in late summer and early fall and windblown to susceptible current-year needles where infection and fungus development takes place. The fungus overwinters in these needles that eventually turn brown and are cast early the following summer.

Spore structures of pine needle rust on red pine needles.

Pine needle rust, Coleosporium asterum, requires two hosts in its life cycle, red pine and an alternate host, either goldenrod or big leaf aster. Spores that develop on infected needles are wind borne and infect alternate hosts in early summer. These spores cannot infect other pines. Another spore type develops on the alternate host, it is this spore that infects pine needles in late summer. The fungus overwinters in infected needles completing the disease cycle. Pine needle rust is most severe on sites where alternate hosts are abundant. On these sites, seedlings and small trees can suffer growth loss and on rare occasions, mortality. Needle rust can be reduced by avoiding planting sites with goldenrod and aster unless they can be removed by mowing or with the use of a registered herbicide.

Needle feeding insects
Red pine does not have a major insect defoliator that erupts into regional outbreaks. However, there are defoliators that undergo localized outbreaks, causing growth loss and on occasion, tree mortality. Redheaded pine sawfly is the most likely species to cause significant damage. Pine tussock moth feeding can also kill trees.

The following insect defoliators can be divided into groups that feed during different times of the year. The species that feed very early in the spring are limited to eating older needles from previous years. Insects feeding in the late spring, summer and fall have the opportunity to eat both new needles as well as older needles. The few species that will eat both the new and old foliage are the greatest concern, this includes the redheaded pine sawfly and pine tussock moth.

Early spring needle feeders - Both red pine sawfly, Neodiprion nanulus nanulus, and European pine sawfly, Neodiprion sertifer feed very early in the spring, prior to new needle expansion. Larvae of the two species look very similar. Only needles from previous years are eaten and therefore, damage is minimal. The European pine sawfly is an exotic species that is limited to warmer parts of the region, specifically the southern half of Wisconsin, southern one-third of Minnesota, and the Lower Peninsula of Michigan.

European pine sawfly larvae.

Late spring needle feeders - Jack pine budworm, Choristoneura pinus pinus, is a major pest of jack pine. However, it will, on occasion, be found feeding on red pine needles. Outbreaks are cyclic, occurring every 7-11 years, each outbreak tends to last 1-3 years. In red pine, growth loss and top-kill can occur. Red pine trees growing in close association with jack pine are most likely to be infested though infestations can occur in pure red pine stands.

Jack pine budworm, late instar larva.

Pine tussock moth, Dasychira plagiata, has infrequent outbreaks that have been generally restricted to northwestern Wisconsin. These outbreaks tend to be short-lived, usually one year. However, trees are often stripped of both old and new needles and tree mortality can be significant.

Summer needle feeders - Redheaded pine sawfly, Neodiprion lecontei, outbreaks have occurred throughout the Lake States. Heavy feeding is more prevalent on young trees (< 20 ft tall), and on sites that would be defined as stressful for red pine. These sites include highly disturbed sandy areas, frost pockets, and along hardwood edges. This sawfly can kill large numbers of young pine during outbreak periods.

Redheaded pine sawfly larvae.

Pine webworm, Tetralopha robustella, forms conspicuous nests of excrement held together with silk. Though commonly encountered in young plantations in the Great Lakes region, large outbreaks have not been reported and damage is generally minimal.

Late summer/fall needle feeders - Feeding by the red-pine needle midge, Thecodiplosis piniresinosae, occurs throughout the summer, but the characteristic needle browning does not develop until late fall. In early summer, midge larvae tunnel into the base of needle fascicles. Feeding causes premature needle mortality referred to as fall browning or needle droop. Damage is often concentrated in the tops of young trees where terminal mortality can occur. Persistent midge populations have been associated with plantations growing on poor quality red pine sites, basically very dry, nutrient poor sandy soils. Outbreaks have been reported in parts of central and western Wisconsin.

Pine webworm nest.

Shoot and branch damage

Shoot blight and canker diseases

In the Lake States region, red pine trees are often invaded by two fungi that can kill shoots and develop into cankers on larger branches and main stems of trees. Diplodia shoot blight and canker and Sirococcus shoot blight are two of the most important diseases of red pine. They can be prevalent on trees of all ages but the most significant damage is generally restricted to seedlings and saplings. Both pathogens have unpredictable outbreak patterns that are often dictated by weather events. Diplodia outbreaks tend to occur during droughts or following hail storms, while Sirococcus outbreaks often occur following cool, wet spring weather. During outbreaks many seedlings and small trees can be killed or deformed. Multi-cohort red pine management, or growing small red pine under larger red pine, will increase the risk of disease development. This is because spores produced on infected large trees are rain-splashed onto seedlings and smaller trees growing below them.

Diplodia shoot blight damage (USFS).

Diplodia shoot blight and canker (also referred to as Sphaeropsis) is caused by the fungus Diplodia pinea. The fungus causes shoot blight on large trees, shoot blight and cankers on sapling and pole-sized trees, and shoot blight and collar rot on seedlings. Trees are infected through succulent shoot tissues, branch stubs and wounds. The fungus can grow from infected shoots into branch and stem wood where cankers develop, often girdling and killing trees.

Diplodia is often an episodic disease, existing at low levels for years in some areas without causing significant injury to trees. Some evidence even indicates that many trees carry latent infections that do not express themselves until a stress event occurs. Weather can play a major role in the epidemiology of this disease. Epidemics are often preceded by several years of drought, which stresses trees making them susceptible to Diplodia infection. Epidemics are often initiated locally after hailstorms, which create wounds in branches and stems that can be quickly exploited by the pathogen. This type of scenario, hail damage and a Diplodia outbreak, can destroy entire plantations in 1 - 2 years.

Diplodia canker on the main stem (USFS).

Infected reserve trees and red pine windbreaks are often the sources of fungal inoculum. Spores are released from fruiting bodies on infected bark, needles and cones during wet weather and are disseminated to adjacent trees. Therefore, growing small red pine trees near larger infected trees is risky.

Planting seedlings that were infected in a nursery but not displaying disease

symptoms at the time of shipment has likely contributed to the widespread occurrence of this disease. The risk of Diplodia can be reduced by planting healthy stock obtained from nurseries known to protect seedlings from infection and by not planting or growing red pine near infected trees. Since this pathogen is especially damaging on stressed trees, avoid planting red pine on very dry, nutrient poor sites. These would be areas where jack pine would probably be more appropriate. Control of competing vegetation to maintain high tree vigor can also reduce disease impact.

Sirococcus shoot blight is caused by the fungus Sirococcus conigenus. Epidemics occur periodically, closely following extended periods of wet spring weather. Damage can be significant. Young red pine seedlings and saplings can be killed outright. Many trees are deformed by the loss of shoots and smaller branches. Trees growing under or adjacent to infected red pine can be severely damaged when conditions are optimum for fungus dissemination and development. Sirococcus shoot blight is most likely to be a problem in northern parts of Wisconsin and Minnesota and in Michigan's Upper Peninsula.

Sirococcus shoot blight damage.

Spores are released in spring and early summer from fruiting bodies that developed on the previous year's infected shoots. The fungus infects needles and grows into current year's shoots. It is not uncommon to have trees and individual shoots infected by both Sirococcus and Diplodia, collectively increasing damage and losses from these diseases.

Similar to Diplodia, outbreaks of Sirococcus are episodic and the incidence and severity of the disease can rapidly increase. Removing infected overstory trees and pruning infected shoots on understory trees before spore dispersal in early spring will reduce the major sources of inoculum and minimize future disease incidence.

Scleroderris canker, caused by the fungus Gremmeniella abietina, is a disease most serious on young trees, seldom causing damage to trees taller than 6 feet. The disease develops on lower branches under snow cover and the incidence and severity of the disease is generally greatest in frost pockets and in areas where deep snow accumulates.

Characteristic lower branch mortality due to scleroderris canker.

Windblown spores are disseminated during wet weather from April to October. The spores infect buds and needles. Infected branch tips are usually dead by the following summer. The fungus can grow from the branch into the main stem where a canker develops that can girdle and kill young trees. The fungus produces a second spore stage that is disseminated by rain splash from killed branches to adjacent trees, increasing the disease incidence.

Preventing damage by Scleroderris canker begins with planting disease-free nursery stock and avoiding establishment of plantings on sites where Scleroderris canker is present or in frost pockets and cold air drainages where the disease can become most severe. Pruning the lower branches on infected and healthy trees will reduce disease incidence.

Shoot- and tip-mining insects

Shoot and tip-mining insects cause damage by affecting tree form and growth rates. Over most of the range of red pine, this group of insects would not be considered a major concern. However, there are two moth species that do cause

considerable damage in some areas. The European pine shoot moth occurs in warmer parts of Lower Michigan and the southeastern portions of Wisconsin. The red pine shoot moth is prevalent in areas dominated by outwash sands, such as the Central Sands region of Wisconsin.

European pine shoot moth, Rhyacionia buoliana, has been a pest in Lower Michigan since the 1950s. Larvae feed on buds and shoots. Damage occurs when a heavy infestation destroys the buds in the top whorl of young trees, creating twisted, multi-stemmed trees. Distribution of this insect is limited by its inability to survive cold winter weather. It can be found in Lower Michigan, southeastern Wisconsin, and a few other locations where consistently heavy snow cover provides insulation for winter survival. Many trees attacked and deformed when young do, over time, recover and grow into reasonably straight trees.

European pine shoot moth damage (USFS).

Red pine shoot moth, Dioryctria resinosella, was initially identified as a significant pest in the 1980s in the Central Sands region of Wisconsin. Larval shoot feeding resulted in height growth losses of 38-65% and radial growth losses of 16-42% over a 9-year epidemic period. Following outbreaks, tree crowns changed from straight-stemmed and conical to a bushy and flat-topped appearance. In some plantations, tree form was altered enough to make it difficult to develop products such as utility poles and cabin logs.

Red pine shoot moth damage.

Management of shoot and tip moths can be difficult, very little can be done to limit damage in the areas susceptible to these two insects. On small trees, corrective pruning may be useful, especially on trees that have their terminal shoot damaged.

Sapsucking insects

Sapsucking insects can reduce tree health or vigor by removing large quantities of sap. But, what is more important, their feeding often creates wounds that eventually plug and permanently reduce sap flow through twigs and branches. Wound sites can also serve as entry points for pathogens. Sapsucking insects include aphids, adelgids and spittlebugs.

Saratoga spittlebug, Aphrophora saratogensis, has historically been the most significant insect pest of young red pine across northern portions of Michigan, Minnesota and Wisconsin. Outbreaks were prevalent in the 1950s through the early 1980s. Adult Saratoga spittlebugs insert their straw-like mouthparts into red pine shoots. Large spittlebug populations cause extensive wounding that can kill branches. Tree mortality can occur and plantation failures have been reported. High populations are associated with abundant sweetfern, the plant that serves as a host for the immature stage of the spittlebug. Planting red pine into areas where sweetfern is abundant creates a high risk of spittlebug attack. Several other plants can also serve as an alternate host including willows and raspberries/blackberries.

Young tree dead in sweetfern.

Root and root collar damage

Root and root collar diseases
Armillaria root disease, caused by several species in the fungal genus Armillaria, is common on stressed and weakened trees. Many trees are probably infected with Armillaria but only exhibit symptoms when stressed by other factors. The fungus causes decay that kills roots. Decay can extend into the lower portions of the main stem. Root diseases often spread out from one infected tree to neighboring trees creating disease centers of dead and dying trees. Typical of root and butt rot diseases, affected trees are subject to wind throw. Damage is often prevalent on young trees growing on cutover hardwood sites. The stumps and dead and dying root systems of the hardwood trees provide a source of fungal inoculum that infects pine seedlings.

Young red pine killed by armillaria root disease.

Mycelial white fans of the fungus found under the bark, at the base of recently dead or dying trees, is a reliable sign of the disease. Stunting and yellowing of infected trees are the first symptoms of disease. Mushrooms may develop at the base of infected trees in the fall.

To reduce the incidence of Armillaria root disease maintain high tree vigor and avoid planting red pine on sites with abundant hardwood stumps that may harbor the fungus.

Annosum root rot is caused by the fungus Heterobasidion annosum and like Armillaria, can result in centers of dead and dying trees. Although Annosum root rot has not been a widespread problem in red pine, the disease can potentially be damaging after thinning and harvesting in some stands. At this time Annosum root rot has been reported in Michigan and rarely in Wisconsin. It has not been observed in Minnesota. However, there is evidence that this disease is spreading in Wisconsin and is likely to be found soon in Minnesota red pine.

Infection takes place in the spring and fall through freshly cut stumps and fresh wounds. The fungus grows into the root systems and can spread underground to adjacent trees.

To reduce the risk of Annosum root disease conduct thinning and harvest operations during the winter. This should reduce the likelihood of infection by spores that can occur via fresh wounds. All fresh stumps on sites where the disease is present should be treated with borax (sodium tetraborate decahydrate) to prevent infection. Infected trees should be removed from the stand or burned to reduce fungal inoculum.

Inonotus root and butt rot caused by Inonotus tomentotus causes a root and butt rot of mature trees, but it can also damage seedlings and young trees on sites where the fungus was present in the previous stand. The fungus infects trees through wounded roots and root collars where a resinous canker will develop. Affected trees have reduced growth and are susceptible to wind throw.

Fruiting bodies of inonotus tomentotus root and butt rot. (B. Livingston)

On seedlings and small red pine trees, the fungus Diplodia pinea (Diplodia) can cause a canker type of injury at the root collar that can kill trees. Diplodia has caused extensive mortality of newly planted seedlings in some years, especially dry years. Seedlings can become infected in nursery beds prior to planting.

Red pine plantations in some parts of the Great Lakes region often develop expanding pockets of dead and dying trees. Some of these pockets can be referred to as red pine pocket decline. The cause of these pockets has not been clearly determined but they appear to be related to a combination of root disease organisms and weevil species that feed on roots and the root collar region (see below) and bark beetles infesting the main stem. Most red pine pockets have been reported in areas dominated by outwash sands in Wisconsin, but this malady also occurs in Michigan and Minnesota.

Once established, pocket decline persists, creating slowly expanding pockets of dead and dying trees. These areas have reached several acres in size in some plantations. Control measures are under evaluation.

Root and root-collar insects
Several insects feed on the roots and in the root collar region of red pine. On occasion, some of these have been significant pests especially on seedlings. This includes white grubs, and several weevil species.

White grubs (Coleoptera:Scarabaeidae) are the immature stage of beetles referred to as May and June beetles. There are several different species of white grubs that can feed on pine roots. The grub stage, also referred to as larvae, live in the soil and feed on fine roots of many plants, including young pine. They have been responsible for planting failures throughout the Lake States region. Most damage has occurred when planting into existing sod. Damage to seedlings can occur at grub populations as low as 0.25 larvae per square foot of sod.

Pine root collar weevil, Hylobius radicis, can be a serious pest of young (5-15 year old) red pine. Larvae feed at the base of trees, the root collar region, where they can girdle trees or cause stem deformity. Heavily infested trees often break at the damaged site and tip over. Damage is associated with poorly stocked stands growing in heavy grass often on very sandy soils. Windbreak trees and trees growing along the edges of plantations are most likely to be infested. Scotch pine, Pinus sylvestris, is very susceptible to this weevil and red pine growing in association with Scotch pine is more likely to become infested.

The root tip weevil, Hylobius rhizophagus, is most often found attacking red pine growing in close association with jack pine. Jack pine is regarded as the main host for this weevil and its presence appears to attract the weevils into red pine stands. Interestingly, little damage is observed on jack pine but, infested red pine trees are often killed. Infested red pines have flagged (dead) branches and can appear stunted. The symptoms can be very similar to Saratoga spittlebug attacks or some of the shoot pathogens. Proof of root tip weevil attack consists of finding larvae or root damage. This weevil does not attack at the root collar, but feeds on the outer portions of the root systems.

Root and root collar weevils have been found associated with a decline syndrome called red pine pocket decline. These weevils along with a couple of bark beetle species (Ips pini and Dendroctonus valens) appear to play a role in introducing root invading fungi that initiate expanding pockets of mortality in plantations.

Characteristic mortality observed with red pine pocket decline. An Annosum root diseas pocket can look very similar.

White grubs.

Pine root collar weevil infested trees have a constricted base and black, resinous stem at the soil line.

Root feeding mammals
Pocket gophers, Geomys spp., can eat the roots off young red pine trees. This damage tends to be isolated to sandier sites and often on areas dominated by grass cover. Damaged trees often tip over and can be easily pulled from the ground. In many instances the entire root system is chewed off. Traps and poisons can be used to eliminate gophers from an area. Large trees are not damaged.

Root tip weevil damage.

Main stem damage

Stem decays
Extensive stem decay is not common in red pine, even very old trees generally have little decay. When decay is prevalent it is often associated with old fire scars.

Phellinus trunk rot is caused by the fungus Phellinus pini. It causes a white pocket rot of mature trees sometimes called red ring rot because of the color of the wood in the early stages of decay. Symptoms include swollen knots, punk knots (masses of brown fungal hyphae protruding from decayed branch stubs) and brown conks on trunks of infected trees. Infection is through wounds and broken branches. There are no effective control measures other than to avoid wounding trees.

Ips pini nuptial chamber and egg gallery.

Bark and wood infesting insects
Pine bark beetles in the genus Ips are found in association with almost every red pine that dies. They are generally viewed as secondary pests, meaning that in most cases they cannot successfully infest and kill a healthy, vigorous tree. Healthy red pine trees can defend themselves by producing pitch or resin. Trees stressed by drought, old age, fire injury, root disease or intense competition (dense plantations) produce little resin and become susceptible to attack.

Red pine is attacked by several species of Ips in the region. The most common is the pine engraver, Ips pini. Other species include Ips grandicollis, and Ips perroti. In general, Ips attacks rarely occur in plantations younger than 25 years of age. Past that point, outbreaks are often associated with lack of thinning and drought. In most situations, outbreaks are limited to small groups (3-5) of trees. However, during periods of significant drought, several acres of trees can be killed. Logging operations can also trigger local outbreaks. Freshly cut logs left in the woods in the spring and early summer can provide breeding material that produces large beetle populations. Population increases of 10-fold can occur in one growing season, with three generations of Ips pini possible. Thus, a local population of 1,000 can increase to 1,000,000 individuals in one season. A single downed large tree can produce as many as 80,000 beetles.

Characteristic pitch tube that forms during a red turpentine beetle attack.

The red turpentine beetle, Dendroctonus valens, is a common bark beetle found attacking at the base of trees or attacking fresh stumps. Attacks occur from the ground-line up about 3-4 feet. Characteristic popcorn-like pitch tubes are diagnostic. These beetles are not considered tree killers but their tunnels and feeding further reduces tree vigor making infested trees susceptible to infestation by Ips bark beetles or Armillaria root disease.

As mentioned earlier, Ips bark beetles along with the red turpentine beetle and several weevil species have been reported to be closely associated with the decline syndrome referred to as red pine pocket decline.

Bark feeding mammals
Porcupines, Erethizon dorsatum, do climb red pine trees and chew off large patches of bark. This can cause top-kill or out right tree mortality. Damage is most often isolated to a few individual trees but in some situations extensive damage can occur.

Seed and cone damage

Seed and cone insects
Red pine has an array of insects that attack its reproductive structures, especially developing second year cones. Cone insects can cause complete crop failures and can be a significant detriment to natural regeneration efforts. The most significant insect pest of red pine cones is the red pine cone beetle, Conophthorus resinosa. The population of cone beetles is controlled largely by the size of the annual cone crops. Cone beetle populations collapse to low levels during years with crop failures. Therefore, damage levels can be quite low in years that follow a cone crop failure. The greatest chance for significant damage follows several years of high cone production. Red pine cone beetles spend the winter on the forest floor in hollowed-out shoots. This behavior makes them susceptible to ground fires. Prescribed fire done prior to beetle emergence in the spring can kill overwintering cone beetles.

Pest problems & stand development

Specific insects, pathogens and mammals are more likely to cause damage at different stages of stand development. As an example, white grubs would be a concern during the seedling stage but would not cause problems for sapling, pole-sized or mature trees. This knowledge makes it easier to identify and manage specific problems. In red pine, most significant pest problems occur during the seedling and sapling stages. Pole-sized stands are generally relatively healthy.

Weather events can occur at any time and some may be more damaging at a given point in stand development. As an example, heavy, wet snow and ice accumulation often damages pole-sized stands most heavily, especially dense stands that have trees with small crowns and tall, thin stems. Wind damage can also be prevalent in these pole-sized stands for the same reasons. Hail injury can ignite a Diplodia outbreak in any age stand, but young trees are more likely to die because of their small size.

Table 1 lists the most commonly encountered insect and disease pests associated with various stages of stand development for red pine in the Great Lakes region.

Table 1: Insect and disease pests associated with different stages of red pine stand development.

Seedlings (1-5 years)	Saplings (6-20 years)	Pole-sized (21-50 years)	Mature and old growth (51-200+ years)
White grubs Diplodia shoot blight & canker Sirococcus shoot blight Armillaria root disease Scleroderris canker Lophodermium needle cast Pine needle rust Pocket gophers	Saratoga spittlebug Root collar weevil European pine shoot moth Redheaded pine sawfly Red pine sawfly European pine sawfly Pine tussock moth Pine webworm Diplodia shoot blight & canker Sirococcus shoot blight Armillaria root disease Scleroderris canker Lophodermium needle cast	Ips bark beetles Red turpentine beetle Root collar weevil Root tip weevil Red pine shoot moth Jack pine budworm Red pine needle midge Pine tussock moth Diplodia shoot blight & canker Armillaria root disease Annosum root rot Red pine pocket decline	Ips bark beetles Red turpentine beetle Red pine shoot moth Jack pine budworm Armillaria root disease Annosum root rot Red pine pocket decline Phellinus trunk rot Inonotus root rot and butt rot Diplodia shoot blight & canker

Seedlings (ages 1-5)
Seedlings have very small root systems that can be easily damaged by root feeding insects. In the Great Lakes region, white grubs are a common problem, especially when seedlings have been planted into existing sod.

Several disease problems can kill seedlings and very young trees. During epidemic years for Diplodia or Sirococcus, seedling mortality can be very extensive. Seedlings can be infected at a nursery, especially with Diplodia and die following planting. Infection can also occur in the field. This is most likely to occur when larger, infected trees are in close vicinity to seedlings. Outbreaks of these two diseases can be erratic in occurrence. Diplodia outbreaks often coincide with drought while Sirococcus outbreaks tend to occur following cool, wet spring weather.

Armillaria root disease can also be prevalent in some young plantations. In red pine it is often associated with the presence of hardwood stumps.

White grubs eat the fine roots and bark on pine root systems.

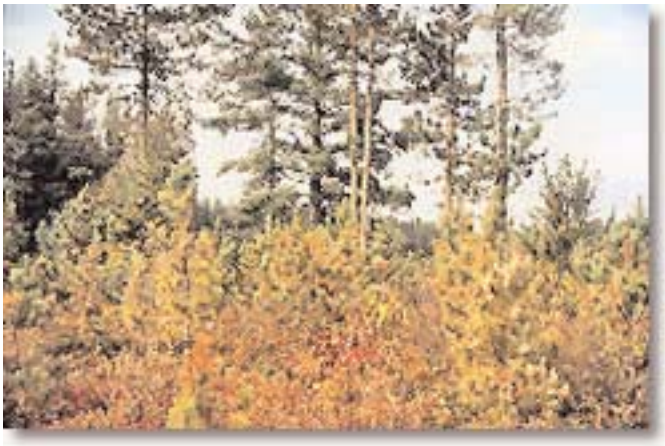
Pocket gophers can be destructive in some locations. Gophers feed on pine roots killing seedlings and young trees. Damaged trees can have their entire root system consumed.

Sapling stands (prior to crown closure, ages 6-20)
In some situations, insect caused damage in sapling stands can be extensive. Cases of plantation failure have been reported, most often due to infestations of Saratoga spittlebug on sites dominated by sweetfern. Many of these sites have been frost pockets.

Saratoga spittlebug damage concentrated in a northern Wisconsin frost pocket.

Root collar weevil can also be a serious pest of young red pine, often on nutrient-deficient sites. Poorly planted trees with j-roots are very susceptible as are trees growing in heavy sod. Scotch pine is a favored host of this weevil and its presence may increase the likelihood of attack on red pine.

Defoliators are an infrequent problem, but outbreaks of redheaded pine sawfly or pine tussock moth can kill young trees. Localized outbreaks of redheaded pine sawfly are most often associated with either dry nutrient poor sites or mesic nutrient rich sites. Nutrient rich sites often develop excessive competition for young red pine.



Extensive Sirococcus shoot blight in young trees near infected overstory pine.

Shoot-mining insects do occur in young red pine stands but, they would be considered relatively minor pests. European pine shoot moth damages the terminal bud and can cause distorted growth. However, it does not occur over most of the range of red pine. Red pine shoot moth attacks can begin in plantations prior to crown-closure but, most outbreaks have been reported in slightly older stands.

The same disease problems found on seedling red pine occur on sapling-sized trees. However, the larger size of the trees often results in limited tree mortality. As red pine get larger, Diplodia and Sirococcus are more likely to kill shoots and branches rather than entire trees. This damage can lead to top-killed trees. Armillaria can kill sapling sized trees, especially during periods of drought.

Pole-sized stands (after crown closure, ages 21-50)
Following crown closure, red pine stands are relatively immune to most insect related problems. Ips bark beetles would be one damaging agent that can kill small groups of 1-10 trees. On rare occasions, such as regional droughts, areas as large 1-10 acres may be killed. Ips bark beetles attack trees that are weakened by poor site conditions, drought or intense competition. Thinning stands as recommended in existing red pine management guides should reduce competition stress and decrease the likelihood of Ips infestations.

Extensive Sirococcus shoot blight in young trees near infected overstory pine.

In areas dominated by outwash sands the red pine shoot moth can be a considerable pest in plantations that are 20-40 years of age. Growth loss and the loss of apical dominance can occur following prolonged outbreaks. If local outbreaks do occur, managers may need to adjust for a loss of tree form, thus eliminating the opportunity to develop certain products such as utility poles.

Red pine pocket decline can occur in red pine plantations during this period of stand development. Bark beetles and several weevil species have been shown to carry pathogens that can initiate decline in red pine trees that may develop into a slowly expanding pocket of dead and dying trees. In some instances, pockets of dead and declining trees are the result of Armillaria root disease, bark beetles, or Annosus root rot.

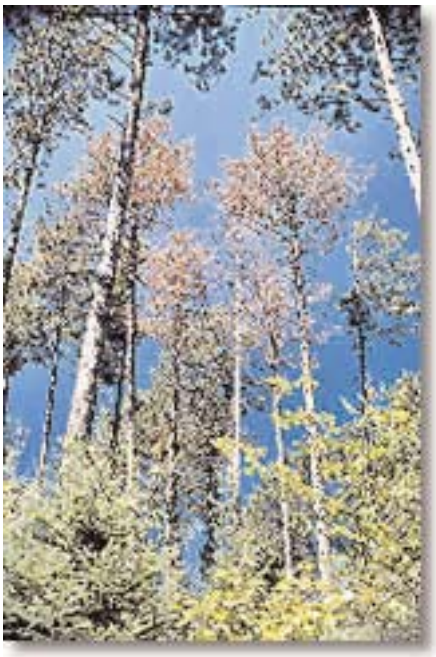
In some areas, the root tip weevil can kill pole-sized pine outright. Root tip weevil is most prevalent in northwestern and central Wisconsin and the western half of Upper Michigan. The presence of jack pine intermixed with red pine increases the likelihood of infestations.

Defoliation events in pole-sized red pine stands are uncommon. Jack pine budworm can be a local concern. Budworm feeding is not common in red pine but when a localized outbreak does occur it can be damaging. Needle midges have caused localized areas of needle browning in late fall.

Mature and old growth trees (ages greater than 50)
Red pine trees are capable of a very long life span. Dead and dying trees do become infested with Ips bark beetles and other wood boring insects but, it is unclear if these insects act as a primary killing agent of older trees or if they are using a host that is dying from other causes. Older red pine trees appear to be capable of maintaining the ability to defend themselves against insects and pathogens.

Armillaria root disease is often found in declining older trees. Armillaria can kill trees outright, dead roots killed by the fungus can also weaken trees making them more susceptible to bark beetles and wood boring insects. Red pine pocket decline and Annosus root rot can be very active in some older plantations. Root disease pockets can be difficult to eliminate.

Stem decay in older red pine is generally minimal. What does occur is often related to old fire scar injuries.



Ips mortality in older red pine.

Sources of technical information

Good general references on insects associated with red pine are Wilson (1977), Goulding and others (1988), and Rose and others (1999). These references provide information on identification, insect biology, and some management recommendations. Nicholls and Skilling (1990) is a pocket guide that includes the majority of red pine diseases of significance.

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