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Tree Talk

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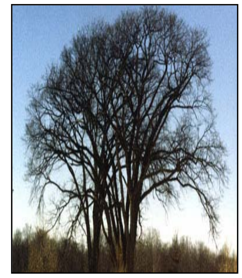


"The true meaning of life is to plant trees, under whose shade you do not expect to sit."
-Nelson Henderson

Flooding and trees

Joe Zeleznik, NDSU Extension forester

North Dakota is a difficult place to grow trees. Extreme temperatures exist in winter and summer, wildfires are common in spring and fall, windstorms regularly knock trees down and droughts frequently occur. This time, the problem is flooding. Spring floods regularly occur along many rivers and streams in the state, as winter snows rapidly melt and drain into waterways that still may be frozen. Summer flooding also occurs, and the effects on trees may be very different than those resulting from spring floods.

Many factors affect tree stress and survival during and after flooding. Even within a species, one tree may die while a neighbor is seemingly unaffected. This article will discuss the many factors involved in flood survival and what to expect when the waters recede. Also, we offer some ideas on how to manage trees and forests to encourage quick recovery.

"Water, water everywhere
Nor any drop to drink . . . "
-Samuel Taylor Coleridge,
Rime of the Ancient Mariner

Flood stressed trees can show many symptoms such as leaf chlorosis, defoliation, reduced leaf size and shoot growth, and crown dieback. But the main stress is caused by anoxia – depleted oxygen – in the root zone. Ideally, the root zone should contain the proper balance of mineral soil (50 percent), organic matter (5 percent) and pore space (45 percent). The pore space is usually divided evenly between air and water. During a flood, however, water fills up the pores and removes all of the air. Trees have evolved several mechanisms for adapting to floods, but even these are just temporary measures designed to keep the tree alive until the floodwaters recede.

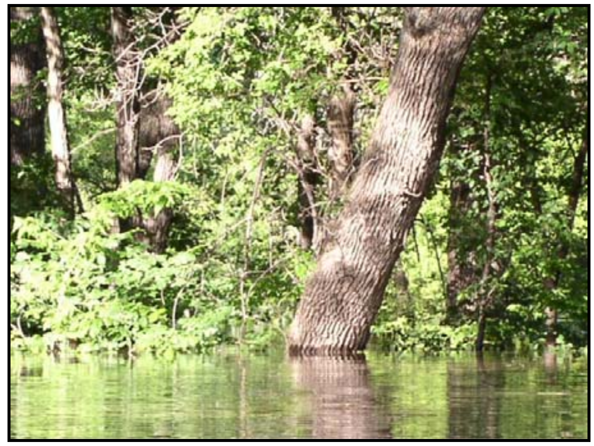
The most direct effect of having roots in a low-oxygen environment seems counter-intuitive. They don't take in water very well and the trees actually suffer from "physiological drought." In the short term, leaves may begin to wilt after two weeks or more and eventually may fall prematurely. Early leaf drop may allow the tree to go dormant early and survive until normal growing conditions return. During early spring floods, trees are still dormant and are able to survive anoxic soil conditions.

Flooding creates many other changes in the rooting environment. For example, flooding often will increase the pH of acid soils and decrease the pH of alkaline soils. Organic matter decomposition still will occur, but only at half the normal rate. The decomposition products can include methane, ethanol and hydrogen sulfide. These compounds also will contribute to root damage. The oxygen level is higher in cold, moving water than in warm, stagnant water.

Physically, soil may be removed by the flood (scouring), exposing a tree's root system and making the tree unstable. In other areas, sediment may be deposited over existing root systems, which will continue to restrict oxygen even when the water recedes. Cottonwood and willows can withstand moderate siltation.

The large structural roots of this tree have begun to be exposed by erosion down the hillside and by scouring from floodwaters.

Floodwaters may get so high that a portion of the tree's crown may be underwater. Generally, the greater the amount of foliage that is inundated, the greater the damage to the tree. However, it depends a lot on species. Observations in Fargo showed that flooded sandbar willows (*Salix interior*) and false indigo (*Amorpha fruticosa*) survived being completely underwater for several weeks. Trees that are in good health will survive much better than those that are not vigorous or already stressed.



The small trees, with much of their foliage underwater, will be more stressed than the large tree in the foreground that has none of its crown below the water.

Trees can also be injured by large debris moving along in floodwaters. In the spring, bulky pieces of ice easily can tear off large areas of bark from tree trunks. The main danger from the current flood comes from dead tree trunks and limbs that can scrape or become lodged against standing trees. As the water recedes, saturated soils may lose structural stability, and standing trees will be more susceptible to tipping and windthrow.

The great amount of debris piled against these stems may cause serious damage by tearing away large chunks of bark.

Several adaptations allow trees to survive floods. First, oxygen must get to the root system. Structures called lenticels are found in all trees and are very prominent in birches (*Betula* spp.) and cherries (*Prunus* spp.). Lenticels facilitate gas exchange between the stem and the atmosphere. During flooding, lenticels become very prominent and enlarge to several times their normal size. These allow oxygen to get into the trees and the toxic waste products (mentioned above) to escape. Other structures called aerenchyma also may increase during flooding. Aerenchyma are soft tissues characterized by large intercellular spaces that increase gas movement within the tree. Adventitious roots also commonly form on the submerged portion of the stem. These roots are more succulent and permeable than the original roots. However, their formation depends largely on the nature of the floodwater. Roots commonly form beneath moving water, but do not form if the water is stagnant.

Tree species tolerance and variability

Several scientists have tried to rank tree species on their tolerance to flooding. While the studies have shown general agreement, they do not always completely concur. These differences can be attributed to several factors, including the type of floodwaters (moving water versus stagnant), the age of the trees studied (older trees are more able to withstand flooding than seedlings) and season of the flood. Nevertheless, some general categories can be established. Table 1 is adapted from the USDA Natural Resources Conservation Service (North Dakota) document Tree and Shrub Characteristics.

The future . . .

As mentioned earlier, several symptoms are associated with flooding stress, such as reduced leaf size and shoot growth, and crown dieback. The symptoms may occur for several years, gradually progressing and leading to the death of the tree, or they may subside, indicating recovery. Another common tree stress response is the production of large seed crops in the years following the stress event. Prolonged flooding may not kill a tree outright, but may stress the tree to the point that it is an easy target for opportunistic insects and diseases.

The major group of secondary insects that will attack stressed trees are the stem borers. Stem boring insects can be further divided into wood borers and phloem borers. The phloem borers include bark beetles and metallic wood-boring beetles. These insects damage and seriously alter the food transport system in trees and actually may girdle the stem. Wood borers generally tunnel and feed within the wood of stems and branches. Although the tunneling usually doesn't directly affect tree survival, it can seriously weaken the stem leading to an increased chance of structural failure. Wood borers often leave small exit holes in the bark of the stem. These holes may exude pitch, sap or may have sawdust around their edges.

Table 1. An established plant's ability to withstand soil saturation or surface ponding during the growing season.

Able to withstand flooding for more than 3 weeks	Able to withstand flooding for 1-3 weeks	Unable to withstand flooding for more than 7 days
Ash – green, black, Manchurian	Quaking aspen	Apricot
Boxelder	Siberian elm	Crabapple
Cottonwood	Hawthorn	Maple – Amur/Tatarian
Common hackberry	American linden	Harbin pear
Bur oak	Russian-olive	Black walnut
White poplar	Eastern redcedar	Rocky Mountain juniper
Willows	Black Hills spruce	Siberian larch
		Ponderosa pine
		Scotch pine
		Colorado blue spruce

There are too many tree species and associated stem boring insects to give a definitive list of possible pests. However, some general management recommendations are available. First, prevent additional wounds because these may serve to attract more borers. Second, remove and destroy large broken limbs and dead trees as this material may act as breeding sites for the insects. Standing dead trees (snags) do provide valuable wildlife habitat, so removing the dead material could result in less habitat for animals such as woodpeckers. Third, insecticides only should be used for high value trees and only following the recommendation of a professional entomologist, arborist or forester. Some researchers recommend light fertilization with a low-nitrogen fertilizer following a flood, but this advice is still controversial.

Flood-stressed trees also are more susceptible to other diseases, such as *Armillaria* root rots, *Phytophthora* and *Pythium* root diseases, and several canker diseases. Because most of these fungi are omnipresent in forest soils, little can be done to combat them. Fungicides usually are not a viable option because of the excessive cost. The best management approaches are to simply reduce stress and minimize injuries to the tree. Remove infected material as quickly as possible.

Flooding and forests

With the advent of modern agriculture and expanding cities, riparian forests – those found along rivers, lakes and streams – have been reduced to the point where many don't exist any more. Some accounts state that the floodplain forest of the Red River originally extended a mile on either side of the waterway. Despite the losses, the majority of North Dakota's native forests still are found along rivers and streams.

The benefits of riparian forests are immense. They provide shade that keeps waterways cooler, allowing fish that need high oxygen levels (such as trout) to survive and thrive. They provide habitat for upland game and songbirds as well. These trees also can anchor riverbanks that are in danger of washing away from erosion. Without them, large areas of agricultural land could be lost by simply washing away. Riparian forests also slow down runoff, allowing sediments to drop out of the water before it reaches the river. Where excess nutrients are applied in fertilizers, or where there are excess nutrients from large amounts of animal waste, trees can take up this surplus before it contaminates waterways. These last two benefits are incredibly important for urban areas downstream from agricultural land because the forests reduce the amount of sediment and nutrients that must be removed from the water before it is safe to drink. For more information on riparian forests and their benefits, please read the National Agroforestry Center's "Working Trees For Water Quality" brochure.

On a lighter note . . .

Trees are perennial plants that create new growth rings every year. This characteristic is incredibly valuable because trees can "record" ecological events in their rings. The events that are studied through dendrochronology – tree ring analysis – have included fire, droughts and even floods. Dendrohydrologists have been able to determine the history of many rivers by dissecting trees and measuring their scars and regrowth periods. Some of the regional studies include a flood frequency of the Turtle River (Harrison and Reid 1967), formation of arroyos in the Little Missouri Badlands (Gonzalez 2001) and a study of 19th century floods in the Red River in Manitoba (St. George and Nielsen 2000). For more information on dendrochronology, visit the Laboratory of Tree Ring Research at the University of Arizona or the Ultimate Tree Ring Web Page from the University of Tennessee, Knoxville.

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Yellow-headed spruce sawfly (*Pikonema alaskensis*)

By Joe Zeleznik

The yellow-headed spruce sawfly (YHSS) is a common pest of Colorado blue spruce and Black Hills spruce in North Dakota. It is more common in the central and western parts of the state, while the Rhizosphaera needlecast fungus predominates in the wetter east and northeast. The sawfly larvae can cause large amounts of damage, but with the proper attention to monitoring, its detrimental effects can be minimized.

Sawflies are not flies at all, but rather non-stinging wasps. They get the name sawfly because the females have a sawlike appendage at the tip of their abdomens that is used to slit or cut plant tissue, helping in the insertion of eggs into the slits. It's the larval stage of the insect (Figure 1) that causes the damage to the tree. The larvae do this by feeding on the newest needles and occasionally older needles. They can completely or partially devour the needles causing them to fade to a pinkish color (Figure 2).

Figure 1. Yellow-headed spruce sawfly larva feeding on Colorado blue spruce, Richardton, N.D.

Life cycle

Sawflies overwinter as prepupal larvae in cocoons, with adults emerging in late May to mid-June. The average date of emergence varies from year-to-year. Morse et al. (1984) found that the overwintering cocoon stage, at 0.l cm soil depth, needed an average of 343 degree-days (base = 1.6°C) for emergence. However, actual emergence may extend over 40 days, depending on the number of weeks spent in "prechill" (time between cocoon formation and chilling) and "chill" (at 0°C or lower, Eller et al. 1989).

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Figure 2. Damage caused by yellow-headed spruce sawfly larvae on Colorado blue spruce in Richardton, N.D. Note the completely defoliated twig at the top and the pinkish, dead needles at the bottom. Photos by Joe Zeleznik.

After emergence, the adults mate and the females lay eggs, with larvae hatching in five to 10 days. Larvae feed for 30 to 40 days, growing from 1/8 inch long to 3/4 inch long at maturity. They are dark, glossy green with a light lateral stripe, and reddish brown head (Figure 1). After the larvae go through four to six instars, they drop to the ground to spin cocoons just beneath the duff. The prepupal larvae complete diapause in this location.

Treatments

Rodents may feed on sawfly prepupae and some birds will eat sawfly larvae and adults (Jackson et al. 2002). There are at least six species of larval parasitoids (Eller et al. 1989). However, all of these natural controls may not be enough to keep sawfly populations in check. For light infestations, removing larvae by hand or with a strong jet of water may be enough. Another method of "natural" control is to crush a package of cigarettes in two gallons of water, then spray the solution onto the larvae. Many people claim that this method is effective, but I have not seen any scientific documentation to back it up, with this particular insect. Popp et al. (1986) applied nitrogen fertilizer to white spruce (*Picea glauca*) trees that were infested with sawflies. They concluded that adding 200 lbs/ac nitrogen increased the density of sawfly larvae on trees, and reduced the larvae's mortality. Adding 400 lbs/ac nitrogen may have reduced sawfly density, though their data on that is incomplete. Indiscriminate use of fertilizers is not recommended.

Insecticide treatment is probably the most effective, but monitoring is critical. The easiest life stage to control is the larvae. Acephate and carbaryl are labeled for use against sawflies, and a contact in Minnesota also recommends malathion or certain imidacloprid formulations. <u>However, make sure the insect is present before application.</u> Monitor spruce trees twice weekly from late May through early July to ensure that larvae are feeding and vulnerable. Because of the variability in emergence, two treatments may be necessary. As always, follow all label requirements when using chemical pesticides.

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Cedar-Apple Rusts (*Gymnosporangium* diseases)

Jim Walla, NDSU Department of Plant Pathology

Diseases caused by rust fungi in the genus *Gymnosporangium* tend to be low profile and impact, primarily because their host plants usually are not seriously damaged by fairly heavy infection and are relatively low in value in the Northern Plains. The unusual and obvious appearance of the orange spore horns on galls after late spring rains and the ease of recognizing some of the disease signs result in these diseases being recognized by many people.

Names

The common names that are used for diseases caused by these fungi are confusing and usually inexact. The name cedar-apple rust refers specifically to the disease caused by *Gymnosporangium juniperi–virginianae* on junipers and apples. In this case, cedar is derived from the name of one of the plants that is infected by the fungus, eastern redcedar, which is a juniper. However, this fungus also infects other hosts and the common name of the disease should (but usually does not) substitute those hosts. The name cedar-apple rust also often refers to any or all of the diseases caused by *Gymnosporangium* species. This is comparable to using the brand name Kleenex for all tissue paper or Jet-ski for all personal watercraft. We know what the object referred to is in general, but we don't know if the subject is generalized or specific. Finally, the galls caused by some species are called cedar apples.

The difficulty in identifying *Gymnosporangium* species contributes to the confusion over names. Kern (1973) was the last to publish any summary account of these fungi. Several *Gymnosporangium* species have been reported in the Great Plains (Table 1). These reports are more than 30 years old or more. No one knows their current distribution or if additional species are present. Species identification is primarily based on size and shape of the various spores, or the morphology of aecia and telia, and on host symptoms. There is much overlap in these traits among species, but each species has a particular combination of the traits that are unique. Short-term field observations and laboratory examination of one life stage of a species do not allow accurate identification to the species level. We usually don't know the pathogen, so calling the disease a cedar-apple rust becomes a necessary generalization. Laboratory examination of one life stage of a species do not allow accurate identification to the species level. We usually don't know the pathogen, so calling the disease a cedar-apple rust becomes a necessary generalization.

Table 1. Some *Gymnosporangium* species in the Northern Great Plains region.

Gymnosporangium species	Symptoms on junipers
juniperi-virginianae	Branch gall
connersii	Branch gall
corniculans	Branch gall
bethelii	Gall-like branch knots
globosum	Gall-like branch knots
nelsonii	Gall-like woody knots or no symptoms
clavipes	Fusiform stem swellings and on needles
nidus-avis	Stem swellings and witches'-brooms
clavariforme	Witches'-brooms or fusiform branch swellings

Biology

Each *Gymnosporangium* species known in the Great Plains requires alternate development on two types of host plants to complete its life cycle. The types of host plants are conifers in the cedar family (Cupressaceae) and broadleaf plants in the rose family (Rosaceae). Junipers are the conifer host in the Great Plains. Common rosaceous host plants in the Great Plains include apple, crabapple, juneberry, and hawthorn. Some of the rusts in this region occur on chokeberry, cotoneaster, mountain-ash, pear and quince in other regions. Some species in other areas can complete their life cycle on only one host, but the various developmental stages are still distinct. Life cycle, the digest version: Basidiospores produced on juniper infect a rosaceous host. After six to 14 weeks, aeciospores blown from the rosaceous host infect juniper. Galls or witches'-brooms (Figures 1 and 2) develop over the next 20 to 22 months, and basidiospores are produced again two years later. In more detail, the *Gymnosporangium* species in the Great Plains have four spore stages in their life cycle: basidiospores, pycniospores, aeciospores, and teliospores. Basidiospores are produced on teliospores on the juniper host in the spring and early summer, and are wind-blown to rosaceous hosts. Infection by basidiospores results in the development of pycnia on upper leaf surfaces (Figure 3). Compatible pycniospores from other lesions are carried by insects to mature pycnia. If cross-fertilization of the pycnia occurs, aecia subsequently develop from the pycnia.

Figure 1. Small, developing gall on juniper twig. Photo by Jim Walla.

Figure 2. Witches'-broom developing on a juniper branch, Billings County, N.D. Note the small orange spore horns developing among the live foliage on the right. The tan foliage on the left is dead. Photo by Jim Walla.

Aeciospores develop in aecial cups or horns in the aecial lesions. Aeciospores are wind-blown to junipers. Production of aeciospores generally occurs over a few weeks in mid-summer in the Northern Plains. Infections in juniper result in development of galls or witches'-brooms beginning about one year after infection. Teliospores develop in galls and witches'-brooms in the late fall and are mature by the next spring. Telial horns (gelatinous structures that contain the teliospores) expand from the galls or witches'-brooms during extended exposure to free water (Figure 4).

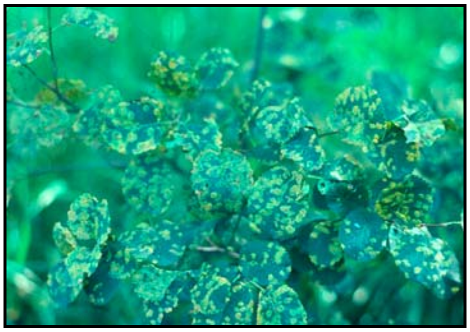

Figure 3. Pycnial spots on the upper leaf surfaces of a juneberry plant, Ramsey County, ND. Photo by Jim Walla.

Meiosis in the teliospores results in basidiospores to complete the life cycle. A diagram of the life cycle can be found online through Cornell University's Plant Clinic.

Spore horns can be exuded from galls or witches'-brooms several times within a single growing season. Also, galls and witches'-brooms of some species may remain alive for more than 10 years and the teliospores may produce basidiospores every year. Thus, a single infection on juniper can result in a prolific and long-term source of inoculum. Basidiospores are the weakest link in the life cycle. They are thin-walled spores and cannot withstand drying, so infections usually occur within a limited distance from their source. If hot, dry weather occurs while they are being dispersed, their survival time will be shorter. Aeciospores are relatively large, thick-walled spores with a rough surface. They can withstand desiccation and can be wind-blown for long distances to their coniferous hosts.

Symptoms and life cycle

Infection of the rosaceous host can occur on shoots, petioles, leaves, and fruit for most *Gymnosporangium* species. On leaves, pycnia are most often produced in the upper leaf surface, and aecia most often are produced directly beneath the pycnia in the lower leaf surface. Pycnia and aecia often are produced in the same lesion on shoots, petioles, and fruit. Pycnial and aecial lesions usually are the same green color as the host tissue during early development and then gradually become yellow or orange. Aecial cups or horns about 0.5 to 2 mm in diameter and 1 to 8 mm high develop on the surface of the lesions. The outer layer of the cups and horns is orange or brown. Depending on the fungus species, that outer layer opens and folds back to form a cup filled with orange or tan aeciospores, or, if the aecia produce horns, the horns split along the sides to release the aeciospores. The time for production of pycnia is about 2 to 3 weeks after infection, and aecia begin appearing as soon as a few hours after pycnia are fertilized. Aecial cups or horns are produced in two to 12 weeks after aecial formation, and aeciospores can be released any time from late June to September, depending on the weather and the rust species.

Infection of junipers occurs on current season leaves or shoots. Symptoms develop beginning the next growing season with the initiation of galls or witches'-brooms. The galls consist primarily of host tissue. They grow from needles, fleshy shoots or woody branches. Galls that grow from needles or fleshy shoots tend to be globose or kidney-shaped. They range in diameter from about 3 to 30 mm or more when mature, staying about the same size whether water-soaked or not. The color of galls on fleshy shoots usually is reddish-brown, becoming gradually lighter in color, turning to a bleached gray after they die. Galls on woody branches tend to be semi-globose or semi-ellipsoid along the length of the branch. Some galls on woody branches shrink when dry to less than half their hydrated size. Galls on woody branches tend to be a similar color as the branch when dry.

Witches'-brooms are branch and shoot proliferations with shorter-than-normal internodes between branches and more branches than is common. They can be relatively loose so they are barely discernable from non-infected tissue or so dense that no light can be seen through them. The fungus is systemic throughout the shoots in witches'-brooms. Witches'-brooms range in size from less than 2 cm and consisting of just a few shoots to a few meters in diameter and encompassing more than half the plant.

Figure 4. Telial spore horns developing on a juniper branch, Kidder County, N.D. The "berries" are actually the normal cones developing on the tree. Photo by Joe Zeleznik.

Importance

Occurrence – Little is known about the specific occurrence of each *Gymnosporangium* species in the Northern Plains, primarily because of the difficulty in identifying them to species. Thus, only occurrence of *Gymnosporangium* species as a group can be discussed. In general, if a susceptible rosaceous host is planted within a half mile of a juniper in North Dakota, the rosaceous host will be subject to infection. Because aeciospores can be dispersed long distances, any juniper in North Dakota is subject to infection. However, just because a plant is subject to infection does not mean that it will be infected. Prevailing wind directions, site microclimates, and host plant genetics are primary factors involved in infection of a plant. If these factors are favorable, infection can be very heavy. Junipers can have hundreds of galls or witches'-brooms and rosaceous plants can have essentially every leaf and fruit covered with rust lesions.

Damage – Damage by *Gymnosporangium* rust is not easily quantified. In general, junipers are not substantially damaged by *Gymnosporangium*. However, occurrence of hundreds of galls can result in damage comparable to a heavy snow load, with permanently bent down and broken branches. Witches'-brooms act as nutrient sinks, gaining nutrients disproportionately compared with the rest of the plant. When the effect is strong, the uninfected portion of the plant has sparse and nonvigorous foliage. The brooms occasionally die, resulting in death of a potentially large portion of the tree. However, since the broom was harming the rest of the tree, it is difficult to describe the death of a witches'-broom as damage. Overall, it is probably best to think of damage in terms of the effects on the host's energy balance. A few infections have no substantial effect on food reserves or utilization. As the number of infections increases, proportionately less food can be produced for reserves and more is shunted to the infections. The threshold of damage has not been determined. I would estimate it to be in the range of one large gall or several small galls per foot of branch to reach the level of affecting the energy balance of a juniper. The threshold should be lower for witches'-brooms, possibly at a level where brooms comprise 5 percent to 10 percent of the juniper's crown.

The rosaceous hosts are generally more subject to damage. That is usually due to loss of fruit quality or quantity, instead of more physical damage to the tree. On apples, one lesion does not have a substantial effect on the size or flavor of a fruit, but the appearance and storage quality can be reduced by that infection. If there are multiple infections of a fruit, the shape, size, and flavor can be affected. On juneberries, one lesion destroys a berry, but the loss of one berry is not substantial. Damage must be determined by the percentage of crop loss that is acceptable, which varies by situation.

Infection of leaves can affect fruit size and sweetness. Again, it is difficult to estimate the threshold of foliage infection that will affect fruit quality. I estimate that the threshold is probably about 30 percent of the total leaf area, but this would vary by date of infection, previous health of the tree, and nutrient availability. Foliage infection probably has a greater potential effect on fruit production the following season than it does on fruit quality the current season. Flower buds are formed in the prior season. If there are substantial food supplies, proportionately more flower buds will be formed. Factors that influence the energy balance will affect flower bud formation. Such factors include fertilization, water supply, fruit load, and health of the foliage. Again, the threshold is not known, but is probably about 20 percent of the total leaf area.

In addition to physical and fruit production damage, there is potential for aesthetic damage. Most people do not notice witches'-brooms or a few galls on a juniper, except possibly when the galls are covered with the spore horns. Similarly on rosaceous hosts, some people are very concerned about a few infections on the leaves. When there are substantial numbers of infections on junipers and rosaceous hosts, effects on aesthetics become greater. Multiple galls can change the crown color from the green of the foliage to the reddish-brown of the galls. On rosaceous hosts, infection of about 30 percent or more of the total leaf area gives the crown an orange-tinted cast.

Management

Disease management is targeted toward quarantine (isolation of rosaceous and coniferous hosts, with removal of less desired host), gall and witches'-broom removal (reduction of basidiospore production), and reducing infection by spores (application of pesticides, use of resistant rosaceous hosts).

Quarantine on junipers

The amount of time that basidiospores survive before desiccation and death varies with the temperature and humidity. It is difficult to define the limits of dispersal. Generally, if isolated from junipers by about a half mile, the amount of infection of rosaceous hosts will be minimal. Two miles is the distance mentioned in the literature for disease prevention on rosaceous hosts.

Quarantine on rosaceous hosts

Because junipers are the lower value plants in many situations and because aeciospores can be dispersed much longer distances to infect junipers, not planting or removing rosaceous hosts is not often practiced and would be needed over a much larger area. However, as with juniper quarantine, there is likely some incremental reduction in infection for every rosaceous plant that is removed and for each greater distance that they are removed.

Removing juniper infections

One means of disease management is the removal of galls and witches'-brooms from junipers. Removal is best done before spores are produced in the spring or early summer so that infection of rosaceous hosts is reduced or prevented. If this is done each year on the junipers, infection can be kept to a minimum. Most people do not find all the galls and witches'-brooms each time removal is done, so repeated observations result in greater efficiency over time. Also, galls and witches'-brooms may be small or undeveloped during one year of removal, so removal for at least two consecutive seasons is needed to have a substantial, lasting effect on the disease.

The practicality of removing galls and witches'-brooms for disease management has limits. If there are many junipers, e.g., in nearby woodlands or windbreaks, if there are junipers that cannot be accessed, e.g., in neighbors' yards, or if the junipers are too large, it can be physically impossible to remove enough infections to substantially reduce the infection of rosaceous hosts.

Application of fungicides

Fungicides are registered for control of *Gymnosporangium* rusts on junipers and rosaceous hosts. As of this writing, they include BannerMaxx, Bayleton, Camelot, Cleary's 3336 DF, Daconil Ultrex, Dithan M-45, and Pathguard 6F. Each fungicide tends to be labeled for a specific host and location, so the labels **must** be used to determine if they are labeled for the specific host or situation (e.g., fruit production, ornamental). Christensen and Steinegger (1997) list several fungicides that had been registered for cedar-apple rust control for various hosts. In general, fungicides prevent infection and need to be re-applied periodically during the time that spores may be present. In North Dakota, this would generally be from leaf out until mid-summer for rosaceous plants and from early to late summer for junipers.

Use of resistant rosaceous plants

Genetic resistance to each *Gymnosporangium* species occurs in rosaceous and juniper species. In North Dakota, resistance information is only available for some apples, crabapples, and junipers. Information about resistance is available in publications by Christiansen and Steinegger (1997), Himelick and Neely (1960), Lamey and Stack (1993), and Pokorny and Gould (2000). Asiatic crabapples generally are resistant to the *Gymnosporangium* species. Some crabapple cultivars that have resistance are Centennial, Dolgo, Donald Wyman, Prairie Fire, and Thunderchild. Some apple cultivars that have resistance are Fireside, Haralson, Keepsake, Mandan, Prairie Spy, Redwell, and Sweet Sixteen. Some junipers that have resistance are Arcadia, Boradmoor, Pfitzer, Savin, and Skandia.

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Small Talk – June 2005

New insect pest of black ash and Manchurian ash in North Dakota

A new insect pest of certain ash trees was recently identified in North Dakota. The cottony psyllid – a.k.a. cottony ash psyllid – (*Psyllopsis discrepans*) was found in both Bismarck and Fargo, feeding on black ash (*Fraxinus nigra*), Manchurian ash (*F. mandshurica*) and their hybrids/cultivars including ‘Mancana’, ‘Fallgold’, ‘Northern Treasure’ and ‘Northern Gem’. It is believed that this insect does not attack green ash (*F. pennsylvanica*). The cottony psyllid is a native of Europe and was first found in North America in 2000, in Edmonton, Alberta.

The cottony psyllid overwinters as eggs on outer branches of the trees. In the spring, the young psyllids hatch and then suck the sap from leaflets of the tree, curling them and giving them a “cauliflowered” look.

The curled leaflets enclose the psyllid nymphs and the white, cottony material they produce. In Bismarck, the adults appeared by mid-June. In Alberta, there are only two generations per year, but we may see three generations in North Dakota.

Certain insecticides are effective against this pest, but proper timing of control is crucial. The current recommendations include use of the systemic insecticides imidacloprid (e.g., Bayer Advanced Tree & Shrub Insecticide) or acephate (e.g., Orthene), or the non-systemic permethrin. Insecticidal soap also is effective, if the product can actually reach the insect. Pest management personnel in Edmonton found little effect of horticultural oil or dormant oil against overwintering psyllid eggs. Also, well-watered trees appear to be less susceptible to injury; if not enough rain falls, give the trees about one inch of water per week.

The current distribution of cottony psyllid is unknown. If you believe that your local black ash or Manchurian ash trees have been attacked by cottony psyllid, please contact your city forester, or else contact Michael Kangas (N.D. Forest Service – 701-231-5936) or Dave Nelson (N.D. Department of Agriculture 701-328-4765) to help them develop a better picture of the pest's distribution.

Second spray for Rhizosphaera

Rhizosphaera needlecast is a fungal disease of spruce trees, especially Colorado blue spruce. The classic symptoms of Rhizosphaera include death of the older needles, with healthy new growth towards the outside of the branches.

Rhizosphaera can be controlled with fungicides containing chlorothalonil, but it takes a total of four applications over two years. The first application should have occurred when the new needles were half elongated, approximately Memorial Day. The second application should occur three weeks later … about now. The third and fourth applications follow next year at the same times. For further information on Rhizosphaera and how to tell the difference between Rhizosphaera needlecast and Cytospora canker of spruce, see the NDSU Extension publication PP-1276, "Spruce Diseases in North Dakota".

Stop fertilizing . . . for now

North Dakota's soils are generally highly fertile, providing trees and other native plants with more than enough nutrients to survive and thrive. Fertilization is rarely needed and not often recommended. However, fertilization usually results in faster tree growth if enough water is available, for example, where a tree is planted in a lawn that has an irrigation system.

One disadvantage of fertilizing trees is that the increased, tender growth may not go dormant in time for winter. If too much nitrogen is added to the soil, trees will remain green far into the fall and will not completely harden off before freezing temperatures arrive. Nursery managers usually stop fertilizing their tree crops in July as part of a program to increase winter hardiness and survival. Fertilization may begin again in mid-September.

Death by desiccation

For years, people have been recommending the use of nicotine as a natural insecticide. Simply crush a packet of cigarettes into a couple gallons of water, then spray it on your plants. A recent article in the June 2005 issue of the USDA-ARS magazine Agricultural Research indicates this is not the case. Researchers at the ARS in Beltsville, Maryland, discovered that the natural insecticides from tobacco plants are actually a group of compounds known as "polyol esters," or sugar esters. Sugar esters have been used for years as food additives, but the ones that work as insecticides are based on different fatty acids and sugars than those that are used in foods.

In short, the sugar esters are found in the leaf hairs (trichomes) of the tobacco plant. They kill insects by breaking down the insect pest's waxy outer coating, forcing the insects to lose water and die from dehydration. The first patented product – sucrose octanoate – was introduced in 2002 and is now registered with the U.S. EPA for a wide variety of insect and mite pests on agricultural and horticultural crops.
To read the full article, Agricultural Research Magazine can be found online at: http://www.ars.usda.gov/is/AR/index.html.

Oak leaf tatters

A recent Illinois study suggests that abnormal leaf development in the white oak group (oak leaf tatters) may be due to drift of chloroacetamide herbicides. The chloroacetamide herbicides that were tested contain the active ingredients metolachlor and acetochlor. These were applied at three different stages of bud/leaf development and at three different concentrations. Several other herbicides were tested, but only those containing the chloroacetamides produced the tattered leaf symptoms. The white oak group contains our native bur oak. Red oak trees were also tested, but they showed no symptoms. In other areas of the

Midwest, hackberry has also shown tatters symptoms in Minnesota.

It must be emphasized that this is a preliminary report and much more research needs to be done to determine the exact timing and other requirements for symptoms to appear. Oak leaf tatters has been reported in many areas of the Midwest, but apparently not in North Dakota or elsewhere in the Great Plains. Additionally, the chloroacetamide herbicides have been in use since the 1960s, while symptoms were not reported until the 1980s. More research will be performed this year, throughout the Midwest. A second article on oak leaf tatters is available from the May 2005 issue of the Minnesota DNR Forest Insect and Disease Newsletter.

Loss of shelterbelts spotlighted in Grand Forks art show

The North Dakota Museum of Art is presenting an exhibit this summer entitled, “The Emptying out of the Plains.” A large part of this show focuses on the removal and loss of shelterbelts. The display includes photographic works by Jon Solinger of Moorhead, Minn., and an accompanying documentary by Kathryn Lipke-Vigessa, originally from Cooperstown, N.D. Greg Blair, a recent graduate of the UND Visual Art Department has created a memorial to trees that once thrived in North Dakota during the glacial Lake Agassiz era. New poems created by Madelyn Camrud, a poet from Grand Forks, accompany the visual artists’ work.

The Museum is open from 9 a.m. to 5 p.m. weekdays and on weekends from 11 a.m. to 5 p.m. The “Emptying out of the Plains” show runs through August 1st. There is no admission charge but the suggested donation is $5 for adults and change from children. Call (701) 777-4195 for more information. Located on Centennial Drive on the campus of the University of North Dakota, the North Dakota Museum of Art is a private not-for-profit institution managed by its own board of Trustees and not an entity of the University.

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