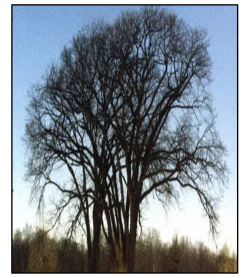
Tree Talk



August 2006
Volume 2 Issue 4

"I like trees because they seem more resigned to the way they have to live than other things do."
- Willa Cather, O Pioneers!

Riparian forest buffers – how and where they work

By Craig Stange, Natural Resources Conservation Service (NRCS) Forester, Bismarck, N.D.

According to the North Dakota Natural Resources Conservation Service (NRCS) (2006), a riparian forest buffer (RFB) is defined as "an area of predominantly trees and/or shrubs located adjacent to and up-gradient from water courses or water bodies." When properly designed and maintained, these buffers effectively trap sediment and nutrients in surface and near-surface runoff, reducing the pollutants entering the receiving water body. Other commonly-used names for RFBs include buffers, tree buffers or riparian communities. These terms all refer to the same piece of land – the interface between the channel and the terrestrial landscape (Petersen et al. 1992).

Raedeke (1998) describes riparian systems as having long, linear shapes with high edge-to-area ratios and microclimates distinct from those of adjacent uplands. Water is present at or near the soil surface during all or part of the year, resulting in variable soil moisture conditions and distinct plant communities. Periodic flooding causes habitat disturbances that result in a greater natural plant diversity than is present in the surrounding upland areas.

Parts of Riparian Forest Buffer

Most authorities on riparian forest buffers generally agree on three distinct zones that serve specific purposes (Figure 1). Depending upon the location and the administrative authority, the management of each of these zones could vary.

Zone 1 consists of large trees, naturally occurring or planted, growing at the very top of the bank and extending from the bank at least 15 feet. For some applications, this zone may be 30 to 50 feet wide. Activity, such as grazing, logging, building construction or recreation, may be restricted in this zone in order to maximize stream shading, accumulation of surface organic matter and to maintain stream bank stability.

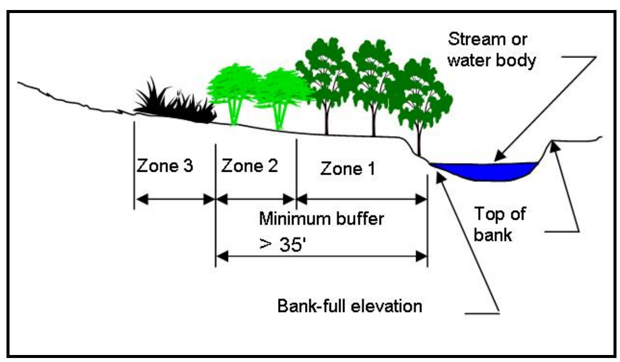


Figure 1. Generalized zones of a fully functioning riparian forest buffer. Diagram by Craig Stange.

Zone 2 is at least 20 feet wide and may consist of shrubs and/or trees, depending upon landowner objectives. This additional area (usually much wider than 20 feet) can be managed for wood production, wildlife or grazing. Zone 2 adds to the filtering capability of the planting. Together, zones 1 and 2 can be wider than 200 feet.

Zone 3 consists of dense grasses, but may not be needed on all sites, especially if the adjacent land use does not contribute significant amounts of sediment. Even if grass is not needed for sediment filtration, it is usually beneficial to leave a 20 to 30 foot wide strip of grass to protect the trees from activities such as livestock grazing, traffic or farm machinery on the adjacent land. When Zone 3 is needed, it is at least 20 feet wide and consists of dense sod-forming, upright grasses such as switchgrass.

Riparian function and benefits

Riparian forest buffers perform many functions and are most effective when established on intermittent or first and second order streams (Figure 2). Buffers established lower in the watershed (fourth and fifth order streams) will still have some benefits in the immediate area, including erosion control, wildlife habitat, and flood protection, but their impacts across the watershed will be greatly reduced.

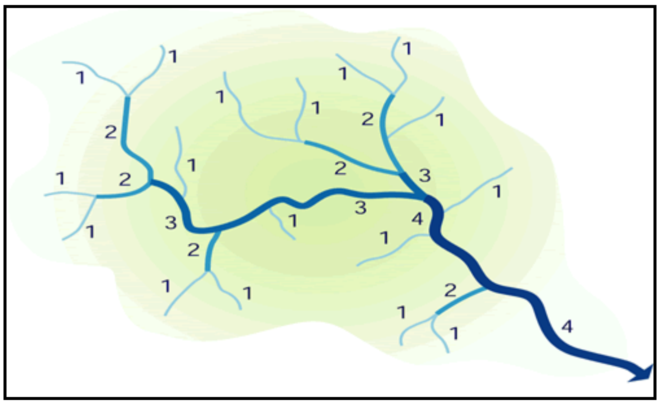


Figure 2. Generalized diagram of a watershed showing the different stream orders. Riparian forest buffers are most effective when established on the first and second order streams. Diagram from Federal Interagency Stream Corridor Restoration Working Group (1998).

The USDA National Agroforestry Center (2004) has published a brochure describing the benefits of riparian forest buffers. These include:

<u>Reduced flooding and flood damage</u>

Extensive root systems bind soil particles together, improving water infiltration which reduces runoff. Woody plant debris also improves infiltration and protects the soil from erosion. Stiff stems of trees and shrubs resist and slow out-of-bank water flow. One study (Dwyer et al. 1994) along a 39 mile reach of the Missouri river in Missouri found that “a woody corridor reduced the chance of primary levee failure and severity of damage to levee failures during the 1993 flood events.”

<u>Improved aquatic habitat</u>

Overhanging trees shade the water surface (Figure 3), which reduces water temperatures and increases available oxygen. Trees and shrubs in the buffer supply detritus (dead leaves, twigs and branches) as part of the aquatic food chain and also provide large woody debris which creates in-water structure. Above-ground and below-ground filtering improves the quality of water entering the stream. Increased infiltration and resultant increased ground water results in a more sustained stream base-flow that lasts longer.

<u>Filtering of contaminants in surface and ground water</u>

Vegetation and plant debris slow surface runoff causing sediment and any attached pollutants to be deposited before entering the water body. Contaminants in the soil are immobilized and transformed by the microbes found in riparian forest soils. Some of these contaminants or those in groundwater flowing through riparian forest buffers may be taken up by the trees and shrubs and stored in the woody stem or transpired. Wind blown dust can be trapped by the foliage and deposited before it enters a water body. In one Iowa study (Licht et al. 1992), a three-row hybrid poplar belt planted 5 feet deep (5 foot long unrooted cuttings planted in a trench on a 3 foot spacing with only the top bud above the soil surface) reduced near-surface nitrate concentrations from 20 to 150 mg/liter on the crop side of the buffer to less than 3 mg/liter on the stream side of the buffer.

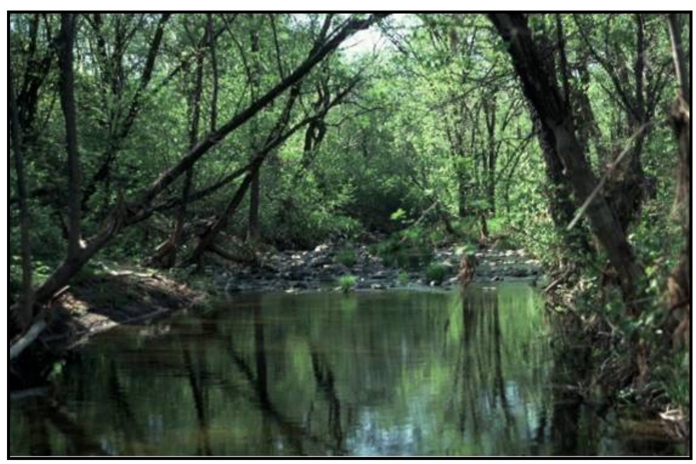


Figure 3. A view of the north branch of the Park River (1979) showing a fully functioning riparian buffer. Note the amount of shade on the river and the volume of detritus (leaves twigs and branches) that are available as food or habitat. North Dakota NRCS file photo.

Riparian establishment

Establishing a riparian forest buffer should begin with a thorough inventory of the existing conditions at the site. Soils, erosion potential, bank stability, hydrology, weed and animal pressure, flood risk and existing vegetation should be documented and used to determine the best establishment plan.

Soils

At first glance, it might seem that all soils that are found in riparian areas are the same because they are subject to the same or similar processes. However, riparian soils are not all the same and the species that will survive and thrive on these sites may differ from one location to the next.

Erosion risk

Is the site subject to sheet erosion or do flood flows scour new channels? If so, this could have an impact on tree planting success or weed control in a new planting.

Bank stability

Are the banks slumping or are they stable? If the banks and site are not stable, much of the riparian buffer planting efforts could disappear due to a channel change or severe bank erosion after the next flood event. Vertical stream instability or excessive lateral movement indicates serious hydrologic and geomorphic problems in the watersheds. Often the best solution is to “fix” the problems within the watershed before investing in riparian forest buffer establishment.

Hydrology

Hydrology can affect the physical site and the biology of the trees. Besides flooding, there are other hydrologic factors to consider. Is the water table within reach of tree and shrub roots during the growing season? How much runoff comes from adjacent land uses? Is the river stable or is it downcutting or moving laterally? Downcutting or lateral movement can take water away from the trees and turn a riparian site into an upland site with respect to available water.

Weed and animal pressure

What are the main weeds to deal with? Quack grass, brome grass or canary grass can reduce the success rate of most plantings. Are deer, moose or beaver populations high? Heavy deer pressure has caused riparian plantings to fail.

Flood risk

How often, how deep and in what season do floods occur? Most established plants can survive floods during the dormant season. In some years, spring floods at ice out can send ice floes across a planting, shearing the trees and shrubs off completely. Growing season floods, if the duration is long enough, can kill established trees and shrubs, though they are less susceptible to damage than are new plants.

Existing vegetation

What is growing on the site and near the site? Existing vegetation on the site, especially sod forming grasses, can greatly reduce tree and shrub planting success. For some sites, adjacent trees and shrubs that already exist can be an important seed source for the new planting.

What is the best establishment method?

Even though riparian areas contain very productive soils and often have access to plenty of water, getting a dense riparian forest established is difficult. Obviously the area is subject to flooding, which can negate the benefits of many of the normal tree establishment processes.

What doesn’t work

Riparian areas often provide habitat for deer, beaver and moose. All of these animals feed on trees and shrubs. Using tree shelters to protect trees from these animals only works in areas that are not subject to flooding because flood waters can lay the tree shelters on the ground with the trees inside.

Weed control also is challenging in establishing riparian forest buffers. While weed control fabric works well on sites not subject to flooding, flood waters can tear the fabric out or cover it with silt. This creates a weed problem that is harder to control than if no fabric had been applied. Chemical weed control can work until the next flood covers the site with silts and deposits a new crop of weed seeds that often have high germination potential.

Young seedlings are much more susceptible to flooding than are mature trees. Recurring growing season floods can wipe out a lot of planting stock. Also, flood debris within the planting restricts access and movement, which complicates maintenance activities.

What does work

From several years of observation on nearly 10,000 acres of land within the flood plain of the Red River and its tributaries, we have observed that natural regeneration appears to be the most successful riparian forest establishment method. On many sites where abandoned fields are to be forested, the adjacent trees have provided a seed source that can result in initial tree stocking rates of more than 10,000 trees per acre. Cottonwood and willow seed can spread to areas a mile away. If an area is subject to flooding, ash, boxelder and bur oak seeds can float in from miles away. Otherwise, green ash and boxelder can blow several hundred feet from seed trees.

With stocking levels that high, at least a few of the trees might escape the deer browse and become full grown. However, growing season floods still can drown out naturally-seeded trees. Ice floes still can sheer them off. Our observations in the Red River system support the research results that seedling establishment is often observed to be high following scouring floods (Fenner et al.1984, Scott et al. 1997). However, mortality from subsequent floods often limits recruitment into older age classes. When floods are frequent, recruitment occurs almost every year, but population increases are balanced by high flood mortality, resulting in small, but stable populations (Lytle and Merritt 2004).

This is precisely what we have observed in the riparian areas of the Red River system. Lots of cottonwoods and willows get seeded every year. If a particular site is fortunate enough to escape a growing season flood (primarily due to a slightly higher elevation), seedlings can get bigger and are better able to withstand the next flood. Based on Lytle and Merritt's (2004) study and from our observations, it appears unlikely that we will see a dense, contiguous band of riparian forest develop along the Red River until weather conditions change the flooding frequency and timing. We are starting to see islands or pockets of trees that have escaped several floods and are becoming a robust riparian forest.

Riparian forests without the water

Throughout the Great Plains, many streams have been altered, resulting in areas adjacent to the stream no longer being influenced by additional water. These areas have dried out from down cutting, diversion, channelization or relocation. Trees in these locations that were established under riparian hydrology are now subjected to stresses similar to trees on upland sites. If the dewatering is severe enough, trees such as willow and cottonwood die prematurely. Additionally, these dewatered riparian zones can become heavily sodded with brome or bluegrass. In some locations, dense stands of Russian-olive have become established in the absence of flooding and/or fire. Reforestation on these sites would utilize practices appropriate to upland sites requiring similar site preparation methods. Reforestation that utilizes natural (volunteer) regeneration likely would be unsuccessful, due to dense sods and lack of water.

Riparian forests, especially within the Great Plains are species rich and very productive when compared with surrounding upland forest sites. These forests provide wildlife habitat, levee protection, erosion control, stream stabilization and filter ground and surface water. The key to this richness and production is the water within the riparian zone. Though trees still may be "growing next to the water," once the water has been taken from the soil and is no longer within reach of the tree roots, the trees-by-the-stream do not function as a riparian forest buffer. They still have value as a forest, but they no longer reduce flood flows, trap sediment or filter ground and surface water.

References

Dwyer, J.P., D. Wallace and D.R. Larson. 1994. Value of woody river corridors in levee protection along the Missouri River in 1993. J. Am. Water Resources Assoc. 33: 481-489.

Federal Interagency Stream Corridor Restoration Working Group. 1998. Stream corridor restoration: Principles, processes and practices.

Fenner, P., W.W. Brady and D.R. Patton. 1984. Observations on seeds and seedlings of Fremont Cottonwood. Desert Plants 6:55-58.

Licht, L.A., J.L. Schnoor and D.R. Nair. 1992. Ecolotree buffers for controlling nonpoint sediment and nitrate. Paper presented at American Society of Agricultural Engineers Annual Meeting, December 17, 1992, Nashville, Tenn.

Lytle, D.A., and D.M. Merritt. 2004. Hydrologic regimes and riparian forests: A structured population model for cottonwood. Ecology. 85: 2493-2503.

North Dakota NRCS. 2006. Field Office Technical Guide. Available on-line at: http://www.nrcs.usda.gov/technical/efotg/. Accessed on 31.July.06.

Petersen, R.C., L.B.M. Petersen and J. Lacoursiere. 1992. A building block model for stream restoration. p. 293-309 *in* Boon, P.J., P. Calow and G.E. Petts *eds*. River conservation and management. Wiley and Sons, New York, N. Y. 470 pp.

Raedeke, K.J. 1988, Introduction. *in*: Raedeke, K.J. *ed*. Streamside management: Riparian wildlife and forestry interactions: Proceedings of a symposium on riparian wildlife and forestry interactions. U. Washington, Institute of Forest Resources, Contribution No. 59.

Scott, M.T., G.T. Auble and J.M. Friedman. 1997. Flood dependency of cottonwood establishment along the Missouri River, Montana, USA. Ecol. Apps. 7: 677-690.

USDA National Agroforestry Center. 2004. Working Trees for Water Quality. 6p.

Pear slug sawfly (*Caliroa cerasi*) – a lot that we don't know …

The pear slug sawfly (*Caliroa cerasi*) has the potential to attack a wide variety of trees and shrubs in North Dakota, specifically those from the Rosaceae family. Despite the broad spectrum of possible hosts (Table 1), the insect has not been observed on all the species listed in Table 1. When damage does occur, it can be minimal or a very large amount. The insect has been seen mostly in central North Dakota. The pear slug sawfly is native to Europe and Asia, and was introduced to the U. S. more than 90 years ago (Cook 1914).

Damage from this insect is due to larval feeding. Early larval feeding is indicated by small "shot holes" in the leaves (Raffa and Lintereur 1988). The leaves become partially or completely "skeletonized" (Figure 1) as the larvae feed on leaf tissue between the veins, but only on the upper surface of the leaves (Ives and Wong 1988). If enough leaf tissue is lost, the plant may simply drop its leaves prematurely (Johnson and Lyon 1991). While this is usually not very detrimental to the host plant (Zeleznik et al. 2005), severe damage in late-summer can hamper bud set (Penman 1976). One report (Edwards 2004) claims that when insect populations are high, they might actually feed on the fruit. However, this has not been reported in the scientific literature.

Figure 1. Leaves of hedge cotoneaster (*Cotoneaster lucidus*) showing partial skeletonization due to feeding of the larvae of the pear slug sawfly (*Caliroa cerasi*). Photo by Joe Zeleznik.

Although they are technically not slugs, the larvae have a slimy covering that makes them look like slugs (Figure 2). Larvae are greenish black and slimy at first, but fully-grown larvae are yellow and about 13 millimeters long (Johnson and Lyon 1991). The slime serves as a protective coating from predators. This protection appears to be purely mechanical, not chemical (Eisner 1994). Fully grown larvae apparently have no slime (Edwards 2004).

Table 1. Potential species and varieties of trees and shrubs that can be damaged by the pear slug sawfly (*Caliroa cerasi*). The sawfly has been observed in North Dakota only on a small portion of the listed species/cultivars

	Species in North Dakota		
Genus	**Common name**	**Scientific name**	**Comments**
Amelanchier	Juneberry	*Amelanchier alnifolia*	Not observed
Cotoneaster	European cotoneaster	*Cotoneaster integerrimus*	Highly susceptible
	Hedge cotoneaster	*Cotoneaster lucidus*	Susceptible
	Peking cotoneaster	*Cotoneaster acutifolia*	Susceptible
Crataegus	Hawthorn	*Crataegus* sp.	'Toba' and 'Snowbird' cultivars susceptible
Malus	Apple, crabapple	*Malus* sp.	Not observed
Prunus	Cherries, plums, apricots		
	American plum	*Prunus americana*	Not observed
	Hardy apricot	*Prunus armeniaca*	Not observed
	Manchurian apricot	*Prunus armeniaca* var. *mandshurica*	Not observed
	Sand cherry	*Prunus besseyi*	Not observed
	Purple-leaf sandcherry	*P.* x *cistena*	Susceptible
	Mongolian cherry	*Prunus fruticosa*	Not observed
	Amur chokecherry	*Prunus mackii*	Not observed
	Mayday	*Prunus padus* var. *commutata*	Not observed
	Pin cherry	*Prunus pensylvanica*	Not observed
	Russian almond	*Prunus tenella*	Not observed
	Nanking cherry	*Prunus tomentosa*	Not observed
	Common chokecherry	*Prunus virginiana*	Not observed
Pyrus	Ussurian (Harbin) pear	*Pyrus ussuriensis*	Not observed
Sorbus	Mountain-ash	*Sorbus sp.*	Not observed

Figure 2. Second-generation larva of the pear slug sawfly (*Caliroa cerasi*) on a leaf of hedge cotoneaster. Photo taken in Mandan, N.D., at the end of August. Photo by Joe Zeleznik.

Insect life cycle and host preferences

Pear sawflies overwinter as fully-grown larvae (Johnson and Lyon 1991) in cocoons in an earthen cell 2 to 6 inches below the soil surface (Antonelli 2006, Carl 1972). Direct contact of the larvae in the cocoons with moisture causes mortality through fungal growth, but low relative humidity also will cause high mortality because of desiccation (Carl 1972). In spring, the larvae pupate, emerging as adults in June and possibly July (Ives and Wong 1988). Adults may be only females, reproducing without breeding, though the evidence supporting or refuting this is inconsistent (Carl 1972). Female sawflies begin to lay eggs on the day they emerge and continue throughout their adult lives (Carl 1972). Eggs are deposited singly on the bottom side of a leaf, forced into the leaf between the top and bottom epidermal layers. The eggs are tan and circular and resemble a blister on the leaf (Beers et al. 1993). Eggs hatch about two weeks later and larvae begin feeding on the upper surface of the leaf. During rainy periods, some larvae move to the lower side of the leaves, feeding there instead of the upper leaf surface (Carl 1972). Feeding continues for about four weeks. Mature larvae then drop to the ground to pupate. In North Dakota, a second generation begins to emerge by August (Zeleznik et al. 2005), but in Canada, these larvae may stay in the soil and overwinter there (Ives and Wong 1988). Adults are about 3/16 inch long and are shiny black with dark wings. The second generation larvae that begin to appear in August have their peak feeding time in early September. As mentioned above, severe damage to the plant in late summer can reduce subsequent bud set (Penman 1976).

The potential hosts for this insect are numerous (Table 1). However, several studies and observations have shown that pear sawflies have definite preferences for their feeding and egg-laying. For example, Raffa and Lintereur (1988) noted the following levels of feeding damage by pear sawfly in Wisconsin: hedge cotoneaster – 90 percent leaf skeletonization, cranberry cotoneaster – 50 percent, hybrid quince – 35 percent, and many-flowered cotoneaster 10 percent. All of these shrubs were within approximately 50 feet of each other. Greg Morgenson, manager of the Lincoln-Oakes Nurseries, notes that pear sawfly is annually severe on European cotoneaster and at times on Peking cotoneaster. He rarely observes this insect on other species. Jeff Heintz, the city forester of Bismarck, N.D., annually notes damage to purple-leaf sandcherry, and also on 'Snowbird' and 'Toba' hawthorns. Carl (1972) noted that certain ecotypes of pear sawfly had specialized plant species preferences in Europe.

A group of researchers from New Zealand studied several different pear (*Pyrus* sp.) varieties and breeding lines in an attempt to find genetic resistance to the pear sawfly (Brewer et al. 2002, Shaw et al. 2003, Shaw et al. 2004). They found that resistance did exist in the different pear parents. Sawflies simply did not lay as many eggs on resistant plants than on susceptible plants. However, larval development was slower on susceptible plants because there were more larvae competing for the food resource.

Control

The easiest method of control is to physically remove the feeding larvae from the plant. This can be accomplished by hand or by spraying the plant with a strong jet of water. Light watering probably will not work, as larvae populations were not reduced following a rain storm (Carl 1972). Pear slugs also are easily controlled by many common pesticides that are labeled for sawflies. They rarely present a problem in commercial orchards under conventional management. Insecticidal soap and horticultural oils (syn. summer oils) also work well. Another control method is to sprinkle the larvae with wood ash.

Smirle and Wei (1996) also tested the effectiveness of neem oil on deterring feeding of pear sawfly larvae. When larvae were offered oil-treated cherry leaves, there was 50 percent feeding deterrence with a 1.11 percent solution of neem oil. When larvae had a choice between treated and untreated cherry leaves, 50 percent deterrence was reached with a solution of only 0.49 percent neem oil. Neem oil that was directly applied to the larvae was more effective against smaller (younger) larvae than larger larvae. Neem oil inhibited the ability to successfully molt and it took as long as seven days for effects to become evident.

Edwards (2004) recommends the use of lime sulfur to control pear slugs. She recommends that this product be applied to cherry trees after the crop is harvested, but also cautions that it can cause russeting of pear fruit. Lime sulfur is normally used as a fungicide and I was unable to find any published experimental results to back up this recommendation.

Not much is known about the natural enemies of pear slugs, especially here in the U.S. However, pear slugs can be parasitized. In Europe and in New Zealand, a flagellate (either a bacterium or a protozoan) causes high mortality of the pear slugs and is responsible for the collapse of outbreaks (Lipa et al. 1977). Edwards (2004) states that when the middle of the eggs are black, they are parasitized, but she does not say what the parasite is. Carl (1976) discussed the natural enemies of pear sawflies in Europe, which included eight parasites, one predatory insect and the flagellate discussed above.

Where a particular landscape plant is desired by the homeowner, it may be possible to use the insect's feeding preferences to your advantage. For example, if the goal is to minimize infestation on a cherry tree, planting a hedge cotoneaster shrub nearby may draw the insect away from the cherry and onto the cotoneaster. However, if the hedge cotoneaster is the homeowner's desired plant species, this method may not work, since that appears to be the insect's most-preferred host.

Literature cited

Antonelli, A. 2006. Pear slug. Washington State University Extension publication EB 1369, available at: http://cru.cahe.wsu.edu/CEPublications/eb1369/eb1369.html, accessed on July 27, 2006.

Beers, E.H., J.F. Brunner, M.J. Willett and G.M. Warner. 1993. Orchard pest management: A resource book for the Pacific Northwest. Good Fruit Grower, Yakima, Washington. 276p.

Brewer, L.R., P.A. Alspach, and A.G. White. 2002. Variation in the susceptibility of pear seedlings to damage by the larvae of the sawfly (Caliroa cerasi). Acta Hort. 596: 571-574.

Carl, K.P. 1972. On the biology, ecology and population dynamics of *Caliroa cerasi* (L.) (Hym., Tenthredinidae). Zeitschrift für angewandte Entomologie 71: 58-83.

Carl, K.P. 1976. The natural enemies of the pear-slug, Caliroa cerasi (L.) (Hym., Tenthredinidae), in Europe. Zeitschrift für angewandte Entomologie. 80: 138-161.

Cook, A.J. 1914. The cherry and pear slug. Calif. State Commer. Hort. Monthly Bull. 3: 40-41.

Edwards, L. 2004. Pear slug (*Caliroa cerasi*). BC Organic Grower. 7(3): 20.

Eisner, T. Integumental slime and wax secretion: Defensive adaptations of sawfly larvae. J. Chem. Ecol. 20: 2743-2749.

Ives, W.G.H., and H.R. Wong. 1988. Tree and shrub insects of the prairie provinces. Canadian Forest Service, Information Rep. NOR-X-292, Northern Forestry Centre. 327p.

Johnson, W.T., and H.H. Lyon. 1991. Insects that feed on trees and shrubs, 2nd ed. revised. Contributing authors C.S. Koehler and J.A. Weidhaas. Cornell University Press. 560p.

Lipa, J.J., K.P. Carl, and E.W. Valentine. 1977. *Blastocrithidia caliroae* sp. n., a flagellate parasite of *Caliroa cerasi* (L.) (*Hymenoptera: Tenthredinidae*) and notes on its epizootics in host field populations. Acta protozoologica. 16: 121-129.

Penman, D.R. 1976. Deciduous fruit tree pests. p. 28-43 *in* Ferro, D.N. *ed*. New Zealand insect pests. Canterbury, New Zealand, Lincoln University College of Agriculture.

Raffa, K.F., and G.L. Lintereur. 1988. New host records and developmental notes on the pear slug *Caliroa cerasi* (Hymenoptera: Tenthredinidae), feeding on *Cotoneaster* and *Chaenomeles* species. Great Lakes Entomologist. 21: 75-79.

Shaw, P.W., L.R. Brewer, D.R. Wallis, V.G.M. Bus, and P.A. Alspach. 2003. Susceptibility of seedling *Pyrus* clones to pear sawfly (*Caliroa cerasi*) (Hymenoptera: Tenthredinidae) damage. New Zealand J. Crop and Hort. Sci. 31: 9-14.

Shaw, P.W., D.R. Wallis, P.A. Alspach, L.R. Brewer, and V.G.M. Bus. 2004. Pear sawfly (*Caliroa cerasi*) (Hymenoptera: Tenthredinidae) host preference and larval development on six *Pyrus* genotypes. New Zealand J. Crop and Hort. Sci. 32: 257-262.

Smirle, M.J., and S.G. Wei. 1996. Effects of neem oil on feeding behaviour and development of the pear sawfly, Caliroa cerasi. Entomologia Experimentalis et Applicata. 80: 403-407.

Zeleznik, J.D., J.A. Walla, J.J. Knodel, M. Kangas, P.A, Glogoza, and C.L. Ruby. 2005. Insect and disease management guide for woody plants in North Dakota (Revised). Publication F-1192. 52p.

Ash rust (*Puccinia sparganioides*)

By Joe Zeleznik

Rust diseases are interesting because they almost always require two hosts to complete their life cycle. Ash rust (*Puccinia sparganioides*) alternates annually between ash (*Fraxinus* sp.) and several species of cordgrass (*Spartina* sp.). Other common rust diseases on trees in North Dakota include Melampsora rust (*Melampsora medusae*) on poplars and larch trees, western gall rust (*Peridermium harknessii*) on pines and cedar-apple rusts (*Gymnosporangium juniperi-virginianae* and related species) on various junipers and trees in the Rosaceae family. More information on cedar-apple rusts can be found in the June 2005 edition of Tree Talk.

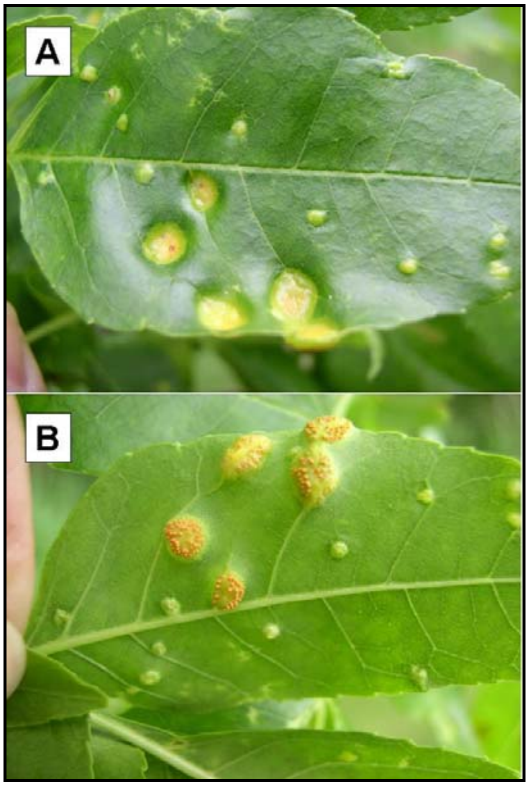


Figure 1. Leaf of green ash infected with ash rust (*Puccinia sparganioides*). A – top of leaf showing raised yellow lesions, B – bottom of leaf showing aecial cups in lesions. Photos by Joe Zeleznik.

Figure 2. Ash rust on the twig of a green ash tree, Logan County N.D. Infections are more common on leaves, but can also occur on newly-formed twigs and on the leaf rachis (leaf stem). Photo by Shelley Feist, Logan County Soil Conservation District.

Symptoms and damage

Ash rust is commonly found on leaves (Figure 1), though infection can occur on all plant parts formed in the current season (Figure 2). The initial symptoms are yellow to orange spots on the upper leaf surface and chlorotic spots on other plant parts. About two weeks later, bright orange lesions (1/6- to 1/2-inch diameter) appear on the lower side of the leaf and on the petiole and stem. These lesions contain two spore types. First, spermatiospores or pycniospores appear, though they generally are not noticed. Then, aeciospores become visible (Figure 3). Diseased tissue may swell, causing distortion of leaves, sharp bends in petioles (Figure 4), and roughly egg-shaped galls on twigs and seeds.

Figure 3. Closeup of distinctive pycnia and aecial "cluster cups" with orange-yellow aeciospores proliferating from the surface of infected tissue. Photo by Edward L. Barnard, Fla. Dept. Ag. and Consumer Services, www.forestryimages.org.

If the infection is severe enough, leaves will fall off the tree prematurely. Defoliation can be severe, causing a great deal of stress to the tree (Sinclair and Lyon 2005). However, infection levels in North Dakota rarely cause more than 30 percent defoliation, the level that is often said to be the baseline for the start of stress. The other type of damage that can occur is deformation or death of the current year's shoot. If that shoot is a leader, its death can result in a multi-stemmed tree. This disease is most serious near areas where the alternate hosts (cordgrass species) are most abundant (Zeleznik et al. 2005), such as wet or saline soils (Stevens 1960).

Figure 4. Green ash leaf rachis (leaf stem) distorted by ash rust, Logan County, N.D. Photo by Shelley Feist, Logan County Soil Conservation District.

There are no other rusts that affect ash, but there are others on cordgrass in the Northern Plains, specifically *Puccinia distichlidis*, *P. seymouriana* and *Uromyces acuminatus* (Hennon and Cummins 1956). Alternate hosts of *P. distichlidis* include fringed loosestrife (*Lysimachia ciliata*) and milkwort (*Glaux maritima*). Alternate hosts of *P. seymouriana* include buttonbush (*Cephalanthus* sp.), dogbane (*Apocynum* sp.) and milkweed (*Asclepias* sp.). The rust species on cordgrass are difficult to distinguish. Therefore the presence of rust on cordgrass does not mean ash in the area are threatened.

Life cycle of the disease

Ash rust overwinters on the cordgrass in structures called telia. It does not overwinter on ash. During warm, wet weather in spring, teliospores inside the telia germinate and produce a second spore type called basidiospores. This process can occur in as little as three to four hours at temperatures from about 55 to 75 F (Partridge and Rich 1957, Van Arsdel and Chitzanidis 1970). Trees become infected when moist air moves the basidiospores onto succulent, wet plant tissue and the surface of the tissue remains wet long enough for the basidiospores to germinate and grow into the tissue.

As the fungus develops in the ash tissue, it produces spore-producing structures called spermagonia or pycnia in the yellow spots on the upper surfaces of leaves and on chlorotic spots on leaf stems and twigs (Sinclair and Lyon 2005). As stated above, the bright orange lesions containing aeciospores appear on the lower side of the leaf and on the petioles and stems about two weeks after the spermagonia appear. Aeciospores are released in spring and early summer and are windborne back to the cordgrass. In warm climates, the fungus will develop another spore type on the cordgrass – urediniospores – which will cause secondary infections on the cordgrass.

Ash rust is most severe along the Atlantic Coast of North America, extending into the Gulf Coast states and Mexico. Infection intensity usually declines with distance from salt marshes (Van Arsdel and Chitzanidis 1970), but sometimes ash trees as far as 30 miles inland are infected heavily (Sinclair and Lyon 2005). One study in North Carolina (Van Dyke and Amerson 1976) found an inverse relationship between the percentage of cordgrass plants infected and soil water salinity. The authors hypothesized that the higher concentration of surface salts on plants growing in high salt regimes inhibited fungal spore germination. Lab tests confirmed this mechanism. In North Dakota, the disease is most serious on trees growing near areas where cordgrass is most abundant (Zeleznik et al. 2005).

Control

While severe ash rust infections may kill young trees (Creelman 1956), infections are usually not severe enough in North Dakota to justify control efforts, but control may be desired for aesthetics. The simplest method of minimizing the disease is to control cordgrass by mowing or using chemical herbicides. However, because infection of the ash trees can occur from cordgrass located several miles away, controlling only the closest, most heavily-infected cordgrass seems justified.

If cordgrass management is not possible, fungicides that contain the active ingredient myclobutanil may be used on the trees whenever conditions for severe infection are high. Myclobutanil is a protectant fungicide, so the ash trees need to be sprayed on a regular basis from late spring through early summer or before periods of weather favorable for infection.

If the leader of a small tree becomes infected and dies, corrective pruning should occur the following year in order to train the stem to a single leader.

References
Creelman, D.W. 1956. The occurrence of ash rust in western Nova Scotia. Plant Dis. Rep. 40: 580.

Hennon, J.F., and G.B. Cummins. 1956. Uredinales parasitizing grasses of the tribe Chlorideae. Mycologia 48: 126-162.

Partridge, A.D., and A.E. Rich. 1956. A study of the ash leaf rust syndrome in New Hampshire: suscepts, incitant, epidemiology, and control. (Abstr.) Phytopathology 47: 246.

Sinclair, W.A., and H.H. Lyon. 2005. Diseases of trees and shrubs. Second Ed. Cornell University Press. 660p.

Stevens, O.A. 1963. Handbook of North Dakota plants. N.D. Inst. for Regional Studies. Fargo, N.D. 324p.

Van Arsdel, E.P., and A. Chitzanidis. 1970. Life cycle and spread of ash rust in Texas. (Abstr.) Phytopathology 60: 1317.

Van Dyke, C.G., and H.V. Amerson. 1976. Interactions of *Puccinia sparganioides* with smooth cordgrass (*Spartina alterniflora*). Plant Dis. Rep. 60: 670-674.

Zeleznik, J.D., J.A. Walla, J.J. Knodel, M. Kangas, P.A, Glogoza, and C.L. Ruby. 2005. Insect and disease management guide for woody plants in North Dakota (Revised). Publication F-1192. 52p.

Elm Planting Revived

By Dale E. Herman, Dept. of Plant Sciences, NDSU

In 1998 an International Elm Conference was held in Illinois. The research papers presented at this conference were published in “The Elms: Breeding, Conservation and Disease Management in 2000.” Keith Warren of J. Frank Schmidt & Son Co., a nursery in Boring, Ore. titled his presentation “The Return of the Elm.” This nursery now sells at least 14 different elm cultivars. Many more cultivars are in the production phase or under evaluation. Yes, it appears the elms will make a comeback and once again shade our homes and frame our streets and boulevards.

A number of American elm cultivars selected for high resistance to Dutch elm disease (DED) are now available (or becoming available) from commercial nurseries. It was not an easy task to produce new hybrid elms with resistance to DED because our native American elm has four sets of chromosomes. Most other elms only have two sets. This is an over-simplification of the complex genetics of elms, but is stated to indicate that American elm cannot be crossed with other elm species with DED resistance to produce new improved elms.

The intent of this discussion is to present brief information involving two Asiatic species and several hybrid cultivars between the two which are now becoming readily available for planting in the Northern Plains.

David Elm – *Ulmus davidiana*
This species is native to Manchuria and other areas of northern China. According to George Ware of the Morton Arboretum near Chicago, this species has superior stress tolerance in adverse urban situations. Trees grow to 30 to 60 feet, about 25 percent to 30 percent smaller than American elms. Height at maturity varies by original seed sources and site of evaluation. The size, resemblance to American elm in form, and functional toughness make David elm a potentially promising tree if it becomes more readily available.

Japanese Elm – *Ulmus davidiana* var. *japonica* (older references often list it as *Ulmus japonica*, a separate species).
This variety is native to Japan and other parts of northeast Asia. It is primarily found growing in forested environments. Several cultivars of Japanese elm have been selected and introduced, particularly in Canada, but only one cultivar, ‘Discovery,’ has been widely accepted to date (see below). A seed source under evaluation at NDSU often produces a reddish autumn color.

Discovery Elm – *Ulmus davidiana* var. *japonica* ‘Discovery’ (PP 10, 558).
This clonal selection originated as an open-pollinated cross of Japanese elm trees from a Manchurian source growing at the Morden Research Station in Manitoba. It was selected by Rick Durand of Portage la Prairie. It is zone 3 winterhardy. It has high resistance to DED, leaf

aphid and elm leaf beetle. It appears to be well adapted to a variety of sites, including residential, urban and park settings. Discovery Elm develops the classic vase-shaped elm crown with good branch symmetry. It grows about 70 percent as large as a typical American elm. Fifth-year growth data at Bismarck and Grand Forks showed greater than 2 feet and 3½ feet of growth, respectively. The height of the trees after 10 years averaged 18.3 feet at these sites, with a stem diameter of 6.65 inches. Growth rates are slower than those of the hybrids listed below, but 'Discovery' is a recommended cultivar for North Dakota. Its crown is dense and may require pruning to alleviate co-dominant leaders.

Hybrid cultivars of Japanese Elm crossed with Siberian Elm – *Ulmus pumila*

Siberian elm has suffered in popularity in the Great Plains due to its weediness, extreme susceptibility to 2,4-D injury and to canker attack. However, hybrids between Siberian elm and Japanese elm show great potential for this region.

Sapporo Autumn Gold Elm – *Ulmus* x 'Sapporo Autumn Gold'

This was the first hybrid of this parentage to be introduced into the nursery trade by Smalley and Lester, University of Wisconsin, Madison, in the early 1970s. It develops an upright, vase-shaped form and has fairly small leaves reminiscent of the Siberian elm. It may not be quite as winter hardy as the three newer cultivars listed below. Five trees at least 35 feet in height are growing on the NDSU campus. Dead twigs develop in the trees and scattered cankers have occurred. This cultivar appears to have fallen out of favor and its production has waned in response to the superior cultivars that follow.

Cathedral Elm – *Ulmus* x 'Cathedral' (PP 8, 683)

This is a rapidly-growing cultivar that develops an umbrella-shaped crown (Figure 1). Introduced at the University of Wisconsin, it is performing well on boulevards and other sites in Northern Plains' cities and communities. Fifth-year growth data at Bismarck, Fargo and Grand Forks showed an average of 4.25 feet of new growth. The average height of the trees after 10 years was 21¼ feet, with a stem diameter of 8.4 inches. It has larger leaves than 'Sapporo Autumn Gold,' which is a characteristic that the public prefers. It is highly resistant to DED, has bright, glossy green foliage (Figure 2) and is winter hardy in zone 3.

This cultivar has good resistance to elm leaf beetle. With its rapid, dense growth, pruning may be needed to discourage co-dominant leaders. Performance in Fargo has been good to date and it is readily available in the nursery trade.

Figure 1. 'Cathedral' elm, a hybrid between Japanese elm and Siberian elm, growing in north Fargo in 2000. Photo by Dale Herman.

New Horizon Elm – *Ulmus* x 'New Horizon'

This cultivar is another University of Wisconsin introduction that also has larger leaves than 'Sapporo Autumn Gold.' It has excellent vigor once it is established and produces a more upright form, but a full crown develops with age. It is highly DED resistant. Fifth-year data at Fargo, Absaraka and Grand Forks showed an average of 4.4 feet of new growth. The average height of the trees after 10 years was more than 24½ feet, with a stem diameter of 9.2 inches. Trees suffered severe dieback in Bismarck during the winter of 1996-97, which was three years after planting. They showed moderate dieback at the NDSU Carrington Research Extension Center during the same winter, but this may have been accentuated by more stressful establishment conditions. Other plantings have shown no deficiency in winter hardiness. This cultivar also is recommended in the Northern Plains for more extensive evaluation. It is available in the nursery trade.

Figure 2. Bright, glossy leaves of 'Cathedral' elm. Photo by Dale Herman.

Vanguard® Elm – *Ulmus* x 'Morton Plainsman'
This cultivar is a more recent introduction from the breeding work of George Ware at the Morton Arboretum. It is reputed to tolerate drought and the more stressful conditions of the Midwest and Great Plains. Trees are loosely rounded to vase-like in form with dark green, glossy leaves. Its leaves are larger than 'Sapporo Autumn Gold,' but somewhat smaller than 'Cathedral' and 'New Horizon.' Three trees planted at the NDSU Research Arboretum in 2000 suffered moderate dieback the first winter, but have been hardy in succeeding years. Growth rate under dryland conditions without watering and fertilizing has been very slow to date. In 2004, replicated plantings were established at test sites in Bismarck, Dickinson and Fargo. In 2005, plants averaged 3.9 feet of growth at these sites under clean cultivation. This cultivar merits widespread evaluation because it is reputed to be very resistant to DED, moderate to fast in growth rate and excellent in hardiness. It has fair insect resistance and also is available in the nursery trade.

The above are just a sampling of elms now available for planting. The return of elms appears to be well on the way in the Northern Plains.

Small Talk – August 2006

More emerald ash borer (EAB) detections near Chicago
On July 13, the Illinois Department of Agriculture announced that the emerald ash borer (EAB) was found in a second site in suburban Chicago. This was in addition to the first EAB detection found in rural Kane County, about 50 miles west of downtown Chicago, in mid-June. A third EAB detection was announced on July 21 in Evanston, another Chicago suburb.

Evanston has 4,059 ash trees on its parkway and in its parks, which is about 12 percent of the city's 33,000 public trees. Additionally, there are thousands of ash trees on private property in Evanston. In 1999, the City of Evanston created a policy whereby any tree species that made up more than 10 percent of the overall population would no longer be planted on public property. This means the City has not planted any new ash trees since 1999. This effort to further diversify the overall tree population was specifically aimed to minimize the effects of an infestation.

Following the initial finding of EAB in Illinois, Agriculture Secretary Mike Johanns announced that an additional $7.6 million in emergency funding would be available for EAB eradication efforts in Illinois and Wisconsin. The funds will be used to conduct an intensive survey program and quarantine affected areas in Illinois to prevent additional EAB spread. The USDA's Animal Plant Health Inspection Service (APHIS) is preparing an interim rule for publication in the Federal Register to implement a quarantine to prevent the movement of host materials (nursery stock, firewood, etc) out of the area. The quarantine may be expanded if additional areas are found to be infested. As of August 3, 2006, EAB has not been found in Wisconsin.

Online learning center for Firewise landscaping available
The Firewise Communities Program has announced the creation of an online Firewise Learning Center at www.firewise.org/learningcenter/. The center is designed to encourage self-paced learning on a variety of topics at no charge. Two courses are currently available – "Fire Fighter Safety" and "Firewise Landscaping." Additional courses will

soon be added to the curriculum, including "Conducting Community Assessments" and "Firewise Construction Techniques."

The safety course addresses problems faced by structural and wildland fire fighters when wildfires are threatening structures in the wildland-urban interface. It examines the technical aspects of fire, including why it burns, the role of fuel, the effects of weather, structure protection strategies and fire fighter safety. Students have the option of watching video lectures from fire fighters who share their experience from the field.

The landscaping course reviews the essentials of landscape design in wildland fire-prone areas and demonstrates how a well-planned landscape can offer effective protection from wildfire to any home. It also includes several maintenance tips, as they are the most important factor in keeping the Firewise landscape functioning as a fire resistive barrier.

The national Firewise Communities program is an interagency program developed by the National Wildfire Coordinating Group's Wildland/Urban Interface Working Team. The program is designed to encourage local solutions for wildfire safety involving homeowners, community leaders, planners, developers, fire fighters, and others in the effort to protect people and property from the risk of wildfire.

Trees, bees and crops

Two recent editions of Agroforestry Notes, a publication of the USDA National Agroforestry Center, focused on the role of bees in crop pollination, and the value that trees and shrubs have as habitat for bees. Over 100 crop species in North America require insect pollination to be most productive and bees are among the most important pollinators. To ensure adequate pollination, producers often rely on European honey bees. However, native bees can also be important pollinators in agricultural fields as long as enough habitat is available.

Crop-pollinating native bees have three main habitat needs:

- Diversity of plants with overlapping blooming times
- Places to nest, such as undisturbed soil, dead trees or old rodent burrows
- Protection from pesticides, including broad-spectrum insecticides and herbicides that remove flowers needed for food

These needs can be met through the use of other agroforestry practices such as windbreaks or riparian forest buffers. Wherever possible in new plantings, consider how to include trees and shrubs that provide pollen and nectar for bees. For more information on the various techniques used in agroforestry, visit the National Agroforestry Center's Web site at: http://www.unl.edu/nac/index.htm.