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Tree Talk

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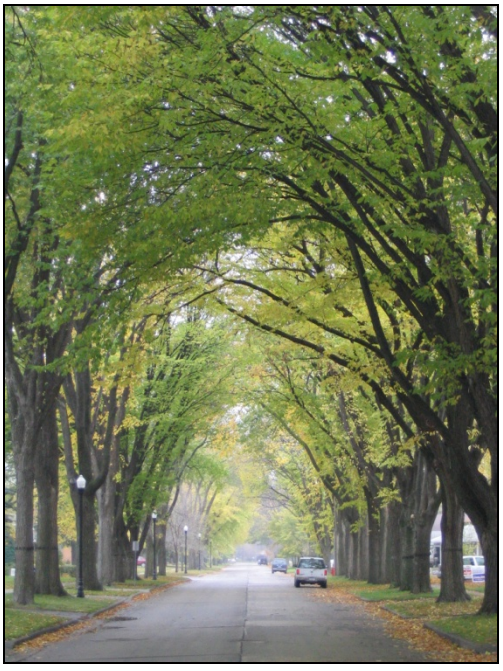
The creation of a thousand forests is in one acorn.
-Ralph Waldo Emerson

Planting for Success:
Problems, Pitfalls and Proper Procedures

By Scott Liudahl, Fargo City Forester

Think of the tree you just purchased as a lifetime investment. How well a tree and investment grows depends on the type, location, proper planting and follow-up care.

More than 80 percent of the inspection calls to our office that are related to tree decline, especially in the newer parts of town, can be attributed to mower/weed whip damage or a tree planted too deep. The first one is easy to fix if it's not too late. Either stop the damage or start over. The second one can be easily avoided at planting time. **When dealing with compacted clay and poorly or slowly drained soils, the proper planting depth is CRITICAL**.



The ideal time to plant trees is in the fall after leafdrop or early spring before bud-break. Weather conditions are cool, which allows plants to establish roots in their new location before spring rains and summer heat stimulate new top growth. Trees that are properly cared for in the nursery or garden center and given the appropriate care during transport to prevent damage, can be planted throughout the growing season. In either situation, proper handling during planting is essential to ensure a healthy future. *Before planting a tree, be sure you have had all underground utilities located prior to digging. Call ND One Call at* ***(800) 795-0555.***

Whether the tree to be planted is balled and burlapped (B & B), containerized or bare-rooted, it is important to understand that the tree's root system may have been reduced by 90 to 95% of its original size during transplanting. As a result of the trauma caused by the digging process, trees will commonly exhibit transplant shock. Transplant shock is indicated by slow growth and reduced vigor following transplanting. A rough estimate is that for each inch of ground-line caliper (diameter), a tree will experience one year of transplant shock as it becomes acclimated to the new site. Proper site preparation before and during planting, coupled with good follow-up care will reduce the amount of time the plant experiences transplant shock and will allow the tree to quickly establish itself. As the saying goes, "It's better to put a $100 tree in a $200 hole than to put a $200 tree in a $100 hole."

Our survival success rate over the last four-plus years is at 95 percent or better on new tree planting projects. A large majority are bare root trees. Bare

root trees are the most cost effective, but can also be a huge problem if not handled or planted properly. LEARN TO PROPERLY PLANT BARE ROOT TREES. Many of our containerized and B&B plantings are in newer areas of the city where the soils and conditions are challenging. When excavated (in the name of science of course), the root systems -- after two growing seasons -- had spread 18 to 24 inches beyond the original planting hole. Wow! And the initial hole was only eight inches deep!

Follow these simple steps to help ensure a successful tree planting:

1) **Dig a wide, shallow hole.** The diameter of the hole needs to be at least three times the diameter of the root ball. The sides of the hole should be loosened and roughed up to allow for root penetration. On most planting sites in new developments, the existing soils have been compacted and are unsuitable for healthy root growth. Breaking up the soil in a large area around the tree provides the newly emerging roots room to expand into loose soil, hastening establishment.

2) **Don't plant too deep.** The first major root should be even with, or slightly above, the existing grade outside of the planting hole. This point is called the root flare where the top of one tree was grafted onto the rootstock of another. There will be a swelling near the base of the tree. This is called the graft union. DO NOT mistake this for the root flare. Keep looking. For B & B or containerized trees, the first main root is often buried under several inches of soil in the container or root ball. Gently pull the soil away from the top of the ball until you find this root. A chaining pin, ice pick, or coat hanger can be used to probe a bit to help locate this root. Make sure the ball rests on a firm base to avoid settling. Call me crazy, but the hole may end up being only 6 inches deep. However, it still should be 60 inches wide.

3) **Completely remove all containers and cut circling roots.** Remove all baskets and containers. Make cuts along the side and bottom of the container to easily slide the tree out of the container once it is in the hole. Cut the bottom rung of the wire basket off BEFORE putting the tree in the hole and then remove the rest after it is in the final location. Peel back and cut out as much of the burlap as possible and remove all twine/string. A recent article by Bonnie Appleton and Scharlene Floyd (Journal of Arboriculture, July 2004) indicated that the flare roots may grow into the wire and cause partial girdling and restricted vascular flow. In some cases, the wire showed little signs of any deterioration over time. I have seen fully intact wire baskets after being in the ground for 20 years. It is not a pretty sight. There also is a common misperception that the burlap will quickly break down. Experience shows that burlap can remain in the ground for years without decomposing. If the ball is dry or crumbles when the basket or burlap is removed, reject that tree. Start over with a quality tree.

It is especially important to make vertical cuts several inches into the ball to cut circling roots on containerized trees. Learn to properly plant bare root trees to spot early problems. Girdling and

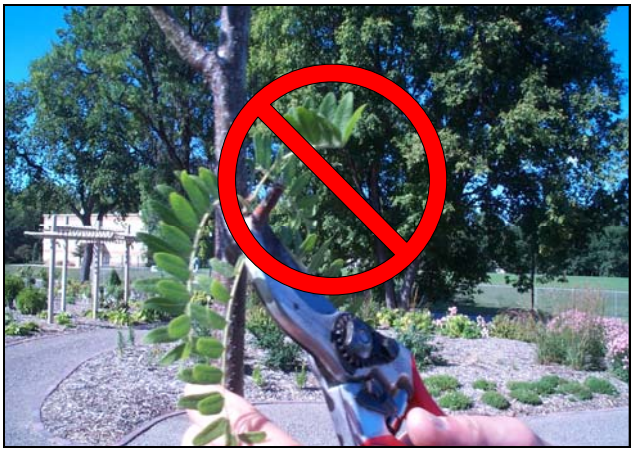
circling roots kill trees. Be aggressive with this step since this is the best opportunity to deal with girdling roots and preventing future problems. Stem girdling roots have been a main focus of Dr. Gary Johnson at the University of Minnesota. In one study, he noted that 73 percent of linden species failed completely in storms. They broke where the stem girdling roots had compressed the stem. For more information about stem-girdling roots, see the University of Minnesota Extension publication, "A practitioner's guide to stem girdling roots of trees."

4) **Loosen and break up existing soils for backfill when possible.** Don't be so easy on the tree that it gets really comfortable with its small planting hole. Tree roots will do better in the long run if they can be encouraged to get used to their new home and not some cushy, feel good, multi-soil type, full-of-fluff site. A research brief by Dr. Ed Gilman (Journal of Arboriculture, September 2004) indicates that there is no apparent benefit to adding amendments at planting time. He tested several amendments in that study, including two water-absorbing gels and several organic preparations, including compost. Too many amendments – compost, peat moss, etc. – leaves the potential for a future problem. Water the soil to allow for natural settling, then continue to backfill.

5) **Mulch.** Mulch has many benefits. Add 2 to 3 inches of woodchip mulch over the entire planting area. Continue to replenish the mulch and make the area wider as the tree matures. Avoid direct contact between the mulch and the base of the tree. Mulch will help keep that nasty lawnmower and weed whip away. Other benefits include keeping the soil cool and moist and adding more organic matter to the soil over time. Caution – too much mulch may cause moisture and oxygen problems.

6) **Water.** A new tree likely will require a slow, thorough soaking once a week, by hose or Mother Nature. One inch per week is typical. According to John Ball, professor of forestry and horticulture at South Dakota State University, an inch caliper tree can use up to 3 gallons of water per day. A 2-inch tree uses 6 gallons. Don't over water. This could easily happen if drainage is poor or the mulch is too thick.

7) **Stake loosely** with a strap or two if necessary. The tree needs to move around a bit to stimulate root growth and develop proper taper. The taper and the roots together provide windfirmness to the tree. The stem should be gently cradled, not strangled, about 2 to 3 feet above the ground. Although a variety of products can be used for staking, never place wire directly against the tree trunk. Some professionals have even questioned the use of a piece of wire placed through a length of garden hose as a staking material. A properly planted tree only needs to be staked for one season (maybe two).



8) **Pruning and fertilizing.** Don't do them yet – maybe later in life. Pruning removes leaves that create sugars during photosynthesis. These sugars are critical to proper growth and recovery during the first few years after planting. Wait at least two years before beginning to prune. Small, structural pruning in the first five to 10 years of life will help a tree develop into a strong specimen. Fertilizing – remember when I stated earlier not to make the tree TOO happy in its new home? Enough said about this.

(M)id (W)est (W)inter (S)urvival -- MULCH, WATER, WIDE, SHALLOW
After completing these simple steps, further routine care and favorable weather conditions will help ensure that a new tree will grow and thrive.

Trees are a valuable asset to any landscape. Trees provide a long-lasting source of beauty and enjoyment for people of all ages. When questions arise about the care of your tree, be sure to consult your local ISA Certified Arborist, tree care or garden center professional for assistance.

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Fall cankerworm – *Alsophila pometaria*

By Joe Zeleznik

In the spring of 2006 and 2007, cankerworms caused heavy defoliation of deciduous trees throughout the Missouri River Valley and elsewhere in the state (Figure 1). The larvae of two insects are the main culprits in spring defoliation of broadleaf trees – fall cankerworm (*Alsophila pometaria*) and spring cankerworm (*Paleacrita vernata*). Repeated heavy defoliation by cankerworms can stress the trees, requiring the use of valuable energy reserves to refoliate (Miller et al. 2001). This stress makes the trees more susceptible to secondary pests, both insects and pathogens. Tree mortality may increase during the next few years, though Stephens (1981) suggested that mortality would no more than double in Connecticut forests that suffered repeated defoliation by fall and spring cankerworms and other insect pests.

The two cankerworm species have very similar feeding habits and life histories (discussed below). Because spring cankerworms were discussed in the

May 2005 issue of Tree Talk, this article will focus on fall cankerworms. The dominant species probably switches back-and-forth – Hiratsuka et al. (1995) stated that fall cankerworm usually is dominant in the southern parts of the prairie provinces of Canada, but Frye et al. (1976a) said that spring cankerworms had been dominant in North Dakota in the early-to-mid 1970s.

Figure 1. Green ash leaf mostly skeletonized by cankerworms, Mandan, 2007. Photo by the author.

Host preferences

Fall cankerworms feed on a wide variety of deciduous tree species. In North Dakota, preferred hosts include linden, bur oak, elm, green ash, maple and paper birch (Zeleznik et al. 2005). However, the preferred hosts will vary based on locally available trees. In North Dakota windbreaks, Siberian elm and green ash are most often defoliated. In Utah, White and Whitham (2000) found that fall cankerworms preferred boxelder foliage over cottonwood (*Populus angustifolia* x *P. fremontii*), and warned that cottonwood seedlings growing beneath boxelder trees are more susceptible to defoliation than cottonwood seedlings growing beneath mature cottonwoods. Schneider (1980), studying fall cankerworms in New Jersey, found that individual insects specialized on particular species – one group specialized on red maple trees (*Acer rubrum*) while a second group focused on several oak (*Quercus*) species.

Miller et al. (2001) studied feeding preferences of cankerworms (both spring and fall) on a variety of Asian, European and North American elm species at The Morton Arboretum in Illinois. In general, Asian elms were least-preferred by cankerworm larvae, followed by European then North American elms. The authors suggested that those species with a large number of leaf hairs (trichomes) were less-preferred by cankerworms. Dix et al. (1996) found similar feeding preferences of spring cankerworms on Siberian elms in North Dakota. Specifically, spring cankerworms ate less leaf tissue on those Siberian elm clones that had more trichomes. Based on their results, Miller et al. (2001) experimentally removed the trichomes from certain species to determine if cankerworms feeding would increase. Interestingly, feeding did not increase on less-hairy leaves.

Smitley and Peterson (1993) evaluated several crabapple cultivars for resistance to a number of insect and disease pests, including fall cankerworm. Their study was done in Michigan and many of the cultivars that they used are not hardy to the northern Great Plains climate. Nevertheless, they found differences among the cultivars in amount of defoliations suffered. ‘Red Splendor’ had the least amount of defoliation (1.5%) while ‘Spring Snow’ had the most (4.3%). ‘Adams’, Centurion ®, and ‘Indian Magic’ were in-between.

Life history

The fall cankerworm overwinters in the egg stage near the tops of trees. In North Dakota, egg hatch occurs in mid-May to early-June, with the exact time depending on weather conditions (Christie 1990). Egg hatching occurs around dawn and is highly synchronized with budburst of the host tree, often occurring within 1-2 days (Futuyma et al. 1984). Females often lay eggs on the same individual trees that they hatched and fed on (Schneider 1976). This, along with the fact that female cankerworms can reproduce without mating, likely explains the year-to-year consistency in timing of egg hatch (Schneider 1980). White and Whitham (2000) found that egg densities were 26 times greater on boxelder than on cottonwood.

Newly-hatched larvae are less than 1/16-inch long and quickly begin feeding on expanding leaves (Christie 1990). They develop through four growth stages (instars) during a 4-5 week period and feed into early July. They are ¾ to 1-1/2 inches long when fully grown. Larvae vary in color from light green to brownish-green with a dark band down the back. Both green and dark larvae have white lines

extending along the sides (Figure 2). Fall and spring cankerworms can have similar coloration, though spring cankerworms vary from green to reddish-brown or black, with a faint dark line or a yellow stripe down the sides (Christie 1990). Also, spring cankerworms have two pairs of prolegs on the abdomen, while fall cankerworms have three pairs (Figure 3).

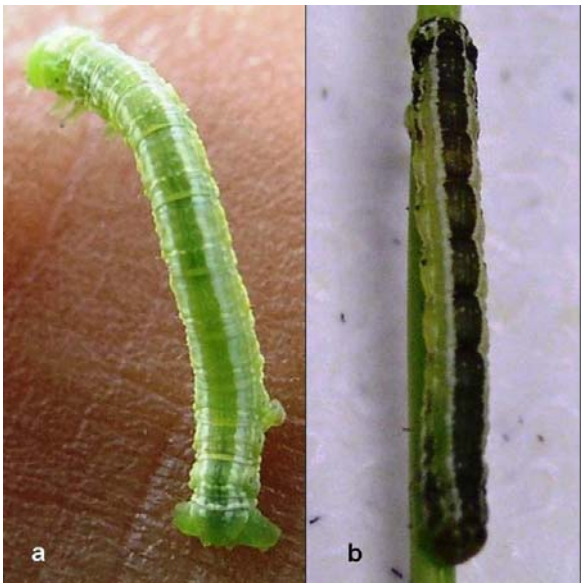

Figure 2. Larvae of fall cankerworm showing color variation from (a) light green to (b) brownish-green with a dark band down the back. Both larvae have white lines extending along the sides. Photos by the author.

If there is not enough food (leaves) available or if the food is poor quality, larvae can move from one tree to another by "ballooning" – travelling on wind currents via silk threads. This can occur at any time during the season, but usually happens very early in the season, if tree buds have not yet broken, or later on as trees get defoliated and food becomes scarce (White and Whitham 2000). Futuyma et al. (1984) found that fall cankerworm larvae were more likely to disperse from oak leaves than from red maple leaves.

Cankerworm larvae lower themselves to the ground via silken threads after completion of the 4th instar in order to pupate. It is at this time that they often become a nuisance to people (Hiratsuka et al. 1995). Larvae also drop on threads as an escape mechanism from predators (Deshefy 1979). Pupation occurs in the soil and takes several months to complete, with adults emerging from late September through October in North Dakota (Christie 1990).

The female adult moths are wingless and grayish brown (Hiratsuka et al. 1995). They crawl up the trees to lay eggs on small branches near the tops of trees. Male moths have wings and the peak of emergence is about a week before the female peak emergence (Palaniswamy et al. 1986). In one study (Wong et al. 1984), males were never captured in traps if the average daily temperature was less than 43° F (6°C). Males try to mate with the wingless females as the females crawl up the trees. Palaniswamy et al. (1986) also found that they caught more males in traps that were positioned at about 18 inches from the ground versus traps that were at about 6 feet in height. As mentioned earlier, females can lay eggs even if they have not mated. Eggs are laid in carefully aligned masses of about 100 on small twigs (Johnson and Lyon, 1991; Figure 4). If the female has not mated, then all of the offspring will be females (Mitter et al. 1979).

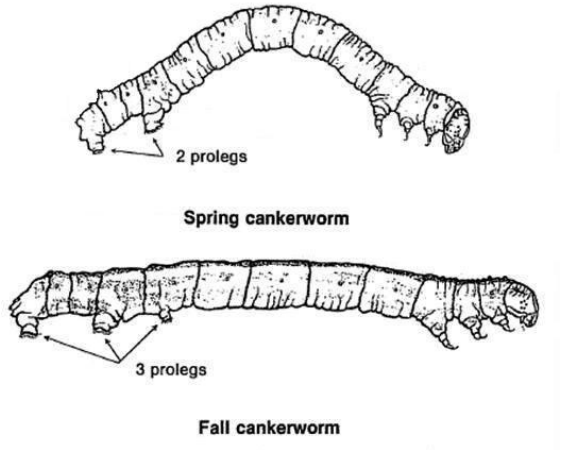

Figure 3. The main way to differentiate spring cankerworm from fall cankerworm is that the former has 2 pairs of prolegs on the back of the abdomen; fall cankerworms have 3 pairs of prolegs. Diagram from Christie (1990).

Figure 4. Female fall cankerworm (*Alsophila pometaria*) adult laying eggs on a twig. Photo by John Ghent, USDA Forest Service, courtesy of http://www.forestryimages.org.

Treatment options

For many people, the first thought for treatment is a chemical pesticide. Carbaryl, acephate and malathion have been recommended for cankerworm control in North Dakota (Christie 1990). Additional chemicals labeled for treatment of leaf-feeding caterpillars include cyfluthrin, esfenvalerate, permethrin and spinosad (Zeleznik et al. 2005). Application timing is critical. Most people don't notice damage until the cankerworms have nearly completed their larval stage. At that point, the tree damage has been done and insecticide application, no matter how effective against the larvae, will have little effect on the trees. Also, many of these chemicals are broad-spectrum insecticides and can kill a wide variety of non-target insects.

Based on the biology and life cycle of the fall cankerworm, several nonchemical treatment options are available. *Bacillus thuringiensis* (Bt) is a bacterial pathogen of the larvae of several moths and butterflies, including cankerworms. It has been used for more than 35 years as a highly specific treatment for caterpillars and is available in many commercial formulations. Several varieties of the bacterium have been tested through the years (e.g., Larson and Ignoffo 1971), but most of the commercial products available today use Bt var. *kurstakis* – Btk. The City of Bismarck Forestry Department is planning on using Bt to treat for cankerworms this year, if weather conditions permit. Bt spores are gradually inactivated by sunlight, with survival being reduced by 50 percent within 2-4 days of application (Frye et al. 1976a). In another study (Frye et al. 1983), spore survival was reduced to near 0 percent by the seventh day after treatment.

In the mid-to-late 1970s, cankerworms were seriously damaging native forests and shelterbelts in North Dakota and throughout the Great Plains (Tunnock and Doooling 1978). Researchers from the USDA Forest Service and NDSU collaborated on a series of experiments to assess the use of Bt for treating these pests. Studies took place near Bismarck and Walhalla.

The first study (Frye et al. 1976a) explored different nonconventional insecticides including Bt, pyrethrum, a natural insecticide, and Dimlin, an insect growth regulator. Different application equipment also was examined, including a hydraulic sprayer, a cold fogger and a thermal fogger. The research team found that Bt and pyrethrum were equally effective in reducing cankerworm numbers, with a mean mortality of approximately 85 percent. The hydraulic sprayer and the cold fogger outperformed the thermal fogger in terms of larval mortality. The cold fogger was easiest to calibrate and the fog it produced was less affected by air currents than the fog produced by the thermal fogger (Frye et al. 1976b).

The second study evaluated day and night aerial applications of Bt in Siberian elm shelterbelts (Hard et al. 1979). The goal with night spraying was to decrease spray drift. The authors concluded that night spraying offered no advantage over day spraying. Also, because of the inherent dangers of spraying at night, they did not recommend its use. They also found more consistent results when Bt was applied at a lower concentration, but in a higher volume of spray. Spraying reduced defoliation by cankerworms during the year it was applied and in the following year (Hard 1979).

DeBarr and Fedde (1978) compared carbaryl with three pyrethroids (synthetic insecticides based on pyrethrum), including two experimental chemicals and permethrin. They found that the permethrin was 2-6 times as toxic to 4th stage fall cankerworm larvae than was carbaryl. The other insecticides were even more powerful, but it is unclear whether or not they were ever released commercially. Thus,

at the later stages of larval development, permethrin may be a better choice than carbaryl.

Another nonchemical treatment for cankerworm control is the use of sticky bands to capture the wingless females as they crawl up the tree to lay eggs. Tree Tanglefoot ™ often is used, though other products, such as the Bug Barrier Tree Band ™ (Envirometrics Systems, Inc., London, Ontario, Canada), also are available. The sticky-band technique is effective when used properly, though there are several drawbacks. First, timing of application is difficult. The damage that people see occurs in May and June. Applying sticky bands at this point is futile because spring cankerworm females crawled up the trees in late March, while the fall cankerworm females won't crawl up the trees until September or October (Christie 1990). To capture female fall cankerworms, bands must be applied in early September. Second, banding an individual tree, without treating the neighboring trees, will be much less effective due to the ballooning mechanism of the larvae. Some cities, including Fargo (Figure 5) and Winnipeg (LaFrance and Westwood 2006), had widespread banding programs in the past, but they have not been continued in recent years. Third, applying material directly to thin-barked trees is not recommended, especially if the plan is to remove the material at a later date. The material may remove bark from the tree, destroying or disrupting its vascular system.

One banding method that has been used involves the use of a piece of fiberglass insulation along with the sticky material. The insulation is wrapped tightly around the tree, with the paper side facing out. It is held in place with duct tape. Any cracks or crevices in the bark are effectively shut off by the insulation. This forces the female cankerworms to crawl on the outside of the insulation. The sticky material is applied to the paper facing of the insulation. This technique offers the advantages of minimal cleanup time and no residue left on the tree trunk (c.f., Figure 5). The Bug Barrier Tree Band mentioned earlier combines the insulation and sticky material together in one product (though the sticky material is on an interior band of plastic, not on the outside). LaFrance and Westwood (2006) compared the Tree Tanglefoot and Bug Barrier Tree Band on urban trees in Winnipeg. In a series of experiments, they found that the products were similar in their effectiveness, stopping 75 percent to80 percent of the female cankerworms (both spring and fall).

Figure 5. Groups of elm trees in Fargo with remnants of sticky material applied several years earlier. Banding groups of trees is much more effective than treating individual trees because of the ballooning mechanism of cankerworm larvae. Photo by the author.

Another non-insecticidal control technique that has been tested is mating disruption using synthetic pheromones. In the early 1980s, the sex pheromones for fall cankerworm were identified and purified (Wong et al. 1984). Palaniswamy et al. (1986) found that the pheromones disrupted male orientation to finding females, but they didn't reduce the percentage of females that mated. Although mating disruption has been effective in slowing the spread of gypsy moths (Leonhardt et al. 1996), this technique does not appear to offer a viable means of reducing the numbers of fall cankerworm. Even if the synthetic pheromones were able to disrupt mating in fall cankerworm, the females could still lay eggs.

Fertilizing stressed trees often is recommended as a way to reduce stress or to help the trees recover. However, entomologists have debated the value of this technique for many years because the increased nutrient content of fertilized plants often translates into increased nutritional quality of the plants. That is, fertilizing helps the plants, but it also helps the insects by making them grow more quickly or by making them more prolific. For example, the growth rate of fall cankerworm is directly related to

leaf nitrogen content (Lawson et al. 1994). While nitrogen fertilization may help defoliated trees regrow their leaves faster, it also may result in increased numbers of cankerworms. More research is needed to help us understand this complicated situation.

Summary

Cankerworms are an annual pest in North Dakota. Populations cycle and outbreaks occur, sometimes lasting several years. Although trees can normally handle some loss of leaves, repeated, heavy defoliation can cause so much stress that the tree may not be able to recover. Many options are available for treating these pests, including physical, biological and chemical control. Deciding which option is right for you will depend on the degree of infestation, how badly the trees are defoliated and how much value that tree holds for you.

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American linden (basswood) – Fantastic or futile

By Allen Lee, Fargo Forestry Department

Love it or not, American linden is a standard tree selection in the landscaping world. Its wide geographic home range, unique formal appearance when young (it looks sheared), and ease of production combine to make this a readily-available and sought-after tree. On the flip side, stem girdling roots, transplant difficulties, lack of desirable fall color and nuisance pests make some people cringe when discussing this tree. This article will help the reader identify American linden, properly evaluate when to plant it and how to mitigate some of its shortcomings.

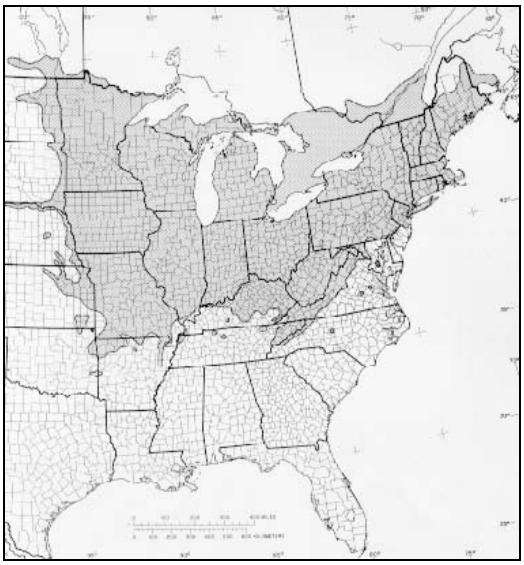

Figure 1. Native range of American linden (a.k.a. American basswood, *Tilia americana*). Map from Crow (1990).

American linden (*Tilia americana*), commonly referred to as basswood in other parts of the country, is a native tree to North Dakota. It is found east of the Missouri River along and adjacent to riparian areas (Figure 1). Identifying characteristics are numerous and fairly easy to recognize. First, it has a simple leaf alternately arranged. The leaves are 4 to 8 inches long and nearly as wide. The leaves also are heart-shaped (cordate), with a dark green upper surface and a lighter green underside (Figure 2). Leaf margins are serrate and the petiole can be 1 to 3 inches long. Buds are often reddish brown, brown or to greenish in color. Stem color is usually gray. However, different cultivars can display reddish colored new growth. The flowers are yellow and form cymes 2 to 3 inches wide and are very fragrant. Additionally, tonguelike bracts are attached to the flower structure aiding in its identification (Dirr 1990). Bees are highly attracted to linden flowers. This is a benefit to the beekeeper, but a detriment to those who have allergies or fear bees. Another distinguishing characteristic of the American linden is its nutlike fruits. They are small, 1/3 to 1/2 inch long and occur in clusters. The fruit is often used as a food source for wildlife.

Figure 2. Heart-shaped (cordate) leaves of American linden, plus flowers. The light green leaf-like structures near the upper corners of the photo are “tongue-like bracts” that develop with the flower clusters. They will turn brown and persist with the fruits into the fall. Photo by Joe Zeleznik.

The ultimate height of this tree varies greatly. Many are more than 100-feet tall in other parts of the country, but most in North Dakota will fall in the 50 to 80 feet tall range. The tree will have a spread greater than or equal to half its height. The largest American linden in the state is located near Leonard. It is 75 feet tall and has a 4-foot 2-inch diameter. Fall color is of little significance. The colors typically are yellow, highly variable and should not be relied upon. Bryan Gaschk, arborist supervisor for the Fargo Forestry Department, has noted that *T. americana* appears to color up earlier in the fall than some of its cultivars. He has observed that ‘Redmond’ linden shows fall color much later in the season and many times barely turns yellow at all. The form of this tree is strikingly pyramidal when young (Figure 3). However, as it ages it will begin to broaden out and lose some of its upright appearance. The large size of mature trees should be kept in mind when this species is planted near buildings.

Figure 3. American linden shown with its upright pyramidal form. As the tree ages, it will become more rounded. (All photos courtesy of the author, unless otherwise noted.)

Propagation of American lindens can be done through seed (requires stratification and scarification), softwood cuttings and grafting. Typical of the species, American linden has a large root system that can dominate a site. The species is found primarily in forested (nonsavannah) areas, such as North Dakota’s riparian areas and Minnesota’s maple-basswood forests. Keeping this

in mind, American linden is more of a climax forest species. It prefers to grow up with other trees around it before it will take over and dominate a site. American linden is tolerant of many light conditions ranging from full sun to partial shade. Implications of this characteristic are evident when planting in open, exposed areas of the state. The Fargo Forestry Department has noticed that heavy winds easily can tatter and rip its large leaves. This will cause stress and can limit transplant success. However, it should be noted that for an otherwise healthy tree, this tattering stress will delay establishment of the tree, but not kill it. Additionally, American linden prefers a moist, well-drained, loamy soil. However, many of the sites where we plant American linden are in urban areas after construction, so the soil structure has been compressed and altered. Additionally, soil conditions often are made worse by the removal of "A" and "O" soil horizons. Thankfully, American linden is tolerant of a wide range of soil conditions. Lindens can be a little touchy the first few years after planting. The Fargo Forestry Department has noticed that there is a period of nonvisible aboveground growth that often last 2 or 3 years when this species or its cultivars are grown in town. However, after a few years of root establishment, the tree often grows up to 18 inches a year when young. *T. americana* also has poor tolerance to soil and aerosol salt conditions.

Figure 4. Branching structure of a Frontyard ® Linden during bud break. Notice the potential for numerous competing leaders.

Once lindens are established, there are other management implications. Their branching structure is often quite dense, which can result in multiple leaders (Figure 4). Consequently, a pruning program at a young age will help reduce the potential for future branch union failures. We should not be surprised of *T. americana*'s propensity to send out codominant leaders. In natural habitats, it normally grows up with other trees nearby, which creates conditions where apical dominance can be maintained. However, planting this tree in isolation, with no nearby competitors for sunlight, leads to the development of codominant leaders. Also regarding management, wood chip mulch should be placed around the base of the tree in an effort to recreate the conditions of the forest floor. Ideally, the mulch ring will be extended out further each year as the tree grows.

Figure 5. *T. americana* showing a large mass of suckers.

One other issue that is worthy of note is the often prolific growing of suckers from the base of the tree (Figure 5). This often is a nuisance to the property owner when attempting to maintain a neat appearance. The presence of these suckers and why they occur more readily from one tree to another is not fully understood. Suckers can be used as an identifying characteristic. Leaves on the suckers often are much larger than those found in the canopy. There generally are two options for dealing with suckers – 1) remove as soon as possible with a hand pruner and/or 2) use a growth regulator, such as Sucker Stopper ®, to limit their production.

Figure 6. Cottony maple scale remnants from the 2007 growing season on an American linden.

Pests of this species are generally secondary in nature. Cottony maple scale (Figure 6), cankers, butt rot and numerous other insects and diseases can be found on linden species (Sinclair and Lyon 2005). However, when these pests appear, there usually is a primary stress being put on the tree. Deep planting, stem girdling roots, excess moisture, heavy winds, drought and mechanical damage can all help facilitate the introduction of these secondary pests. Most recently, heavy infestations of cottony maple scale could be found on almost every American linden in the Fargo area. However, trees that were otherwise healthy and established suffered only temporary, visible damage. The scales rarely killed their host trees.

Figure 7. Sapsucker damage on *T. americana*.

In Fargo, we have noticed two main "pests" associated with linden, stem girdling roots and sapsuckers (Figure 7). Stem girdling roots can be mitigated with proper planting techniques, but sapsuckers are always a nuisance. Control for the yellow-bellied sapsucker is often difficult. Consider hanging a plastic owl or pie tins in the tree, temporarily wrap the area of attack with burlap, or chase away the birds before serious damage occurs.

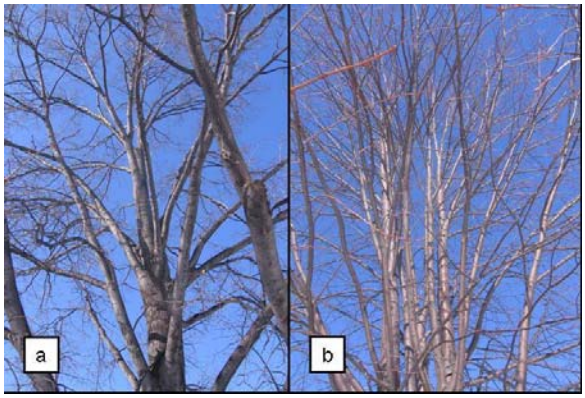

Figure 8. Branch densities of (a) American linden (*T. americana*) and (b) littleleaf linden (*T. cordata*). American linden canopy is more open compared to littleleaf linden. Notice a browner hue to the bark of littleleaf linden as well.

Due to the popularity of American linden, numerous named cultivars have been introduced into the nursery trade (Table 1). Most selections appear to have been made for their smaller stature and narrower width. *T. americana* and *T. cordata* (littleleaf linden) often are confused, though there are several key identifying characteristics (Figure 8). First, leaves of *T. cordata* are much smaller than *T. americana*, often only 1.5 inches to 3 inches long and just as wide. Additionally, the stem color on *T. cordata* has more of a brown and greenish-brown hue, which is strikingly different than the predominant gray color of *T. americana*.

Table 1. Cultivars of American linden (*Tilia americana*) that are commonly available in the Upper Midwest.

Cultivar	Common or trademark name	Unique characteristics
'Boulevard'	Boulevard Linden	Narrow form, 30' spread
'Bailyard'	Frontyard ® Linden	Slightly wider than 'Boulevard'
'Dakota'	Dakota Linden	Round headed form, introduced by Ben Gilbertson, Kindred, ND
'McKSentry'	American Sentry ™ Linden	Upright, narrow form
'Redmond'	Redmond Linden	Reddish colored twig growth
'True North'	True North American Linden	Very narrow, 20'+

Summary
Management and planting recommendations for American linden include:

- Planting in exposed areas may prolong their transplant shock and may increase the need for replacement.
- Plant the tree with its buttress roots at grade; deep planting is deadly.
- Install a wide woodchip mulch ring.
- Water thoroughly, but do not continually oversaturate the soil profile.
- Structural pruning throughout its first 10 years is necessary to develop strong branch unions and minimize multiple leaders.
- Grass will probably not grow well under its canopy.

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Small Talk - April 2008

Flooding and nitrogen fertilizer
When trees are stressed, there are many things we can do to help them recover. Fertilizing trees is a common recommendation even though there is little scientific evidence to support its use. However, a recent article in Arboriculture and Urban Forestry (Percival and Keary. 2008. 34: 29-40) reported that fertilizing with nitrogen helped trees recover quicker from flooding stress.

The authors tested two species of trees, European beech (waterlogging-sensitive) and English oak (waterlogging-intermediate). Trees were flooded with plain tap water, or water-and-fertilizer at rates of approximately 1-, 2- or 4-oz of nitrogen (slow-release) per gallon. Freely-drained trees were used as the controls. Two experiments were performed.

In the first, trees were flooded for 18 days and recovery was observed 10 days later. In the second experiment, recovery was observed regularly over the next 6 weeks. A wide range of physiological parameters and growth variables were measured.

Results were fairly consistent. Trees that had ≥2 oz/gal nitrogen added to the floodwaters recovered quicker than those without nitrogen or with only 1 oz/gal. With the higher fertilization rates, leaf physiological parameters generally recovered to the same level as those in non-flooded trees within 10 days of the end of flooding. Growth, however, was still reduced after 10 days. With added nitrogen (and 10 days recovery), most trees put relatively more energy into growing roots, reducing the shoot:root ratio. Many trees also lost some leaves during the flooding (a common response), but new leaf growth was observed 4-6 weeks after flooding ended; the amount of leaf growth increased with increasing nitrogen concentration. As expected, English oak trees recovered more quickly than European beech trees.

Since the majority of North Dakota's native forests are found along rivers and streams, it is reasonable to ask if these results are applicable in our state. A related question is, "Should we fertilize trees that have been flooded?" As with most things, the answer is, "It depends." Flooding during the dormant season does no lasting physiological damage to trees. The only time that dormant-season flooding causes a problem is when ice and debris move along the trunks of trees and remove the bark. Growing-season floods do result in physiological damage similar to that seen in this study. However, our riparian tree species are flood tolerant and are adapted to recovering after floods. Fertilizers may speed their recovery but it may not. Additional research would be needed in order to make this recommendation. Additionally, this experiment was done on potted trees; mature, established trees often recover more quickly than those that are young or newly-planted.

If you have trees that have been flooded and you want to fertilize them, definitely do not add fertilizer directly to flood waters. Ecologically, this could do much more harm than good. Also, be careful not to fertilize in mid-to-late summer, about July 1 – September 15. Fertilizing at this time could result in a flush of new growth that would be too tender in the fall, not hardening off properly before winter.

Mechanical root disruption and circling roots

Landscape trees that are grown in pots for too long tend to have roots that circle around the sides of the pot. After transplanting, the root system often takes a long time sending new roots outside of the original environment, exploring the native soil. If it takes too long, the tree may not establish at all and will die. Even if the tree does establish on the new site, the circling roots may become girdling roots in the years ahead, slowly killing the tree by squeezing off water, nutrient and energy transport between the roots and the crown. The situation must be dealt with at transplanting in order to give the tree a better chance to establish and prevent future problems.

Researchers from the University of Minnesota are testing several mechanical methods of root disruption that they hope will remedy the situation. Initial results were presented in a recent article in Arboriculture and Urban Forestry (Weicherding et al. 2007. 33: 43-47). The root-disruption methods included scoring (slicing), butterfly pruning, or teasing. Butterfly pruning consists of splitting and splaying apart the lower two-thirds of the root ball. Root balls on the controls were left undisturbed. Two tree species were used – littleleaf linden (*Tilia cordata*) and 'Niobe' white willow (*Salix alba* 'Niobe'). Following root disruption, trees were transplanted and allowed to establish for two growing seasons. After this time, the roots growing beyond the original root ball were counted and their diameters were measured to assess the effectiveness of the techniques.

There was no difference between the treatments and the controls in either number or size of new roots following transplanting. Therefore, there doesn't appear to be any advantage in mechanically disrupting roots of pot-bound container grown trees, if the goal is to increase the number of roots following transplanting. The authors caution, however, that the standard recommendations of physical disruption of the root systems should not be abandoned. This study was done with only two species of trees and for only two years. Longer

experiments with more tree species are needed before broad recommendations can be made.

To that end, a brief update on the research was published in the Winter 2008 issue of the Minnesota Shade Tree Advocate newsletter (Giblin et al. 2008. 10(1): 1, 4-5, 9-10). A new study was begun in fall 2005 using four different species: Techny white cedar (*Thuja occidentalis*), Red Splendor crabapple (*Malus* 'Red Splendor'), Sienna Glen ® Freeman maple (*Acer* x *freemanii* 'Sienna'), and Deborah Norway maple (*Acer platanoides* 'Deborah'). Root disruption treatments were more aggressive, including deeper root scoring on both the sides and bottom of the root ball, and a "box-cut" method where all visible portions of circling roots were removed, essentially squaring-up the root ball.

Although the growth data is yet to be analyzed, the researchers made some interesting observations. For example, in the first growing season, many of the box-cut trees had smaller leaf size and reduced leaf density compared to the control trees. However, only a slight decrease in these parameters was observed in the second year. The authors will continue this study for two more years before it is complete.

Juneberry project

Juneberries (*Amelanchier species*, also known as saskatoon berries) are the most highly-prized fruit for many people in North Dakota. These small berries grow on trees and shrubs and ripen in late June or early July. Many people pick wild juneberries and several U-pick orchards operate throughout the state. Numerous commercial varieties have been released and are available from Canadian sources, but they are often expensive and difficult to import.

In 2007, researchers at NDSU launched a search for superior wild- or planted-juneberry plants that can be developed into new commercial cultivars. What makes a good juneberry? Commercial growers look for plants with a lot of big berries that are easy to pick. Consistent production from one year to the next is also desirable. Good insect- and disease-resistance are valuable traits, too. Dense branching and relatively little suckering are desirable. Mature plant heights ranging from one foot to about 14 feet would have potential for release as commercial varieties. Flavor and texture of juneberries are highly variable in the existing cultivars and among wild plants. The NDSU team is searching only for plants with good to excellent berry taste. Berry ripening time and uniformity are not of major importance because each ripening time and uniformity has some advantages – growers that want to harvest all at once (for instance, to sell to a processor) can select varieties that ripen over just a few days, while growers that want to extend the harvest season (for instance, to sell in a U-pick operation or to reduce labor demands) can select varieties that will ripen from early season to late season.

The project began very well in 2007. More than 900 plants in the eastern part of the state were observed, and 17 specimens were selected for further evaluation. In 2008, the research team will scour the western part of the state looking for great juneberry plants. Juneberry patches are relatively easy to locate, but finding outstanding individual specimens is a lot tougher. This is where the NDSU team needs your help. Do you know of any individual juneberry plants with the characteristics described above, or do you know of someone who might have that knowledge? If you're willing to share that information, please contact Jim Walla (701-231-7069, j.walla@ndsu.edu), Harlene Hatterman-Valenti (701-231-8536, H.Hatterman.Valenti@ndsu.edu) or Joe Zeleznik (701-231-8143, joseph.zeleznik@ndsu.edu). The locations of those plants will be kept confidential to protect the privacy of the plant owners and finders. Owners and finders of plants that are eventually released as new varieties will be invited to participate in recommending the variety names and be offered a reward. By helping in this search, you could help to grow a fledgling North Dakota industry.

Gypsy moth update

The ND Forest Service recently announced that no gypsy moths (*Lymantria dispar*) were found in their 2007 survey. This was the third year in a row that no gypsy moths were detected in North Dakota. Previous detections, in 2003 and 2004, were extremely limited – one and two specimens, respectively. Over 300 traps are set out each year in

North Dakota in a cooperative effort among the ND Forest Service, ND Department of Agriculture, USDA Forest Service and USDA Animal and Plant Health Inspection Service.

The gypsy moth was introduced to the U.S. in 1869 in New England and has been slowly spreading south and west. It prefers to feed on oak trees but can eat over 300 species of trees. Although some gypsy moths have been detected in Minnesota, there are no known permanently established infestations in the state (Minnesota DNR). The USDA Forest Service's Slow-The-Spread program (http://www.gmsts.org/) has reduced the spread from 13 miles per year down to 3 miles per year, preventing more than 40 million acres from being infested in the last 6 years.

Is anyone growing hazelnuts in North Dakota?

American hazelnut (*Corylus americana*, also called American filbert) and beaked hazelnut (*C. cornuta*) are native to North Dakota. In the wild, neither species produce nuts that are generally desirable for human consumption. Most of the hazelnuts that are available in our grocery stores are actually common filbert (*C. avellana*), a European/western Asian species. In the US, common filberts are produced almost entirely in Oregon. Outside of Oregon, hazelnut plants with improved suitability for nut production are available from commercial nurseries; these may be selections of American hazelnut, common filbert, or hybrids of American hazelnut, beaked hazelnut, and common filbert. The American hazelnut and the hybrid hazelnuts are relatively cold hardy, but no common filbert varieties are cold-hardy enough for North Dakota. A hobbyist hazelnut grower in North Dakota has been growing and hybridizing hazelnuts for several years in order to develop selections suitable for orchard production of nuts. He has what appear to be some very desirable plants that produce good-sized, delicious nuts.

Jim Walla, forest pathologist in the NDSU Department of Plant Pathology is interested in learning of others in North Dakota or nearby areas that are growing hazelnuts for nut production. He hopes to learn as much as possible about regional nut production – what selections are being grown, if new selections have been discovered or developed, or how plantations are being managed. Any information received will remain confidential, if desired. If there are multiple hazelnut growers in or near North Dakota, Walla is interested in working with them to create best management practices and perhaps assist in industry development. In addition, Walla has already been looking into pest management recommendations for hazelnut production, adapting recommendations for managing the most common hazelnut disease. If you know of anyone growing hazelnuts for nut production, please contact Walla at 701-231-7069 or j.walla@ndsu.edu.

Riparian buffer publication available

The USDA Forest Service recently released a new handbook for designing riparian buffers: Riparian buffer design guidelines for water quality and wildlife habitat functions on agricultural landscapes in the Intermountain West (General Technical Report RMRS-GTR-203, available at http://treesearch.fs.fed.us/pubs/viewpub.jsp?index=29201). The publication, written by Craig W. Johnson and Susan Buffler, provides a step-by-step protocol for determining optimal (variable) buffer widths for water quality and wildlife, while maximizing riparian ecosystem benefits and minimizing the loss of productive farm and ranch land. The handbook includes a CD with a case study, data forms, worksheets, reference appendices and other informational material.