Minnesota Department of Natural Resources
Division of Forestry

FOREST INSECT & DISEASE NEWSLETTER

Sept. 22, 2000

In this issue:

Afflictions Apparent this Autumn

So, is the answer behind door number one, two or three?

Over the last month, the most obvious symptoms observed among trees in the Twin Cities were flagging and tip dieback of oak. All species of oak have been affected. Three to twelve inch shoots have wilted and browned on scattered branches of scattered oaks across the region. The leaves have hung on, leaving trees dotted with brown patches throughout their crown.

Although a few twigs can be found with cicada injury and in most years twig pruners and twig girdlers can be found, very few of the samples taken this year show signs of these insects. What has been found are fungi, in particular *Botryosphaeria quercuum*, and tiny borers which are as yet unidentified.

Borer larvae, 1-2 mm in size, and their tunnels have been found just under the bark near the base of damaged shoots in nearly half of the samples collected. Their presence near the base of the injury, rather than further out along the damaged shoot, suggests they may be causing the damage. Their tunneling destroys the tissue beneath the bark which can girdle and kill the twigs they inhabit, producing the dieback symptoms. However, their absence in so many shoots indicates they aren't the only agents causing the damage we're seeing across town.

B. quercuum and related

This is the last issue for 2000. Look for us again in March next year.

fungi enter twigs through wounds and/or lenticels causing small lesions in the bark. As the infection expands, the fungus kills the cambium, girdling the twigs and causing dieback in much the same fashion as the twig borers. Since both the borers and the fungi are usually associated with stressed trees and/or damaged tissue, what predisposed the shoots to invasion is of concern.

Weather is commonly associated with both the predisposition of host trees and the success of insect and disease organisms. It is likely involved in this case as well. This has been an unusual summer. The season began early with high April temperatures. A sudden drop in temperatures late in the month caused visible cold injury among some species. May turned hot and dry, scorching new shoots in some areas. June was very cool and wet, conditions ideal for most fungi. Since then, the weather has been on the warm and dry side producing drought stress symptoms among maple, ash, birch and poplars.

While drought can aide boring insects by reducing sap flow, moisture is critical to most fungi, particularly those specializing in tree leaves and shoots. Since both fungi and borers are active in this case, drought stress is not likely to be the predisposing factor. Another possibility is the wide fluctuation seen in early season temperatures. The warm weather forced buds to expand prematurely. The sudden cold spell late in the month killed expanding shoots. While oak shoots were still protected at the time, their buds were active and swollen. Vascular damage could allow buds to expand normally, but leave shoots weak and susceptible to invasion. The damage would become evident once the combination of pest injuries and heat-induced transpiration exceeded the capabilities of the shoots. While unproven, cold injury seems to be involved in the damage this year. So rather than picking door one, two or three, it looks like all of the above is the best answer.

Yellow witches' broom on spruce

What appears to be yellow witches' broom of spruce, caused by *Chrysomyxa arctostaphyli*, was found on a white spruce in Judge Magney State Park northeast of Grand Marais this summer. This rust disease occurs mainly on black, Norway and white spruce. Bearberry, also called kinnikinnick, is the alternate host. This disease is reported to occur throughout the range of its hosts in eastern Canada but this may be the first report of the disease in Minnesota.

The most obvious symptom of the disease is a witches' broom with stunted needles. In summer the broom turns a very conspicuous yellow. The needles are shed in the fall and the broom appears dead over the winter but produces new needles the next spring.

Cercospora needle blight of juniper

New guidelines under the Conservation Reserve Program have led to an increase in the number of redcedar plantings across a number of southern MN counties. Now that these trees are putting on some size, excessive needle loss has concerned land owners and area consultants not familiar with the symptoms. The cause is a fungus, *Cercospora sequoiae var. juniperi* that attacks juvenile needles and the previous year's spurs. Infected needles turn bronze by midsummer and then die and drop off by late September. Under conditions favorable to the disease, whole trees can be defoliated and killed.

Junipers have three types of needles; pointed juveniles often found on seedlings; the flat, blunt needles clasping short spurs put on every year and the long whip foliage found on branch tips. Cercospora infects juvenile needles and the previous year's spurs. Infected needles and spurs fall off, leaving affected branches bare, except for the healthy green whip foliage on the end. Over time, branches become tufted as all but the tip is killed.

Like most needle diseases, the symptoms are usually worse where the humidity is high. So early symptoms are most noticeable on the north side of the tree and low in the crown. While applications of preventive fungicides are effective in controlling Cercospora tip blight (Daconil, Bravo and Domain are among those that work well), the use of chemicals may not be feasible. Where possible,

avoid planting susceptible species. Only species in the Cyprus family are susceptible to Cercospora tip blight (while redcedar is susceptible, Rocky Mountain Juniper is even more so). Pines and other conifers are immune. Where other species are not available, locate cedar plantings on exposed sites with good air flow and orient the rows on an east-west basis, so all trees receive adequate sunlight. Space the trees well apart from each other. To keep the disease incidence low and manageable, mow regularly in order to keep humidity low and maintain good air circulation.

Summer heat takes its toll on urban sugar maples

This year the mid-summer heat has taken a sizeable toll in the southern Region's sugar maple trees, especially those growing on boulevards. Despite the extra rainfall earlier in the summer, the weather turned dryer and hotter by mid-July and acute leaf scorch became evident. By early August, widespread early fall color and defoliation were common. These observations are likely going to translate into serious losses of maples in many cities and towns.

There are several problems this year that may all be related to recent climatic conditions. The fall of 1999 was very dry. In southern Minnesota, a news release was issued to address the moisture shortfall going into the fall. The winter of 1999-2000 was very mild, in fact, a twenty-year high temperature of 75 was recorded in March at Rochester. In some areas, a frost followed later in the spring. In addition to affecting maples, this weather pattern may also be related to the scattered dieback in hardwoods across the region and to the ash dieback in city of LeSuer.

Sugar maple losses will mount and continue to be an increasing problem. Although weather-related stresses are widespread, individual trees also suffer from additional stresses including, planting depth, girdling roots, root disease, Verticillium wilt and site disturbances. These injuries and maladies reduce the tree's energy supply and it can take years for the inevitable end to occur.

Spruce beetle

Spruce beetles, *Dendroctonus rufipennis*, were founding killing white spruce in Judge Magney State Park north east of Grand Marais. According to the park manager, trees have been dying since 1998 and die over a period of one to two summers. They are killing mature white spruce that appear quite healthy although there probably is some soil compaction in the campground. As far as we know these beetles are not very common in Minnesota and have only been reported once or twice in the past.

The spruce beetle is a bark beetle that occurs across North America. It is a serious problem in the western US with Alaska reporting an estimated 300 million trees killed by spruce beetle in the 1990's. It infests all species of spruce in its range.

The first sign of attack on standing trees is reddish-brown boring dust on the ground around the trunk or in bark crevices. Pitch tubes made of a mixture of pitch and reddish-brown bark may also be obvious. The pitch tubes are about 3/8 inch in diameter and up to about 3/8 inch long with a hole through the center. The beetles may complete

their life cycle in one year on warm sites or take up to three years on cooler sites. We don't know how long their life cycle is in Minnesota, yet. They may overwinter as adults or as larvae in infested trees. Most of the adults are thought to move to the base of the tree where they bore into the bark near the litter line to overwinter. Here they will be under the snow protected from cold temperatures as well as from woodpeckers.

Spruce beetles prefer mature white spruce twelve inches in diameter and larger, however, some were found in trees as small as eight inches in diameter at Judge Magney State Park. A stump with pitch tubes was also found in Cascade River State Park. Trees under stress from over crowding, soil compaction and/ or spruce budworm are probably more likely to be attached. The beetles also can buildup in recently blowdown spruces.

So keep an eye out for spruce beetles. They might be more common than we think.

Spruce budworm

Spruce budworm egg mass surveys are nearly completed in Region 1 and they indicate a continuing population decline. The last hold out in this Region is a spruce plantation in Two Inlets State Forest. This summer spruce budworm larvae averaged 60 to 80% defoliation of the new needles and egg mass surveys indicate moderate defoliation is in store for these trees next summer. Elsewhere, only one egg mass was tallied on five plots.

Spruce budworm populations continue to decline in Region 2. Acreage of defoliation from aerial surveys this summer have not yet been compiled. However it is expected that this acreage will be less than in 1999.

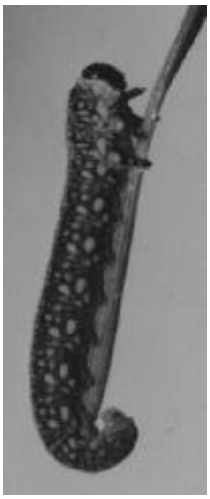
Defoliation and egg mass surveys were completed on 23 plots in Region 2 this past year. Results are shown below. The egg mass survey predicts that defoliation will continue to decline next year as well.

	Level of Defoliation			
	0	Light	Moderate	Heavy
Plots defoliated in:				
1999	4%	65%	17%	13%
2000	26%	52%	17%	4%
Predicted defoliation in:				
2001	61%	17%	17%	4%

Egg mass and defoliation surveys during July and August found no budworm in Region 3 except in a plantation of 25+ foot unthinned spruce in northeastern Aitkin County. Here, this year's defoliation was mostly light but egg mass survey indicates that heavy defoliation is possible next year.

Introduced pine sawfly

As of September 1st, reports of white pine defoliation were received in Region 1. By September 5th, introduced pine sawflies were found in large numbers around the Region Headquarters grounds. (Obviously a case of the mountain coming to



Mohamed.) This caused many inquiries as to their food source as there are no white pines around that area. Later they were observed feeding on the Scots and Norway pines that are common on the grounds. They appear to do only minor defoliation of these species. Introduced pine sawfly larvae caused light to moderate defoliation of white, Scots, and red pines in central Minnesota during the first week in September. Larvae will continue to feed this fall until they are killed by freezing temperatures.

The introduced pine sawfly larvae defoliate white pines during the summer and then again in the fall which can decrease the tree's vigor and growth.

Open grown stands appear to be particularly vulnerable to defoliation by this sawfly species. Severe defoliation can cause mortality. Occasionally, heavy outbreaks on white pines can lead to the insect migrating to and defoliating other pines.

Jack pine budworm

Feeding activity by the Jack pine budworm was not observed anywhere in Region 1 during 2000 growing season. No larvae were tallied during larval surveys in June, and only one egg mass was counted on twenty plots taken in August and September.

Pine tussock moth

Pheromone trapping of male pine tussock moths in northeastern Wadena and southeastern Hubbard Counties in late June, July, August and early September indicated that the population of this pest of jack pine is increasing. At five locations it has increased sharply. Larval and defoliation surveys in May and June of 200l will be done to determine if an insecticide application or harvesting of affected jack pine trees is warranted.

Pine bark adelgids

Reports of activity by the pine bark adelgids, *Pineus strobi*, are common around Beltrami and Hubbard Counties this summer. Though commonly (and formerly) called the white pine aphids, this adelgid occasionally attacks Scots and Austrian pines, too. Adults secrete a material that combines with dried pitch which looks white and cottony. Populations usually aren't noticed until the white cottony material that collects in patches around their feeding areas becomes abundant. Adelgids usually attack the trunk and undersides of branches from the ground up. Younger seedlings and saplings can be seriously damaged by this feeding activity. Apply a "superior" type dormant oil spray in early spring and, toward the end of April and May, a pesticide registered for adelgids.

Aspen blotch miners

Aspen blotch miner defoliation was common throughout most of Region 1 during late August and early September. Only minor defoliation has been observed during the past two years.

Aspen in some parts of northeastern Minnesota are looking quite brown from heavy aspen leaf blotch miner activity. Many of these trees were defoliated by the forest tent caterpillar then refoliated only to be attacked by the blotch miner. These aspens definitely have been stressed but they did receive a good moisture supply this summer and should survive well.

Aspen leafblotch miners, *Phyllonorycter ontario*, are flat larvae that feed between the upper and lower surface of the leaf creating round or oval blisters that are pale green and later brown. Several mines on a leaf can turn the entire leaf brown. The larvae change to pupae in the mine. A tiny moth emerges from the pupal skin in August. The tiny little moths, only about 5mm long, hibernate over winter under bark scales on pine and spruce trees and lay eggs next spring. Usually the blotch miners are controlled by their own competition for feeding sites and by

parasites that build up during their peak years. When there is an outbreak of blotch miners, homeowners often call about piles of bark scales around the base of pine trees. Birds flick the bark scales off trees to get at the thousands of overwintering moths and at times can remove almost all the bark scales from individual jack pines. This doesn't hurt the trees since it doesn't damage the phloem or cambium and is just removing the outer dead bark.

Orangestriped oakworm

The orangestriped oakworm, *Anisota senatoria*, is one of more than seven species of caterpillars that defoliate oaks and other broadleafed trees in central Minnesota during late July, August and into September. They are collectively called the "fall defoliator complex". This year, the orangestriped oakworm is the only species of this complex that was found during our August surveys. It is present in small numbers on oaks about six miles south of Little Falls near the Mississippi River in Morrison County. Unlike other many defoliating moths, these insects overwinter as pupae in the soil and ground litter until late June or early July when they emerge, mate and lay eggs in clusters on leaves.

An orangestriped oakworm has a black head, a pair of "horns" just behind the head, a body with black and yellow stripes and black legs. It feeds on oaks until it reaches a length of just over two inches and a body thickness of 1/4 inch. Its yellow stripes tends to change to a light orange color as it exceeds 7/8 inch in length. These caterpillars consume large quantities of leaf tissues, leaving only the veins and petioles. As of September 7th, they had not started dropping to the ground where they will change into dark brown pupae and overwinter. If it doesn't freeze hard, feeding can continue into October. When these insects are at high levels, extensive defoliation can occur for a few years, but parasites and predators attack various stages of their development and they decline naturally. Insecticides can be used to control these pests on yard and nursery trees.

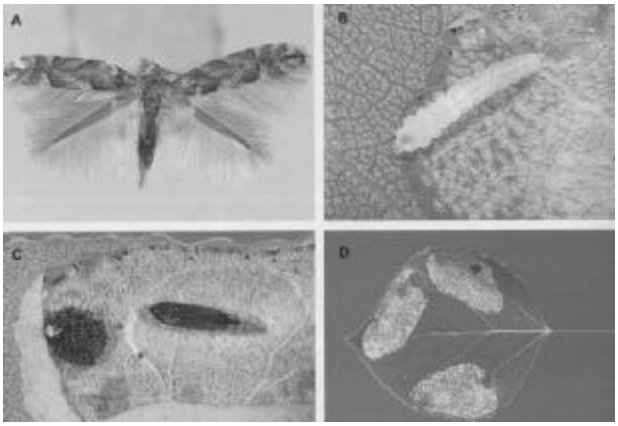
Imported leaf beetle

The imported willow leaf beetle, *Plagiodera versicolora*, was observed on willow in scattered locations in central and northern Minnesota during August causing severe leaf skeletonizing and browning. This introduced pest was first found in Staten Island, N. Y. in l9l5, and it is now widely distributed in the eastern United States, southern Canada and Alaska. It also feed on poplars.

Our mild winters over the past three years may have contributed to the buildup of this beetle because only extremely cold winters kill the adults which hibernate under loose bark or in debris under trees. Adults emerge in May or early June, and females lay yellow spindle-shaped eggs on both sides of leaves in groups of two to thirty. Black larvae develop from these eggs and eat some or all of the green leaf tissue between the veins. These larvae pupate on leaf surfaces, and then change into oval, metallic blue or greenish blue adult beetles. Adults also consume leaf tissues. There can be two or three generations each year. Both adults and larvae skeletonize and brown leaves, but the larvae do most of the damage. An imported pupal parasite, *Schizonotus latus*, can increase in numbers and exert considerable natural control on beetle populations. To control this pest, acephate or other labeled insecticides can be applied to leaves of ornamental or plantation willows in the spring, when larvae are observed.

Striped alder sawfly

Defoliation of white birch was reported in the Bemidji area. *Hemichroa crocea,* an introduced species, occurs occasionally in epidermic numbers across parts of Canada and the northern United States. Its preferred host is alder but is also known for severely defoliating birch. In Canada it is known to have two generations per year as larvae are present from late June to early October. The larvae are gregarious feeders initially eating holes in the leaves before



consuming the rest of the leaf except the heavier leaf veins. The larvae have black heads, and a yellowish green body with dark-green to brownish lateral stripes. Winter is spent in the cocoon stage inside an earthen cell in the soil beneath the host tree. The female lays her eggs in a row of slits cut on either side of the midrib on the bottom of the leaf. Artificial control measures are not necessary and their occurrences are quite infrequent.

Publications

Autumn Colors brochure

If you want to understand how and why leaves change color during autumn, this brochure provides good information, and it is useful as a poster in schools or as a display for the general public.

The l999 brochure unfolds to an l8 by 24 inch sheet and is illustrated with beautiful color photos and diagrams. It is free and available from the USDA, Forest Service, Attention Publications, l720 Peachtree Road N., Suite 7l6 N, Atlanta, GA 30367, or by telephone 404-347-4278.

News from Elsewhere

Iron Chlorosis: Some mysteries surrounding iron deficiency chlorosis in trees

By Carl J. Rosen
Professor and
Extension Soil
Scientist
University of
Minnesota

Iron, in alkaline soils (soils with high pH), is often in a form too tightly bound to other molecules to be available for trees. This problem occurs most frequently in high calcium carbonate soils and is sometimes called lime-induced iron chlorosis.

Iron chlorosis is seen in most years on the side slopes, bluffs, hardwood forests, and urban areas across southern Minnesota. Most often in southeastern Minnesota, a line of yellow (chlorotic) trees will be seen along a side slope, usually associated with a limestone outcropping, or just scattered individual trees across the landscape. Where we see these chlorotic trees, the pH is higher there, than in the surrounding soils. In soils of a high pH, soluable iron can become unavailable for trees, (see chart). "Fe" is iron.
Symptoms. A general yellowing of most of the leaves is the first visible symptom of iron chlorosis. A closer look will reveal the yellowing to be interveinal, meaning the chlorosis is between the veins, while the veins remain green. In severe cases, interveinal necrosis (dead tissue) can result, (see photo).

Why do we see the high visibility of iron chlorosis this year across southern Minnesota, and why is this most evident following periods of high rainfall as we have seen since May?

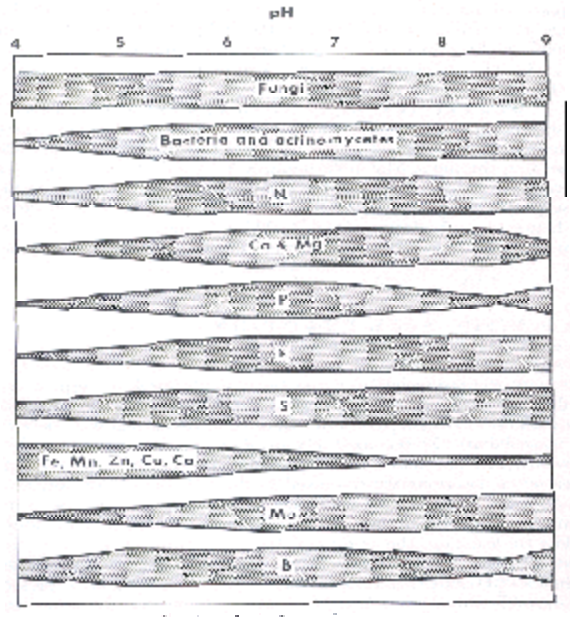
As it turns out, the reasons are more complicated than meets the eye and not completely understood. However, what we know is this. In calcium carbonate containing soils, excess water will actually increase the bicarbonate content, which will act to "tie up"the

iron and or, reduce iron availability. Bicarbonate is HCO3. Bicarbonate acts as a buffer for hydrogen ions. It in effect captures or binds the hydrogen ions. It is these hydrogen ions that play a role in providing the soluble iron. In fact, one mechanism that plant roots of some species have developed to acquire iron is to excrete hydrogen ions. The hydrogen ions act to solubilize or free up iron. But if the bicarbonate content is high the hydrogen will react to form water and carbon dioxide before it has a chance to " un-tie" the iron. So the extra rainfall complicates the otherwise peaceful co-existence for some of these tree species and their alkaline soils. In addition, a lot of water in poorly aerated soils can destroy the smaller roots and reduce the uptake of all minerals. Some days you just can't win.The roots of some grass species have apparently developed a different mechanism to deal with this problem of high bicarbonate.

How will this chlorosis effect the trees? Some tree species may be affected longer term by the decreased production of food reserves. Oaks will be more sensitive to what is in effect a stress event. However, most species should return to what's normal, green.

A large number of trees are susceptible to iron chlorosis and include American elm; black cherry; cottonwood; Norway, red, silver and sugar maples; the oaks; walnut; jack, ponderosa, and white pines. Tree susceptible to iron chlorosis vary in their high pH tolerance for example Jack and ponderosa pine are much more tolerant than white pine. Norway and silver maple are more tolerant than sugar or red maple. The trees most affected this season in southern Minnesota include northern red oak, eastern white oak, silver maple, and birch. There are likely several other species affected this year.

Treatment. It is difficult to mitigate the effects of iron chlorosis. Iron can be applied to the leaves or added to the soil around the tree as iron sulfate or as one of the synthetic iron chelates. However, both foliar and soil application of iron salts and iron chelates have only resulted in limited and short term success in the treatment of iron chlorosis. Long-range control of iron chlorosis in trees would involve permanent changes in soil pH. Alteration of pH around a tree is extremely difficult because of the large mass of soil involved and the large capacity of soil to resist or buffer (organic matter, and fine textured soils) against a pH change.



Feature Articles

Granite Falls tornado: Risk inspection and loss assessment of storm damaged trees

By Ed Hayes

On Tuesday evening July 25, 2000 at 6:05 PM, a class F-4 tornado touched down in the city of Granite Falls, Minnesota. One life was lost, several people were injured and millions of dollars of property damage occurred. In addition to the property damage, over 500 shade trees were destroyed. By the end of the week, the city requested a risk inspection of all the remaining trees within the storm damaged city blocks, to be conducted by the DNR. On the following Monday, July 31st, the inspection was conducted.

The inspected area covered approximately 370 residential lots (which included the front and back yards), the grade school grounds, existing parks, and some limited commercial areas within the storm damaged blocks. Five, two-person DNR crews inspected 1, 001 remaining trees in approximately seven hours. (That works out to be an average of 143 trees per hour).

Tree Removals: A five point defect system was used. Thirty nine trees were marked for removal. The table below summarizes the recommended tree removals which included ten species with the majority being ash, elm, and silver maple.

Type of defect	Number of trees marked for removal
Crown damage (45% was threshold)	21
Wind-throw	4
Failed union main stem (½ stem cross section was threshold)	5
Decay (main stem failure with pre-existing decay was threshold)	0
Multiple (two or more of the above)	4
In addition crews, marked 2 trees that had been girdled and 2 that had been topped.	4
Total number of remaining trees needing removal = 39	

Tree Pruning: Crews marked only trees with broken or lodged branches. Forty seven (47) trees were marked for pruning. They included 13 species with the majority being elm, silver maple, hackberry, and ash.

Loss Assessment: In addition to the standing tree inspections, the DNR crews surveyed, and tallied the missing trees, those already removed by residents. This was done by a tally of both the stumps and the stump holes. A total of 146 stump holes and 361 stumps were recorded in the storm damaged blocks for a loss of 507 trees before the

DNR inspection. See table below.

Number of trees	Species	Average size in d.b.h.
140	green ash	16"
120	silver maple	16"
100	spruce sp.	12"
25	elm	16"
122	other species *	12-14"
Total number of trees lost = 507		

* = Included white birch, crab-apple, hackberry, cottonwood, other conifer, black willow, boxelder, linden, oaks, red cedar, mountain ash, sugar maple, black walnut and balsam fir.

All of the trees marked for pruning or removal represented a public health and safety concern. In the end, all of these trees qualified for the FEMA cost share assistance.

Our thanks go to the DNR crews for the efficient, professional job that was done. The tree inspectors were:

Kerry Christoffer, and Bill Dineson, Parks and Recreation
Greg Johnson, Linda Johnson, Richard Peterson, Sue Burks, and Ed Hayes, Forestry
Clay Cotey, Jacob Rechzigel, and Chris Hanson, MCC

In addition, several other DNR professionals were involved in a number of efforts in the first few days following the tornado. Efforts continue today and will continue in the years ahead to assist the City with replanting and a number of related issues.

Establishing transplanted trees: *Water* you going to do?

By Rich Hauer
Mn Dept. of Agriculture

Healthy trees that mature into legacies don't just happen by chance. For some planting programs the project ends after planting. For others, trees are periodically watered when maintenance staff are not mowing turf. Others may be more dedicated and water trees weekly. During some years all scenarios will work when rainfall is frequent and plentiful. However, during normal years even weekly watering of newly transplanted trees may not be enough.

In the process of becoming established, trees are subjected to water deficits, growth and function of the leaves, shoots, and root growth slows to negligible levels. This delays establishment and may even lead to the death of these parts. In the worst case scenario, which too often occurs needlessly, a net decrease in living biomass occurs and the canopy becomes smaller. The tree canopy may now resemble a one-inch-caliper tree rather than the planted 2-inch-caliper tree.

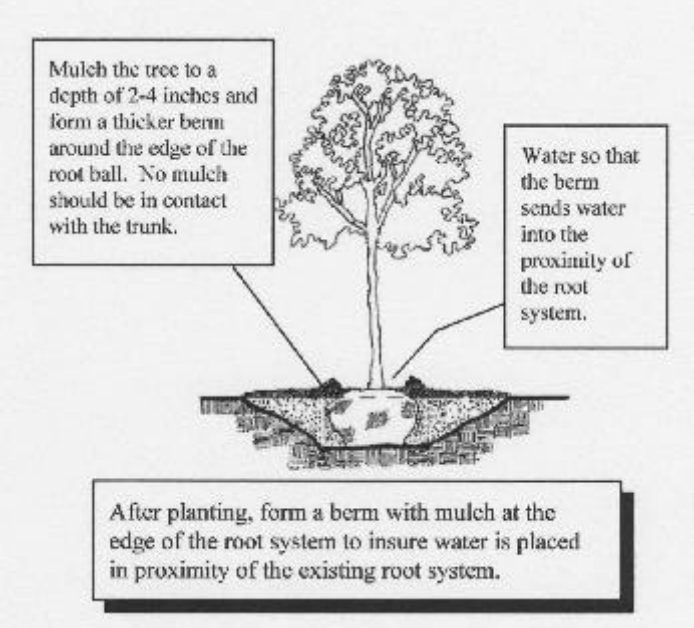
Water and tree physiology

The function and growth of plants as suggested by Justus Von Liebig in 1840 (modified later by others) is limited by the factor present in the smallest amount relative to its minimum requirement. Water is the factor that most often limits growth. In humid regions, water accounts for approximately 80% of the variation in diameter growth. In arid regions water accounts for approximately 90%.

For the most part, trees can only take up water from soil in proximity to roots. Established trees are in contact with greater volumes of soil due to wide-spreading root systems and are more capable of obtaining adequate amounts of water. Newly transplanted trees have less soil volumes from which to extract water. Obviously, trees that have root systems severed to facilitate transplanting (i.e., bare root, balled & burlaped, and tree spade) have fewer roots and a smaller soil volume in contact with roots. Container raised trees also have a small root area to obtain water even though they are transplanted with the majority of their root system intact. In fact newly planted container grown trees require daily watering the first few weeks following transplanting. Just ask a nursery operator how often they water their containerized trees!

Prescription or dosage based watering

Historically tree-watering guidelines have suggested watering trees every 7 to 10 days with 1 to 1½ inches of water. While this frequency and amount of water may work in some situations, research within the last five years from the Morton Arboretum and the University of Florida at Gainesville suggests more frequent watering is necessary for optimal tree establishment. Within 2 to 3 days, rootballs of newly planted trees will dry to levels that impede root growth. Newly transplanted trees will benefit from daily watering for the first one to two weeks, applying approximately 1 to 1½ gallons per-stem-caliper inch per watering in the Midwest. Thereafter, water trees every 2 to 3 days for the next two to three months and then weekly until established at the same rate.



Remember, newly transplanted trees are absorbing water from a diminished rooting area (i.e., apply water to the root ball). Roots must generate and grow into surrounding soils before a larger soil volume can be tapped for moisture. Tree roots grow approximately 18 inches in length annually in the Midwest. Trees in Minnesota will become established within 1 to 1½ years for each caliper inch of stem. Thus, it takes 2 to 3 years before a 2-inch-caliper tree is established. The more closely you match your watering frequency to the optimum the quicker trees become established.

The moistness of the soil beneath the mulch should be checked to determine the need to water. Over-watering can be as detrimental as under-watering and can also kill trees. This is especially true on clayey, compacted and poorly drained soils.

If the water requirements of newly transplanted trees cannot be met, planting smaller trees is recommended. For example, 1 and 2 inch caliper trees have less root loss and recover faster than trees 2 to 3 inches in stem caliper. Mulching trees to a 2 to 3 inch depth is recommended as it helps to reduce evaporation and conserve precious water. Incorporating the labor cost of watering trees within the tree planting budget should insure adequate watering occurs and trees establish successfully. If tree planting is contracted out, consider including watering as an additional component in the bid. Your community forestry program will be far better off if trees are adequately watered rather than continually replanting and not realizing the benefits that mature and established trees provide.

Irrigation guidelines for quickly establishing trees in *well-drained* sites during the growing season in the Midwest.

Size of nursery stock	Watering prescription *
<2-inch caliper	Daily for 1 week; every other day for 1 to 2 months; then weekly until established
2 to 4-inch caliper	Daily for 1 to 2 weeks; every other day for 2 months; then weekly until established
4 inch caliper	Daily for 2 weeks; every other day for 3 months; then weekly until established

* = See notes below.

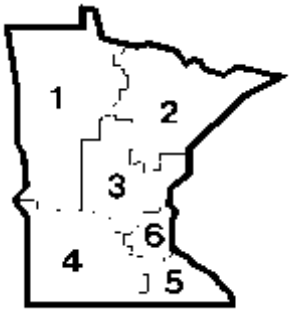
Notes:

- At each irrigation, apply 1 to 1½ gallons for each inch of trunk diameter to the root ball.
- Irrigation can cease once trees drop deciduous foliage in the fall.
- Eliminate daily irrigation in poorly drained soil (soil drains <3/4 inches per hour in a percolation test). Following a rainfall, wait until all free moisture drains out of the soil.
- Reduce frequency of watering during cool, cloudy or wet weather, especially if soil is poorly drained.
- Establishment takes 12 months per-inch-trunk caliper.
- Minimum watering frequency for tree survival would be once each week.

This information was modified from Gilman, E.F. 1997. Trees for Urban and Suburban Landscapes. Delmar Publishers. 662 pp.

Editor's note: This article was excerpted from the *Shade Tree Advocate*, summer 2000 issue, with the author's permission.

This newsletter is developed as a service to forest land managers and shade tree owners. The Forest Health Unit would appreciate comments concerning the newsletter and its contents. These can be directed to Jana Albers, Editor, 1201 E. Highway # 2, Grand Rapids, MN 55744. To add, change or delete your name from our mailing list, please contact the editor. Thanks.



S. Olin Phillips
FUHN Supervisor - Forestry
500 Lafayette Rd.
St. Paul, MN 55155
(651) 296-5971

Alan Jones
Forest Health Coordinator
2605 AGA Dr. Unit 6
Alexandria, MN 56308
(320) 762-7812

Vacant
Reg 1 - Forest Health Specialist
6603 Bemidji Ave.
Bemidji, MN 56601
(218) 755-2891

Roger Hannigan
Plant Health Specialist
6603 Bemidji Ave.
Bemidji, MN 56601
(218) 755-2891

Mike Albers
Reg 2 - Forest Health Specialist
1201 E. Hwy. # 2
Grand Rapids, MN 55744
(218) 327-4115

Jana Albers
Reg 3 - Forest Health Specialist
1201 E. Hwy. # 2
Grand Rapids, MN 55744
(218) 327-4234

Bob Tiplady and Mark Platta
Plant Health Specialists
1601 Minnesota Dr.
Brainerd, MN 56401
(218) 828-2616

Ed Hayes
Reg 4 & 5 - Forest Health Specialist
2300 Silver Creek Rd. NE
Rochester, MN 55901
(507) 285-7431

Susan Burks
Reg 6 - Forest Health Specialist
1200 Warner Rd.
St. Paul, MN 55106
(651) 772-7927

DNR-Forestry
1201 E. Hwy. # 2
Grand Rapids, MN 55744

U.S. Postage
PAID
Bulk rate
Permit No. 525
Grand Rapids, MN

Post Master: Contains dated materials