University of Minnesota Department of Forest Resources

Minnesota Tree Care Advocate

People Helping Trees Help Communities

Minnesota Tree Steward

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Acknowledgements

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Updated on April 2019

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Tree Steward Program Overview

Tree Steward Program History

Minnesota Tree Steward is a community-based program designed to increase local capacity by working with municipalities and engaging citizens in community forestry. Tree Steward Program volunteers are trained in a range of topics predetermined by their community. Tree Steward training can include but is not limited to: best planting practices, watering devices and community practices, pruning suckers and sprouts, developmental pruning on young trees, monitoring tree health for disease, defects, and pests.

Renewal competency assessments will be available online or through postal mail at no cost. Recertification is issued every three years to ensure you are up to date on information.

Tree Stewards are an asset to their community in that they are trained to engage in many types of tree care activities within their communities and assist in teaching others within their community these skills. As municipal budgets continue to be cut, the aid from citizens becomes increasingly more important to communities. Tree Stewards are the second pair of eyes in their community.

Code of Conduct

Tree Steward volunteers serve at the discretion of the Tree Steward Program. Just as it is a privilege for the Tree Steward Program to work with volunteers who offer their time and talent, volunteer involvement in the program is a privilege and responsibility, not a right.

The purpose of the standards of behavior is to ensure the safety and well-being of all Tree Steward participants (i.e. target audiences, staff, other professionals, volunteers) and to ensure a positive, enjoyable experience for volunteers.

Tree Steward volunteers will:

- Uphold volunteerism as a way to meet the urban forestry needs of Minnesota
- Represent the program with dignity and respect by being a positive spokesperson for the program and the city
- Be courteous, civil, and respectful.

Failure to honor these standards can result in Tree Steward status removal. The program director must authorize any termination.

Resolution of the conflict may lead to reinstatement, reinstatement with limitations, reassignment of volunteer duties, or removal from the program.

Program Staffing

- Gary Johnson - Director: directs and administers the program; oversees development and delivery of education and program operations. Contact: johns054@umn.edu
- Ashley Reichard - Volunteer Program Coordinator: organizes and relays program information to volunteers from the University of Minnesota. Contact: info@mntca.org or 612-625-2361

Communications & Resources

- MNTCA Website - program specific information and reporting hours (www.mntca.umn.edu)
- UMN Trees - additional resources for volunteers (trees.umn.edu)
- UMN Headquarters - 115 Green Hall, 1530 Cleveland Avenue North, St. Paul, MN 55108-6112

Program Guidelines, Policies and Procedures

Minimum Age Requirement

Participants in the Tree Steward program must be 18 years or older, confirmed with a valid photo I.D. or have signed parental consent.

Data Collection & Reporting Hours

Data collection by Tree Stewards is crucial. Data is used to generate reports that are given to stakeholders and municipalities. Tree Stewards are expected to help collect data at municipal hosted events and to record personal hours dedicated toward Tree Steward activities outside of scheduled events.

Data collection forms are given to each group of Tree Stewards at the start of a volunteer event. One volunteer from each group collects data. The data collector should have legible handwriting, and must be accurate and concise.

Once data is collected in the field, the original paper form will be given to the city contact overseeing the event for them to provide to the program coordinator. See the data collection example in Appendix A.

Tree Steward hour requirements can be fulfilled by any event related to trees. Reporting of volunteer hours is through the Volunteer Hours Reporting Page, available at: http://mntca.umn.edu/resources/education-volunteer-hours-reporting

Public vs. Private Property

Public property delineation in boulevards are typically within 10-15 feet of the curb, but this can vary greatly from street to street. If it's questionable whether a tree is on public or private property, ask city staff. This applies primarily to pruning and watering trees.

How To Work with the Public

The public is interested in what volunteers are doing. Provide a courteous explanation about the Tree Steward Program and the partnership between the county and the University of Minnesota. Many people are concerned and care deeply about trees, especially if it is right in front of their home. Most people are positive, a few may be negative. It is important to remember that you are an ambassador for your county and the Minnesota Tree Steward Program. Being in the public's eye allows volunteers the opportunity to share about the program and recruit new volunteers to help care for the public trees.

Show your Tree Steward ID to anyone who questions what you are doing, and explain that you have taken a course and a competency assessment for certification. Inform them that what you are doing is helping the trees and emphasize that you have been authorized by your county to assist in this regard. Thank them for their concern, as we need more people who are concerned about the public's trees. If a citizen exhibits resistance to your activities, discontinue your work and move to another location if possible. Note the location you discontinued work and inform your city contact of the interaction.

The public will see you as a source of knowledge and may ask you to look at their own tree. Do not answer questions about private trees. This could be a liability to volunteers and the program, and can infringe on private industry. In a courteous manner explain to them the Tree Steward Program, and the partnership between the city and the University of Minnesota. Recommend they contact a Certified Arborist and provide them with the Tree Owner's Manual card (see Appendix B).

All questions involving public property, including trees and infrastructure, should be directed to the city. If possible, provide the citizen with the appropriate city contact information.

Safety

There are a number of safety regulations in place for the safety of volunteers, citizens, and the protection of surrounding infrastructure. Volunteers are expected to follow all of the regulations set by the Tree Steward Program and by the county. If the Tree Steward Program discovers that safety precautions are being disregarded by any volunteer, Tree Steward status will be suspended. The volunteer will be immediately placed on temporary inactive status and may be placed on permanent inactive status following decisions made by the city contact and the program director.

Pruning specific safety regulations:

- Only branches within arms reach, while both feet are firm on the ground, may be pruned. Pruning anything above that is prohibited. A rule of thumb is to only prune within 6.5 feet from the ground. Any low hanging branches that require the attention of the city should be reported to Jen Kullgren.
- Branches removed from the tree should be approximately 2 inches in diameter at the branch collar ridge or smaller. A good way to approximate this size is by wrapping a hand around the branch; it is the right size to remove if thumb and fingers touch.
- Electricity can flow through branches, so never prune trees/branches that are within 10 feet of utility lines.
- Never get on a ladder - if pruning cannot be done with both feet on the ground, do not do it.
- Be aware of your surroundings.
    - Sometimes you won't be able to make pruning cuts without stepping into the street. If you are on a street that is not busy, you may have a group member watch for cars while you make a proper cut.
    - When you are pruning, or others are pruning around you, make sure that you or others stand clear of the branch drop zone. Even seemingly small branches can injure a person.

Dress Code

- Wear city supplied safety equipment at all times, this includes but is not limited to protective eyewear, helmet, high visibility safety vests, etc.
- No open toe shoes
- No offensive clothing (e.g., too revealing, offensive graphics or words)

Managing Pruning Brush

Manage brush so it is safe for citizens and convenient for the county. Keep brush cleared from all sidewalks, out of the street, and at least 10 feet away from any fire hydrant. Maintaining brush in a courteous and safe manner is crucial.

Following a volunteer event, the county will haul the brush away.

Make as few piles of brush as possible. For ease of handling brush, stack the brush with the pruned end of the material facing the street or easiest access point. If brush is too large to fit with the pruned ends of the branches facing the street or access point, cut the brush into smaller pieces or, turn the brush pile parallel with the street while keeping the cut ends together.

Figure 1. Proper brush management.

Tree Anatomy

Basic Tree Anatomy

Leaves: Leaves are responsible for carrying out photosynthesis which creates food for the tree and releases oxygen into the air.

Branches: Branches and twigs are the support structures for the leaves, flowers, and fruits. They are also responsible for transporting materials between the trunk and leaves.

Trunk: The trunk consists of multiple layers: outer bark, inner bark, cambium cell layer, sapwood, heartwood and pith.

Outer bark: This is the outer protection that keeps the inner soft wood from damage.

Inner bark (or phloem): This is the area in which food is transported throughout the tree.

Cambium cell layer: This produces the new bark and new wood of the trunk.

Sapwood: This is the new wood of the tree and is responsible for moving water throughout the tree.

Heartwood: This is the central, supporting pillar of the tree composed of lignin and cellulose for structural purposes.

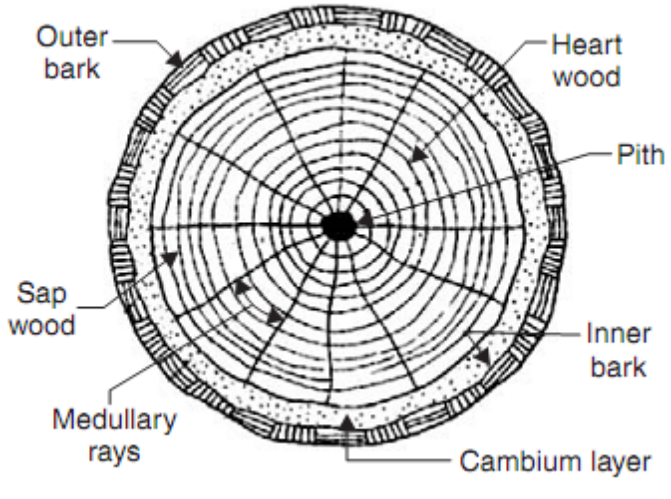


Figure 2. Cross section details of a tree

http://signaturetreeservice.blogspot.com/2014/06/anatomy-ofredwood-oak-tree-exogenous.html

Pith: This is the central core and oldest part of the tree.

Roots: Roots are typically in the top three feet of soil and expand well beyond the dripline (the area two to four times the size of the tree crown). There are two main types of roots:

Structural Roots: These roots are larger, woody roots that exist mainly to stabilize the tree and provide structure.

Fine Roots: These small roots and primarily utilized by the tree to transport water and nutrients from the soil to the rest of the tree.

Types of Planting Stock

Balled and Burlapped Stock

- Often more mature than other stock varieties; always more expensive as well
- Soil ball is encased with burlap and held together by a wire basket and string
- Important to cut and remove as much wire and burlap around the stem as possible before and during planting
- Remove any and all twine and/or string from packaging , especially any touching the trunk of the tree.

Figure 3. Balled and burlapped tree stock.

It is important to keep note of whether the burlap is treated or untreated, as you will want to remove as much of the copper treated burlap as possible. Copper treated burlap is used because it is meant to last longer and will not decompose as quickly as traditional burlap. Research conducted at the University of Minnesota found that untreated burlap on average decomposed in 12 weeks, while copper treated burlap on average decomposed in 13 months. Finally take extra care to remove all twine from around the trunk of the tree to allow the plant room for growth and to avoid stem girdling.

Figure 4. Potted tree stock.

Potted/Bagged Stock

- Grown in a container most of its life
- Can be planted any time of the growing season
- Root systems may be deformed due to container restriction resulting in:
  - Stem Girdling Roots: encircling roots around the tree trunk/stem causing stem compression
  - Rootbound Stock: roots growing in a spiral around the soil ball

With many containerized trees, deformed root systems can be remedied by utilizing the box cut method (see page 14). A new technology, the architectural pot or air-pruning pot, is a container that has holes to allow for oxygen to meet the root ball. When the oxygen meets roots that are growing out or around the container, the roots will die off at that location. When you plant the tree, less action will be needed to remedy deformed root systems.

Bareroot Stock

- Available during their dormant season, typically in early spring before plants have leafed out
- Competitive process to obtain the desired species of bareroot stock due to high demand
- A less expensive stock variety than balled and burlapped and containerized
- Have robust root systems when planted out of a gravel bed
- Lack a soil ball (but utilizing gravel beds can form a healthy root system comprised of many fine roots which help in establishment once planted)

It is important to remember that transplant shock may occur more often for this stock type as removal from gravel beds may cut or tear roots. When transporting this type of stock it is essential to keep the roots moist and protected from the sun and wind, as they come without any soil around the roots. In order to do so, utilize damp burlap or plastic bag and hydrogel substances (see page 19) and plant as soon as possible.

Figure 5. Bareroot stock samples.

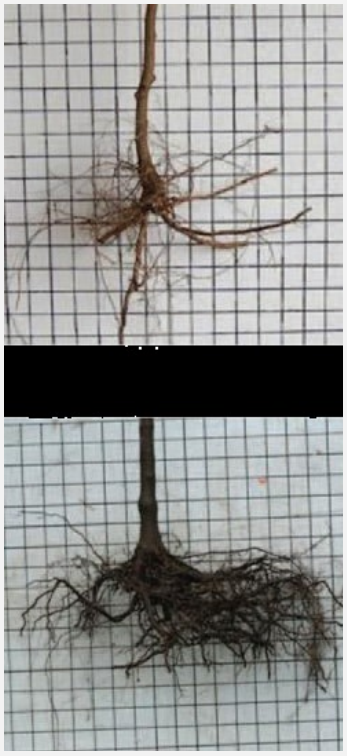


Figure 6. Pre gravel bed root culture.

Figure 7. Post gravel bed root culture.

Gravel Beds

A gravel bed is an irrigated bed or pile of gravel where bareroot or washed containerized stock is placed and safely held for up to 3-6 months. This temporary system has been in use at commercial nurseries, municipalities, and universities for over 20 years. There are many communities in Minnesota that have built and are currently using the gravel bed system with great success.

In a gravel bed, the above ground portion of the tree will not grow any faster than normal. The purpose of the gravel bed is to increase the fibrous root system, prepare for planting at a later date and recover poor root systems.

Figure 8. Plymouth gravel bed.

Figure 9. North High School gravel bed in Minneapolis.

Advantage of a Gravel Bed

- Gravel beds save the community money as bareroot stock is typically 1/2 the price of containerized trees and 1/4 the price of balled and burlap trees and installment costs are eased with bareroot stock .
- Gravel beds aid in plant health and survival, as increased fibrous root systems formed in the bed allow for an increased intake of water and nutrients which then reduces potential transplant shock.
- Gravel beds allow for fall bareroot planting which then allows tree roots to establish in more favorable conditions.
- Gravel beds increase species availability because there are typically more species available as bareroot stock than in containerized or balled and burlap stock.
- Gravel beds provide great opportunities for community members to get involved in planting. Bareroot trees can be planted by everybody as they are easy to carry and do not require excess manpower or machinery to dig holes.

Preparing for Planting

Site Selection

When planting, it is important to select or prepare a proper site in order to provide the best environment for the tree. Some trees do well in sites that may be unfavorable for others. It is important to know what your site is beforehand so that you can pick the best tree for it, or modify the site. More information regarding site selection can be found in the Tree Owner's Manual.

When considering where to plant, keep in mind the following:

- The location:
  - Are there utilities overhead or underground? Contact: http://www.gopherstateonecall.org/
  - Is there enough room for root growth and expansion?
  - It the soil too compacted?
- The cold hardiness zone:
  - Which hardiness zone are you planting in?
- The soil drainage:
  - Does the soil drain slowly or quickly?
- The soil pH:
  - Is the soil more acidic, or more alkaline?
  - Soil testing for lawns & gardens can be done through the University of Minnesota. See: http://soiltest.cfans.umn.edu/testing-services/lawn-garden
- The sun exposure:
  - Is the site fully sunny, partly sunny, mostly shady?
- Compaction:
  - Is the soil a heavy clay or compacted due to equipment/vehicles?
  - You can remedy compaction issues by combining the existing soil with compost to create air space and soil that is easier for roots to penetrate.

Stock Selection

When selecting a type of stock, keep in mind the pros and cons of each kind of stock, as well as who will be conducting the planting and what equipment will be used.

Species Selection

When considering which species to plant, it is important to consider the preexisting trees in the area. Diversity in both species and age creates a healthy urban forest as it creates resiliency in the landscape. Planting a variety of species can help protect against widespread loss due to pest, disease, or wind loading events that may affect one species more than another.

Removing Excess Soil

It is also important to remove excess soil and avoid planting too deep in order to prevent sucker formation and stem girdling roots. A study at the University of Minnesota found that 87% out of 881 balled and burlapped and containerized trees sampled were planted with 2+ inches of excess soil.

If the first main lateral root, or main order root, is not visible, you need to determine how much soil rests on top of it. To find the main order root, you can take a surveyor's arrow or food skewer and poke around the stem of the tree until you find the shallowest root. This is likely the main order root.

Once you find your first main order root, you can remove excess soil to that point either with your hands or by taking a hand saw to shave off the excess soil. Be careful not to injure the tree by cutting into the first main order root or stem as you correct depth.

Figure 10. Checking first main order root depth.

Figure 11. Removing excess soil above roots.

Boxing

With many containerized trees, deformed root systems can be remedied by utilizing the box cut method. To perform this method, make vertical cuts on the sides of the ball about one inch toward the stem at the thickest part of the cut to sever the majority of encircling or entangling roots. Additionally, make a criss-cross cut across the bottom of the ball or slice off the very base of the root ball to ensure that there are no additional dysfunctional roots and no J-roots (roots that point downward and then bend back up toward the main stem of the tree) forming that could come in contact with the tree's stem. Performing this cutting method removes roots that may become a problem for the tree as it matures.

Figure 12. Example of a cut when boxing.

Planting & Tree Stock Preparation

Transporting a Tree

Keeping roots moist is important during transportation as moisture keeps the tree alive and helps the tree establish quickly. Wrap the soil ball or container in a tarp or large plastic bag to trap moisture until planting time. If transporting bareroot trees, the roots should be covered with mulch, sawdust, burlap, or other moisture holding medium (such as hydrogel) and wrapped in a large plastic bag or tarp to trap moisture until planting time. Bareroot trees should be planted as soon as possible after they arrive home to ensure roots do not dry out.

If transporting trees in leaf in the back of an open pickup or trailer, it is recommended that the canopy be wrapped in burlap or an old sheet and tied loosely closed to prevent wind damage to the leaves. You want to prevent further stress on the tree than is necessary.

Balled and Burlapped trees

1. Cut and remove the wire and burlap from the top of the soil ball and around the trunk to check for excess soil over the first main lateral root; remove excess soil if present.

2. Measure the depth of the tree's soil ball and dig a hole that will fit the soil ball with the first main order root placed at the soil surface. This can be tested by placing the soil ball in the planting hole and laying a shovel over the hole to make sure the first main order root is level with the soil surface.

3. Place the tree in the planting hole. Cut and remove as much of the wire basket and burlap containing the soil ball as possible without allowing the soil ball to fall apart.

5. Begin to backfill, keeping the tree straight and the first main lateral root within 1 inch of the soil surface.

6. Finish filling the hole with soil, watering slowly and intermittently to remove air pockets in the backfill.

Figure 13. Removing burlap and string.

https://www.youtube.com/watch?v=bek6ggGIcmU

Figure 14. Watering intermittently during planting.

Containerized trees/shrubs

1.Check the planting depth of the containerized tree to make sure there is no excess soil above the first main order root. If there is excess soil, remove it at this time (see page 14).

2.Check for deformed root system issues (potbound or encircling roots). If there are root issues, correct them at this time (see page 14).

3.Dig a hole that will fit the soil ball with corrections. Measure the distance from the first main lateral root to the bottom of the soil ball to determine the hole's depth and ensure that the first main lateral roots are within 1 inch of the soils surface.

4. Once the planting hole is prepared, remove the tree or shrub from the container by lifting it up by the stem and tapping down on the rim of the container.

5. Begin to backfill, keeping the tree straight and the first main lateral root within 1 inch of the soil surface

6. Finish filling the hole with soil, watering slowly and intermittently to remove air pockets in the backfill.

Figure 15. Checking main order root depth.

Figure 16. Using the container to support box cutting.

Figure 17. Checking level of main order root with soil line using a shovel.

Bareroot trees/shrubs

1. Keep roots of bareroot trees and shrubs moist and protected at all times prior to planting. Prepare planting hole for each plant before removing it from it's protected, moist site.

2. Prepare a hole that is large enough to spread the roots without crowding and deep enough so the first main lateral root is within 1 inch of the soil surface. Rough the sides of the hole to be sure they are not glazed from digging, which can form a barrier for water and roots.

3. Examine the stock and prune away any diseased or damaged roots or branches.

4. Place the roots in the hole at a level so that the first main order root will be at or within 1” of the soil surface.

5. Backfill the soil into the hole a few inches at a time, firming the soil after each addition. While backfilling, be sure the plant remains vertical and centered, and be careful not to damage roots. Use water to settle the soil around the roots while backfilling. Gently raise and lower the plant while adding soil to eliminate air pockets. In loamy soils, use your foot to press down the soil to eliminate extra air pockets.

6. Finish filling the hole with soil and then water thoroughly.

Figure 18. Bareroot stock from a gravel bed prior to planting.

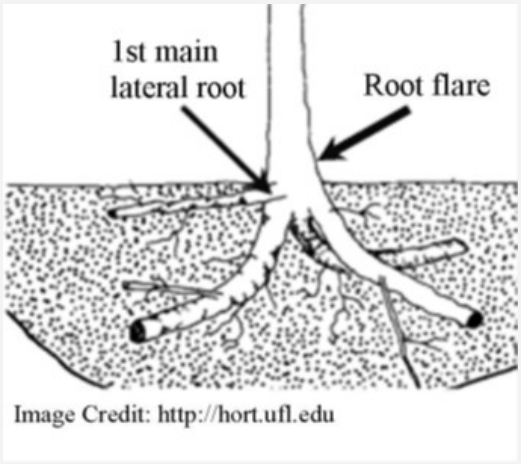


Figure 19. Bareroot stock from a gravel bed prior to planting.

Figure 20. Eliminate air pockets by packing down mid backfill.

Additions

Amendments

In some instances soil amendments, such as compost, composted manure, peat moss, coir, leaf mold, and other plant or animal remains or waste products may be necessary in order to provide a tree with the adequate level of macro and micronutrients and/or water retention. In most instances, this is not necessary when planting a tree. However, soil amendments are a great option when you have poor or compacted soils that need some remediation.

Fertilizers and Nutrients

Fertilizing is not necessary for all trees, but can be helpful if your tree is experiencing long term issues. The best indicator of whether or not fertilizing is necessary is to conduct a soil test (see page 14). In the absence of a soil test, an examination of shoot growth (the growth occurring in the present year) can be done. When fertilizing, make sure to apply in the early spring before the growing season begins in order to increase the amount of available nutrients for the tree. Fertilizer can be applied uniformly over the surface, and watered in, or uniformly placed in holes around the plants. Phosphorous and potassium can be applied in the fall as they will enhance winter acclimation.

Hydrogel

Hydrogel can be helpful when planting new trees. Hydrogel is a network of highly absorbent polymers that absorb and retain up to 500 times their weight in water. When transporting bareroot stock, hydrogel can be applied in order to help retain moisture until the new tree is planted. Dipping the roots in a hydrogel “bath” before transporting the trees prevents the roots from dying out.

Post Planting Care

Mulch

Adding mulch around the base of the plant is a very important part of plant care that is often overlooked. By mulching plants, a more favorable environment is provided for the tree roots. Mulching allows better infiltration of water, holds soil moisture, limits weed growth, and discourages injury from lawnmowers and weed whips. Make sure to keep the mulch off the trunk, and avoid mulch "volcanoes."

Lay mulch around the tree that is roughly 2-4 inches deep at the widest point, 2-4 inches or more away from the stem and in a doughnut shape. Keep the mulch off of the tree trunk to prevent stem girdling roots from forming and to prevent insects and critters from hiding in the mulch next to the trunk and harming the tree.

Figure 21. Improper mulching.

Figure 22. Proper Mulching.

Stem Protection

What does stem protection do?

- Helps prevent unintended damages to the stem
- Provides protection to trees during the harsh winter months
- Deters animals from damaging the stem

There are many materials that can be used as stem protection, but most are plastic tubing that is wrapped around the stem of the tree. The stem protection device should cover the entire circumference of the tree without tightly touching the stem, as this can eventually girdle the tree if left on too long. Finally, make sure the stem protection is on your tree by early to late fall and removed promptly in the spring.

Figure 23. Improper stem protection that was left on too long.

Grow Tubes

Grow tubes may be used when working with seedlings as they act as stem protection while also aiding in tree growth. Grow tubes act as greenhouses as they allow UV light to pass through the tube, giving the seedlings enough sun and warmth for photosynthesis, which then promotes tree growth.

Grow tubes are typically installed with fiberglass stakes (these stakes are flexible, easy to install, and easy to remove) and rubber ties (prevent slipping and provide movement).

Grow tubes are typically used on very young trees and will stay installed for multiple years while the tree builds up enough woody tissue and size to support itself throughout the rest of its life. When the tube outgrows the tube, simply cut it off and recycle it.

Figure 24. Grow tubes installed on for seedling planting.

Stakes

Staking a tree is only necessary if the tree is prone to leaning or falling. If you need to stake your tree, limit the number of stakes used and only keep them on the tree for one growing season, unless it is absolutely necessary to keep on longer. Typically staking is only necessary for trees planted in open, windy sites, in loose soils, or if the stock planted is bare root and has not had time to build up a dense root system in a gravel bed.

When staking, your first attachment and stake should be placed on the windward side of the tree to counter push from the wind. If a second stake is needed, place the second one on the leeward side of the tree to counter movement back and fourth. If more support is needed, a three-stake system can be utilized.

Attachments should be two-thirds of the distance from the ground to the first branch and stakes should be driven deep into the ground for stability. It is best to use wide materials such as canvas burlap or an old bicycle inner tube to loosely attach the stakes to the tree. This allows the tree to move slightly without damaging the bark. Do not use thin string or wire as it can easily damage and girdle the tree.

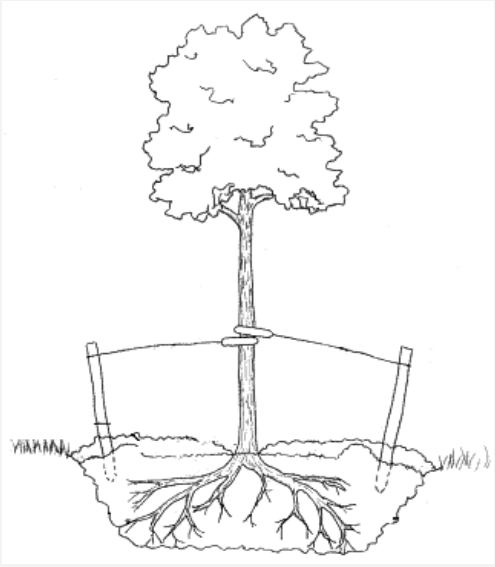


Figure 25. Proper use of the 2-stake method.

Ties and Strings

It is important to remove all ties and strings when planning in order to avoid girdling the stem. Although some ties and strings may break down more quickly than others, and therefore may not cause any long term stem issues, it is best to be proactive and protective, removing all constraints from the start.

Figure 26. Girdling as a result of string being left on a tree too long.

Stem Girdling Roots (SGR)

Stem girdling roots are roots which grow against or around the stem of the tree. As the tree increases in size the roots expand and compress the stem. This is commonly unseen as it is most likely to take place under the soil or mulched surfaces. This compression prevents water and nutrients from being transported through the tree and can cause the tree to decline prematurely. SGR may lead to tree failure during storms or high winds.

Figure 27. A dysfunctional root system that would eventually grow to girdle the tree.

Why are SGRs a problem?

- They can create safety hazards, as a poorly anchored tree is more likely to fail and fall during a wind loading event, which can cause damage to the surrounding homes, sidewalks, or utilities.
- They create economic losses as they require more care and inspections for a property owner, and a failure may create additional and unexpected costs.
- They can reduce the relative health of affected trees, making the trees more susceptible to drought, disease, and pests.

How do SGRs form?

- Can form due to improper planting depth
- Can form due to genetic predisposition, as is the case in Norway maples, ashes, lindens, other maples, crabapples, and hackberry.

How to identity SGRs

- Look for unusual leaf color and/or size, scorched leaves or unusual leaf drop.
- Look for early autumn color, dieback, a thinning canopy density, and stagheading in the canopy.
- Look for leaning stems, lack of a stem taper, cracking of the stem or bark, or secondary invaders (wood boring insects or fungal cankers) in the stem.

Post Planting Care

How to prevent SGRs?

Figure 28. Girdling roots as a result of a tree planted too deep (see soil line on stem).

- Do not plant trees too deep.
- Inspect all containerized, and balled and burlapped trees to make sure they aren't planted too deep.
- Inspect a trees root system that may be growing around the stem and prune them out before planting.
- Box cut trees that are showing signs of a pot-bound or potential girdling situation (see page 15).
- Do not pile mulch against the stem of the tree.
- Continually monitor the stems of your trees (e.g. once a year).

How to fix established SGRs?

Compared to prevention, there are few choices for treating trees with stem compression from girdling roots. The reality is that prevention is much more effective and successful than treatment of SGRs. If the roots are not yet contacting the stem, simply prune out the roots before they have the chance to cause compression. Removing them now at inspection time with a pruner or saw will prevent those future problems.

If stem compression has already occurred, there is often not much that can be done, depending on the severity of the compression. The tree may live for a long time with the girdling root imbedded in the stem. Removing the girdling root may involve the removal of an extensive branch root and the fine root system and the decline in health could actually be accelerated. If the removal or pruning of SGRs requires more than hand tools, you should seek professional advice before attempting any treatments to the trees.

Watering Newly Planted Trees

Tree Watering Needs

Newly planted trees require routine watering. Thoroughly water the tree at the time of planting with approximately 10-15 gallons of water. Continue to water your tree, until established, once or twice a week for a total of 10+ gallons per week. If the tree is receiving an inch or more of rain per week, then watering is not necessary . Stop watering in the fall once the ground freezes and the tree goes dormant.

Examine the soil moisture to a depth of 4-8 inches to determine the need for water. If the soil feels dry or just slightly damp, watering is needed. Soil type and drainage must also be considered. Well-drained, sandy soil will need more water compared to a clay soil that may hold too much water. A slow trickle of the garden hose at the base of the plant for several hours or until the soil is thoroughly soaked is the best method. Short, frequent watering should be avoided as this does not promote deep root growth but rather, the development of a shallow root system that is vulnerable to several environmental stresses.

Cost of Watering

The overall cost of watering is ultimately dependent on the type or tree, age of tree, placement of planting, and weather and other natural conditions. To find out how much water is necessary for your tree and the overall cost, see http://mntca.umn.edu/resources/reference-materials .

Devices for Watering

- **Water bags:** Water bags, depending on size, can hold up to 20 gallons of water that slowly release into the soil around the tree. You zip these bags on to secure. However, they must be removed in the winter, so critters do not make a house inside of the water bag. If critters make this home, they will likely eat through the watering bag and they will eat the stem of the tree for food. Bags are typically used for one to two growing seasons and reused on other newly planted trees.
- **Water rings:** Water rings are a fairly new device. They hold 5 gallons of water at one time and slowly release into the soil around the tree. They are simply slid on around the tree. The perks of the rings are that you can bury them within your mulch ring to hide the device. Rings are typically used for one to two growing seasons and reused.
- **Soaker Hose/Drip irrigation:** Cut slits or poke holes into a hose to allow water to seep into ground rather than spraying over the tree and ground. Keep flow rate low to allow for seeping. Commercially produced soaker hoses are available for purchase.
- **Drip tape:** A flat, hose like device, water tape is highly efficient for irrigation. It seeps at a very low rate, only at points of perforations, and is commonly used in nursery operations.
- **Sprinklers:** The least desirable due to high rates of evaporation and low efficiency ratings.
- **Tree Diapers™:** an "irrigation product to combine the functions of slow release irrigation, automatic recharging with natural precipitation, weed control, and protection against extreme weather conditions (winter and summer) into one low-cost package."

https://www.treediaper.com/index.cfm

Figure 31. Tree Diaper™.

Figure 29. Water bag on a young tree.

Figure 30. Water ring buried in mulch.

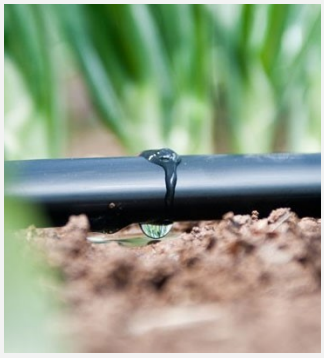


Figure 31. Drip tape.

http://en.deere.co.th/common/media/images/product/equipment/water/irrigation_and_water_management/drip_micro_irrigation_emission_devices/drip_tapes/hydrodrip/product_hero_hydrodrip_642x462.jpg

Pruning Tools

Tools

When pruning trees, different tools are used for different types of pruning. The tools used are typically chosen based on the size of what is being pruned as some tools work better for smaller diameter cuts while others work better for larger.

Types of Tools

Bypass pruners

Bypass pruners have curved blades that act like a scissor as they overlap. Properly sharpened pruners leave a smooth well defined cut and do not crush the plant material. These pruners are typically used for branches 1/2 inch or less in diameter.

Tricut handsaw

Tricut handsaws come in many shapes and sizes. The blade may be curved or straight and have fine or coarse teeth. Handsaws should be used to remove branches with diameters between 1-inch and 4-inches.

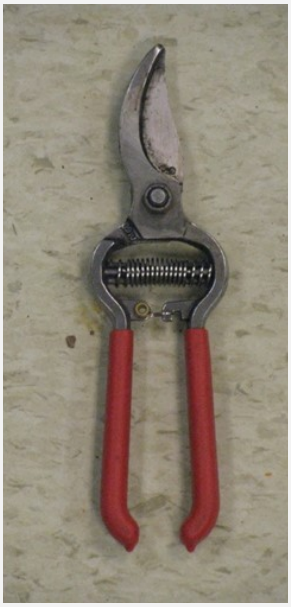


Figure 32. Bypass pruners.

Figure 33. Tricut handsaw.

Types of Tools Continued

Pole pruner

Pole pruners are similar to a bypass pruner in that they cut like a scissor, however, they are extended on a pole to reach higher into the canopy. Pole pruners should only be used to prune branch material that is unreachable with a bypass pruner or handsaw. Properly sharpened pruners leave a smooth, well-defined cut and do not crush plant material. Pole pruners are best used for cuts of 1 inch in diameter or less. All pole devices should be utilized in conjunction with a hard hat and proper safety clothing such as protective eyewear and gloves.

Figure 34. Pole pruner.

Pole saw

Pole saws are similar to a tricot handsaw, however they are extended on a pole to reach higher into the canopy. The blade may be curved or straight with fine or coarse teeth. Pole saws should be used to remove 1-inch to 2-inch diameter branches. All pole devices should be utilized in conjunction with a hard hat and proper safety clothing.

Figure 35. Pole saw.

Cleaning Your Tools

To clean pruning tools, clear off all debris and dirt with soap and water and disinfect with rubbing alcohol. Make sure to dry them off before storing and spray with WD-40 in order to prevent rusting. It is especially important to clean and disinfect tools with 90%+ rubbing alcohol before pruning some tree species like honeylocust or crabapple in order to prevent the spread of disease.

Tree Identification and Pruning Restrictions

Correctly identifying the type of tree about to be pruned is the first crucial step in pruning trees. Different species of trees are susceptible to diseases at different times of year. Pruning trees at the wrong time can lead to infection.

Linden

Lindens, also known as basswoods, are a species that commonly produce sprouts and suckers.

Photos: Dave Hanson

Leaves: alternate, simple, 4”-8” long, coarsely serrate edges; heart-shaped, unequal base.

Twigs: slender, round 2-scaled, reddish bud. **Fruit**: ¼-⅜”, round, under leaf like bract, no ridges.

Bark: light gray when young, darkens with age, narrow/shallow flat topped ridges.

Oaks

When pruning oaks, it is important to wait until the proper pruning season, as pruning at the wrong time of year can lead to infection by oak wilt. Oak wilt is caused by a non-native fungus and is spread from diseased to healthy trees either below-ground via connected roots or above-ground by insects. Most new infections are the result of fungus transmission through roots of adjacent trees that have grafted together, but fresh pruning wounds attract the beetles and could start a new infection center. In Minnesota, the disease is currently found in an area bounded on the north by Pine County, on the west by Stearns and Nicollet counties, and south to the Iowa border.

The safest time to prune an oak in Minnesota is typically November through March .

Visit www.myminnesotawoods.umn.edu/2010/03/oak-wilt-risk-status-in-minnesota for the current oak wilt infection status.

Swamp White Oak

Code: QUBI

Family: Fagaceae

Quercus bicolor

Photos: Dave Hanson

Leaves: alternate, simple, 4-7" long, 5-12 shallow rounded lobes, shiny green top, whitish below.

Fruit: ¾" to 1¼" paired acorns, 1"-4" stalk. Acorns mature in the autumn.

Bark: light brown, papery, scales become blocky and deeply fissured with age.

Northern Red Oak

Code: QURU

Family: Fagaceae

Quercus rubra

Photos: Dave Hanson

Leaves: alternate, simple, 4-9" long, 7-11 bristle-tipped lobes, sinuses cut ½ way to midrib.

Fruit: ⅝" to 1⅛" acorn, shallow cap, scales pubescent, acorns mature autumn of second season.

Bark: gray to red-brown, smooth, shiny, becoming grayish flat-topped ridges, deeply furrowed.

Bur Oak

Code: QUMA

Family: Fagaceae

Quercus macrocarpa

Photos: Dave Hanson

Leaves: alternate, simple, 4-12" long, 5-9 rounded lobes, center sinuses cut to mid-rib.

Fruit: acorn, fringed (bur) cap covers ½ or more of ¾" to 2" acorn, acorns attached direct to twig.

Bark: grayish with vertical ridges, deeply furrowed. Bur oak can have corky twigs.

White Oak

Code: QUAL

Family: Fagaceae

Quercus alba

Photos: Dave Hanson

Leaves: alternate, simple, 4-9" long, 5-9 rounded lobes, sinuses nearly uniform in depth.

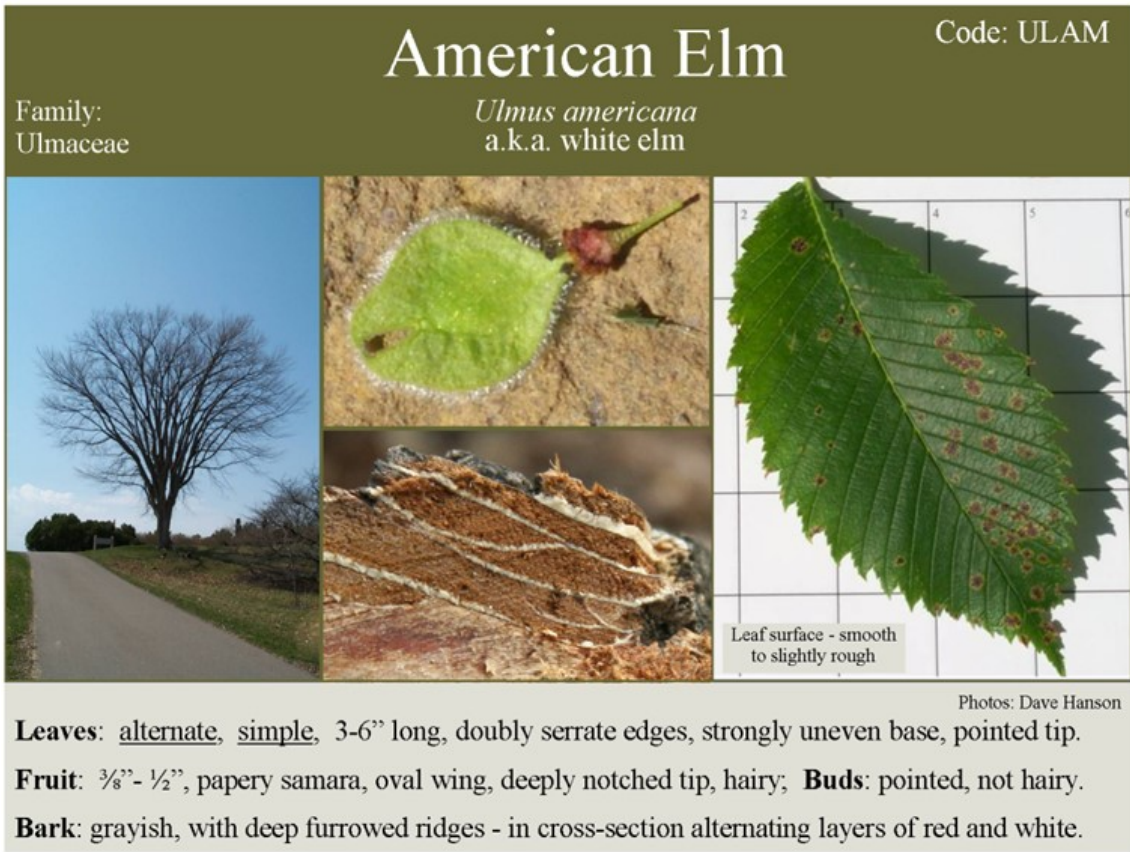
Fruit: acorn, ⅜" to 1¼" acorns, cap covers top ¼-⅓, acorn is attached via a ¼" stalk.

Bark: Light ashy-gray, narrow vertical ridges, with age breaks into blocky, irregular shapes.

Elms

There are a variety of diseases that can affect elms, the most common being canker formation and Dutch elm disease. Cankers can form on twigs and branches and can be identified by the reddish-brown infected wood, contrasted by the whiter healthy wood, as well as by the yellowed leaves that fall without wilting. Dutch elm disease (DED) can be identified by the wilting, yellowing, and premature falling of leaves as well as by the streaked sapwood on affected branches.

The safest time to prune an elm in Minnesota is typically in November through March.



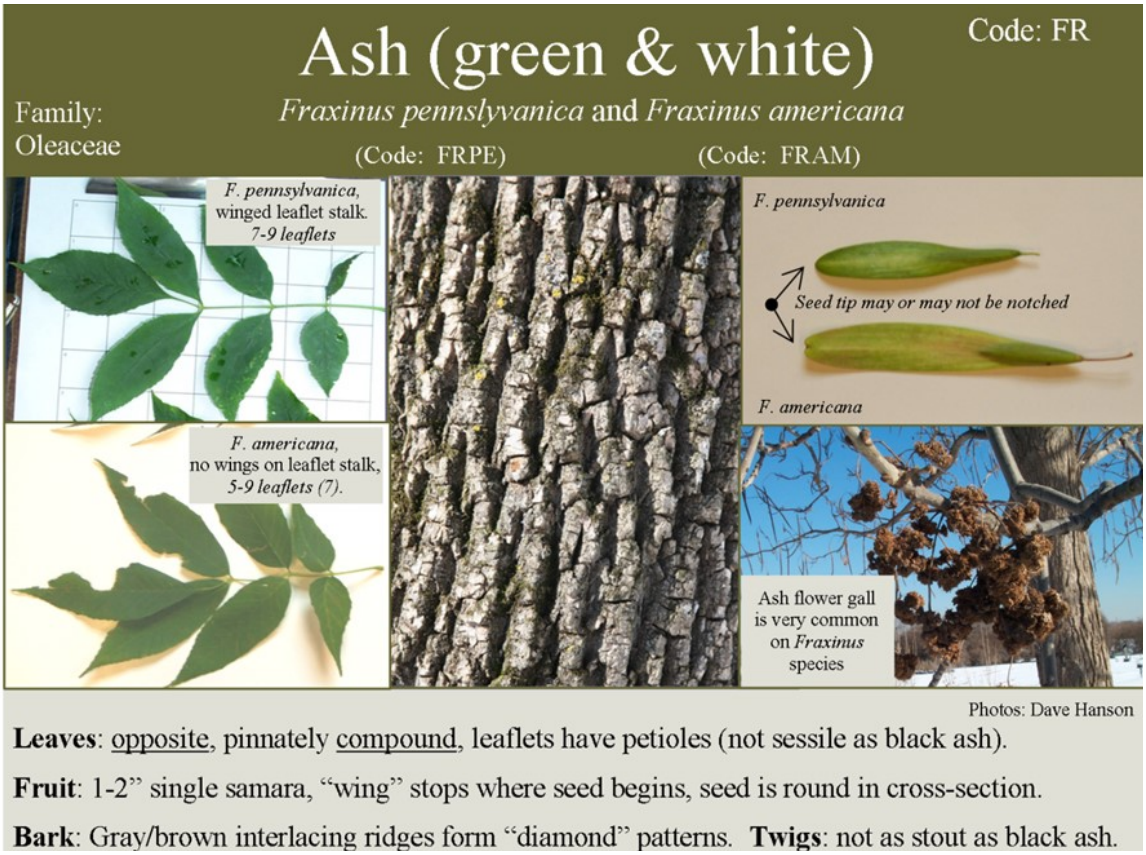
Ash

When pruning ash trees, it is important to prune only during the dormant flight season of emerald ash borers (EAB). Pruning during flight season encourages the adult insect to move from tree to tree, potentially infecting more trees as a result. Ash trees infected by EAB can be identified by the S shaped galleries, D shaped exit holes, woodpecker holes, and overall health decline of the tree (canopy die back and bark cracking).

Although flight seasons can change depending on spring and fall temperatures (cold springs may delay flight whereas warm falls may extent it), pruning typically ranges from October through April.

For more info about EAB and for the current EAB risk status visit:

http://www.myminnesotawoods.umn.edu/eab-risk/



Honeylocust

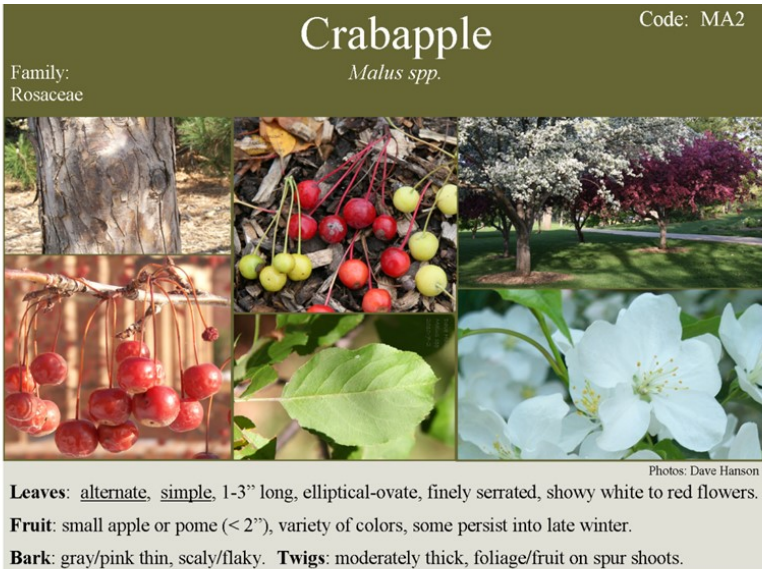
Pruning honeylocust in the spring and fall should be avoided in order to decrease the spread of nectria canker, a disease that spreads during the wetter seasons. Nectria canker is a fungus that causes target-like cankers on the stem of trees and is most severe on stressed trees.

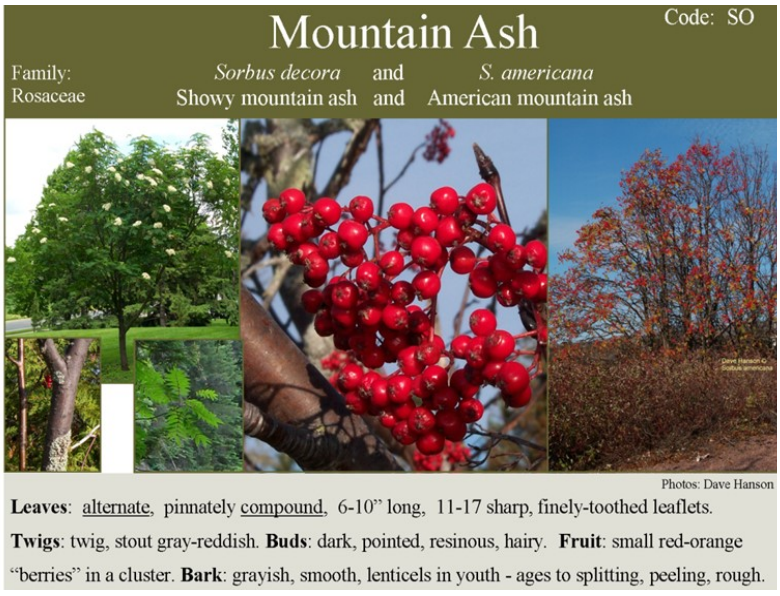
The safest time to prune honeylocust in Minnesota is in the heat of summer or from late fall to late winter. It is also important to remember to clean and disinfect tools before pruning honeylocust in order to prevent the spread of disease.

Crabapple and Mountain Ash

When pruning crabapples and mountain ash trees it is important to remember that they are susceptible to fireblight, which can be spread through pruning wounds during spring and early summer. Fireblight is caused by the bacterium *Erwinia amylovora* and can be identified by the wilting of flowers, leaves, and shoots and the discoloration of leaves, bark, and branches.

The safest time to prune both crabapple and mountain ash trees is typically October through early April.





Birches & Maples

There are a variety of problems that can affect birches, none of which are related to pruning. People fear pruning in the spring causes them to bleed and causes problems. Trees don't bleed, they exude sap. No harm done.

Again, there are a variety of problems that can affect maples, none of which are related to pruning. People are even more fearful of pruning maples in the spring that results in "bleeding." Maples do not bleed, they exude sap. Note that people aren't squeamish about pouring maple "blood" on their pancakes.

Paper Birch — Code: BEPA

Family: Betulaceae

Betula papyrifera

Photos: Dave Hanson

Leaves: alternate, simple, coarse doubly toothed margins, leaf base - symmetrical, rounded.

Twigs: reddish-brown with prominent lenticels. Male catkins are often present at twig ends.

Bark: young reddish bark, lenticels - matures to white peeling bark, at tree base dark and fissured.

Sugar Maple — Code: ACSA2

Family: Aceraceae

Acer saccharum

Photos: Dave Hanson

Leaves: opposite, simple, 3-6" long, 3-5 pointed lobes; "U" sinuses, coarsely toothed margins.

Twigs: brown, pointed buds. **Fruit**: 1-1¼" long, paired; horseshoe shape, green turning brown.

Bark: Young gray/brown and smooth; Becomes dark and deeply furrowed when older.

Types of Removals

Stem Protection Systems

Tree stem protections are used to protect the tree's stem from physical damage. Even though the intent of the tree stem protection is to protect the tree, they can be damaging if secured improperly of left on too long. Stem protection applied too tightly or left on too long can compress the stem. This can restrict water and nutrient uptake and constrain normal flow through the stem. Stem protection systems should be removed when they are tight to the stem.

Figure 36. Grow tube method.

Figure 37. Fence protection.

Mulch Volcanoes

A mulch volcano is a term for an improperly mulched tree, where mulch is piled high against a tree stem. This practice can often be seen in landscapes. Having mulch touch the stem of the tree increases the chances of stem girdling roots.

Figure 38. Example of mulch volcano.

Figure 39. Improper mulching.

Sprouts and Suckers

A sprout is a fast growing, often very upright branch that emerges from the trunk of the tree, often developing from stem damage or pruning. It is important to remove sprouts before they become a problem, as they can block sight lines, creating safety issues for drivers and pedestrians. Sprouts can also be a disadvantage to the tree itself as they can create weak branch unions because they are more shallowly attached than branches at a normal union. These weak branch attachments are more likely to fail than strongly attached branches.

Figure 40. Suckers on a Linden.

A sucker is a sprout that develops at the base of the trunk off the tree's root system. Suckers can form for a variety of reasons such as improper planting, stress, or simply because they are a species prone to suckering, like apple or linden. It is important to remove suckers as they can block sight lines, sidewalks and streets.

Figure 41. Close up of suckers.

Figure 42. Example of suckers.

Included Bark

Included bark is when bark grows in between a branch union which prevents the branch from attaching correctly to the trunk or another branch. This is problematic as bark and the woody branch material cannot graft or grow together which creates a weak union, increasing the likelihood of failure.

Figure 43. Included bark example.

Co-Dominant Leaders

The term co-dominant leader is used to describe two or more main stems that are about the same size in diameter. This branch structure can become a problem as the closer in size a branch is to the main stem the more likely it is to fail. This is because co-dominant leaders are competing for dominance, and with increased size comes an increased chance of splitting and structural failure. In order to prevent damage to the tree, a leader can be chosen and pruned for. In order to chose a leader, look for a leader that is central to the stem and straight in nature. Also, be aware of leaders that have the best structure with good branch attachments. Once you've chosen the leader you do not need to completely remove all of the competing leaders but the ones you do not remove you should suppress using a reduction cut. A reduction cut, or suppression cut, shortens the stem back to a lateral branch or to a node, which then forces future growth into the unpruned branches.

Figure 44. Co-Dominant leaders and where to remove one of the leaders.

Crossing/Rubbing Branches

Crossing or rubbing branches occur when two separate branches begin to collide with one another. Crossing or rubbing branches can injure bark and other living tissue on the branch, which makes the branch more prone to decay or disease.

Figure 45. Rubbing branches on an apple.

Good Branch Spacing

The vertical space between branches should eventually be 12 inches for fruit or small stature trees, and 18 inches or more for medium and large stature deciduous trees (this spacing does not apply to coniferous trees).

Good branch spacing is important for future growth of the tree. As branches increase in size, it's more likely they will grow into each other if not properly spaced. Pruning for proper spacing can prevent this

Figure 46. Poor spacing on an apple tree.

Deadwood

Deadwood occurs for a number of reasons and is easily identified during leaf out. Use either a bypass pruner or pruning saw to remove deadwood at the branch collar. Use the three-cut method if the branch is large.

When pruning branches with deadwood and live wood, prune only deadwood and save as much of the live wood as possible. The deadwood on a live branch should always be pruned back to a node.

Figure 47. Before pruning.

Figure 48. After pruning.

Temporary Branches

Trees grow outwards, not upwards, so branches that you see now will remain at the same height until you or a storm removes them. Trees need to be pruned up to clear space for cars and trucks to drive through. Different streets vary in their requirement of clearance levels, but the average is 14.5 feet in height. Temporary branches can be removed at any point in a trees life. Use your collective group judgment to decide whether temporary branch removal is necessary at this time.

Figure 49. Temporary branch on an apple.

1. Always keep a good live crown ratio. This means that for deciduous trees 60% of the tree should contain a living crown, and for coniferous trees this means 75% should be in live crown
2. Never remove more than 25% of the tree's live crown in one pruning season.
3. When pruning, aim to create a symmetrical canopy.

Figure 50. Live crown ratio example and equation.

Pruning Branch Material

First identify the branch collar, the area of swelling. This may be hard to find with sprouts as they will often swell where there are several small sprouts in one area. The branch collar is more noticeable on larger branches. Prune sprouts and branches just beyond the branch collar because it makes a smaller, more sealable wound that does not injure the main stem's cambium.

Sharp tools make the best pruning cut on a tree. Prune small sprouts and branches with a pruning shear. If the sprout or branch is too large for bypass pruners, use the three-cut method with a pruning saw to prevent bark rip-

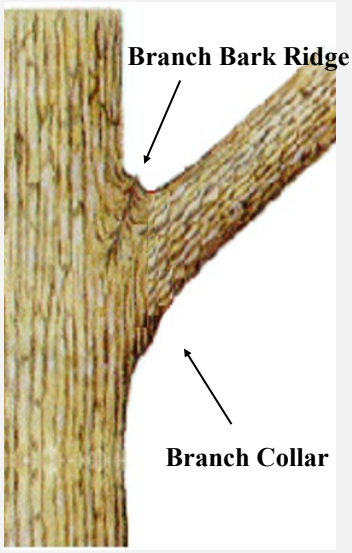


Figure 51. Branch identification.

Pruning Branch Material

How to prune branch material (sprouts, included bark, etc.) that is less than 1/2 inch in diameter:

- Hand support the end of branch away from the tree stem to stabilize the branch as you make your cuts
- Identify branch collar
- Place pruning shears just outside of branch collar with the sharp end of the blade on the underside of the branch material
- Apply pressure through squeezing handles
- Once blades cut all the way through, place branch material in pile facing pruned ends in the same direction

Figure 52. Sprouts on an elm.

How to prune branch material (sprouts, included bark, etc.) that is 1/2 to 2 inches in diameter:

- Hand support the end of branch away from the tree stem to stabilize the branch as you make your cuts
- Identify branch collar
- Proceed using the Three-cut method

Three-cut method:

1. With your handsaw make a shallow cut on the underside of the branch 1 or 2 feet out from the branch union
2. Make a top cut all the way through the branch slightly farther out than the first cut to leave a short stub
3. Remove the stub by cutting just outside the branch collar, perpendicular to the direction the branch is growing

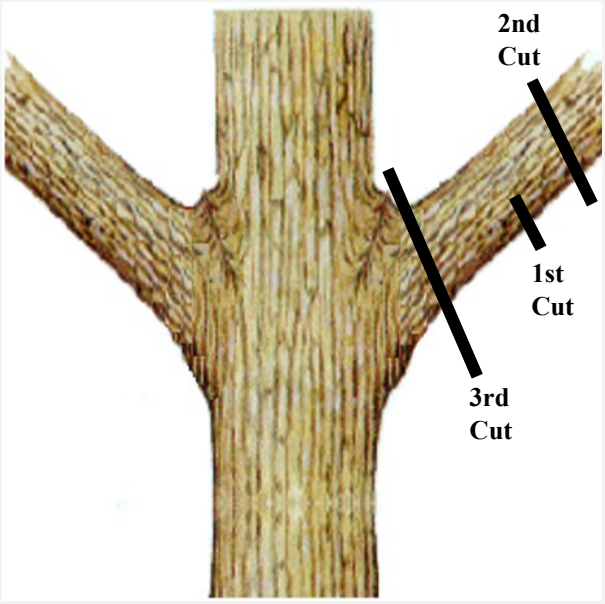


Figure 53. Three-cut method cut placements.

Pruning Branch Material

How to prune branch material (sprouts, included bark, etc.) with a pole pruner:

- Identify the branch you want to prune, making sure it is not too large for the pole pruner. Do not cut anything too large, as doing so may break the pole pruners.
- Identify the branch collar.
- Do not stand directly below the branch that you are cutting. Make sure that you stand off to the side of where you are cutting so the branch doesn't fall on you.
- Place the branch between each shear of the pole pruner.
- Make sure that your placement of the shears will make an appropriate cut for the branch.
- Pull sliding handle or rope towards you to make the cut.
- Review the cut made and amend if needed.

Figure 54. Pole pruning of a co-dominant leader on a maple.

Reduction Cut

Pruning to a node is used when pruning out deadwood or when making a suppression cut, also known as a reduction cut. A reduction cut shortens the stem back to a lateral branch or to a node. Future growth is forced into the unpruned branches.

Figure 55. Pruning back to a node.

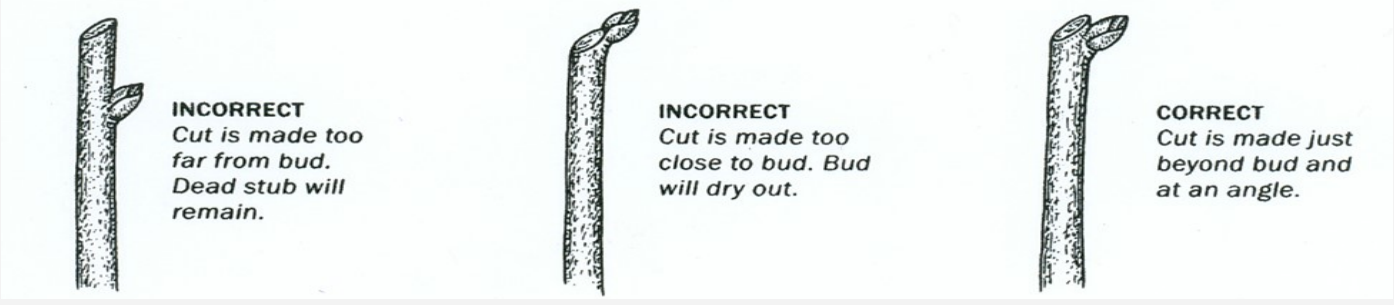


Figure 56. Incorrect and correct pruning when making a reduction cut.

Poor Pruning

Bark ripping can occur when the three-cut method is not used to remove large branches. This often happens when the pruning cut is made by starting the cut on the top side of the branch. The branch fails because it doesn't have enough support, causing the bark at the base of the branch to tear.

Flush cutting occurs when a pruning cut is made close to the stem and removes part of the stem's living tissue. This inhibits the flow of water and nutrients up the stem, and can affect branch development in the canopy and will lead to decay.

Stub cutting occurs when a branch is pruned too far outside the branch collar. It takes longer for the tree to grow new wood and bark over the wound.

Figure 57. Bark ripping.

Figure 58. Flush cutting

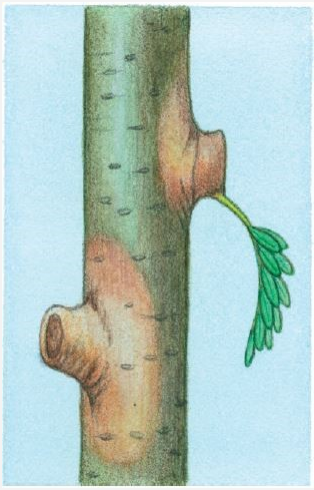


Figure 59. Stub cutting.

Compartmentalization of Decay in Trees

Compartmentalization of Decay in Trees (CODIT) is a complex tree process to prevent the spread of decay and disease. Trees do not heal like humans. Instead of healing an injury, a tree will compartmentalize it. Even though pruning is beneficial to the tree, pruning is still considered an injury.

Compartmentalization is a unique way trees plug up their vascular system to prevent the transport of diseases and decay in the stem. This plugging also prevents the transport of water and nutrients. Some tree species are better at compartmentalizing than others.

Pruning a tree leaves an open wound. If pruned correctly, the wound will compartmentalize and new growth will form over the wound.

Figure 60. CODIT as dark color in plugged vascular tissue..

Dieback/Death

Dieback, or canopy decline, can be caused by a variety of factors (e.g. root damage, soil compaction, girdling roots, stress or drought) and can occur quickly or over an extended period of time.

Dieback may vary in appearance or severity but is typically identified by the lack of growth, lack of foliage, slight twig mortality, and premature fall coloration and defoliation.

Figure 61. Death in a spruce.

Leaf Scorch

Leaf scorch is a condition caused by a variety of environmental factors such as high temperatures, dry winds, and low soil moisture.

Scorch symptoms can vary between plant species, but typically appears in July and August as a yellowing between leaf veins and along leaf margins, and a browning on the tips of leaves. In severe cases, entire leaves may curl and wither.

Figure 62. Leaf scorch example.

Trunk Wounds

Trunk wounds can be caused by a number of factors, like lawn mowers or pests, and depending on severity can have lasting effects on a tree's health.

Trunk wounds may resemble scratched, chipped, or removed bark, and depending on the cause may vary in size, location, and severity.

Figure 63. Trunk wound, often a product of mechanical devices.

Leaf Wilt

Wilting can affect both the leaves and branches of a tree and may be caused by a number of factors, such as root damage or water shortage.

Symptoms may occurs at anytime during the growing season and can be acute (wilting, drying, leaf discoloration) or chronic (stunted growth, sparse foliage, branch dieback).

Figure 64. Wilting on a dogwood.

http://www.missouribotanicalgarden.org/Portals/0/Gardening/Gardening%20Help/images/Pests/Drought_Stress1921.jpg

Broken Branches

Broken branches can happen for a number of reasons (wind damage, included bark splitting, vandalism, etc.) and are important to remove as they may lead to further bark ripping and tearing, further and more extensive tree damage, or may become a hazard. For branches high in the canopy or with wide diameters, report them to your city forester or arborist so they may be properly removed.

Figure 65. Broken branch.

Dead Branches/Stagheading

Dead main branches and stagheading are branches that have experienced die off and are still attached to the tree. As you can see from these examples, dead branches can vary from one branch in the canopy to large sections of branches. There are many reasons that branches may die, so further investigation needs to be done to determine why this is happening in a tree and if it can be helped.

Figure 66. Stagheading example.

Stem Girdling Roots

Stem girdling occurs when there is atypical compression to the tree's stem. In the first example, stem girdling roots have encircled the base of the stem. In the second example we see girdling causing tree instability (See page 23 for more information on SGRs).

Existing stem girlding roots (like those pictured) can be fixed later on in a trees life. This typically involved using some sort of wedged tool and a hammer to cut the roots off and relieve the compression issue. If the roots are too large to do this on your own, you can consider having an experienced certified arborist to remove the roots and potentially save your tree.

Figure 67. Stem girdling roots.

Leaning

Leaning may occur for a number of reasons but is commonly caused by root damage. In some cases, typically in younger trees, attempts can by made to correct leaning by implementing a staking system.

Figure 68. Leaning tree.

Storm Damage

Storm damage can cause a variety of damaging effects to a tree ranging from small broken branches to splitting open to the complete uprooting of a tree.

Figure 69. Storm damage tear out.

Vandalism

Vandalism can appear in a number of forms and is typically identified by the atypical nature of the damage and the location of the tree.

Figure 70. Vandalism on young tree.

Reporting Trees of Concern

Often, you will see trees of concern that show examples of the previous tree health and structure issues. As volunteers in your community, you have the ability to alert city staff of these problematic trees so they may address the tree and make management decisions. Course of action is determined by the severity of the issues and more importantly, the safety of the citizens within your community.

Emerald Ash Borer (EAB)

The Insect

The Emerald Ash Borer (*Agrilus planipennis*) is an insect native to northeast Asia that specifically targets *Fraxinus* genus trees as habitat and a food source[1].

Figure 71. Galleries created by the Emerald Ash Borer.

Figure 72. Emerald Ash Borer insect.

http://www.emeraldashborer.info/

Signs & Symptoms

- Woodpecker damage in the canopy.
- Larvae create S-shaped galleries beneath ash trees' bark.
- Small, D-shaped exit holes from the adult insect on the stem.
- Epicormic sprouts (suckers) at the base of the stem.
- Canopy dieback & thinning of the upper canopy[2].

Common Misconceptions

- The insect is not a vector for a fungal pathogen! Physical damage from the insect weakens the tree and causes notable symptoms.
- The trees aren't the only ones at risk. Weakening ash trees increases risk of failure in loading events, thus putting people and property at an increased risk of injury, damage, and/or death[1]!

Implications for Minnesota

- Emerald Ash Borer poses a significant risk to urban communities with many planted ash trees, some communities possessing a 60% ash canopy[2].
- If left unchecked, EAB could spread to northern MN's black ash communities, disrupting native ecosystems.

Management & Control Considerations

- Do not move firewood or other materials that could contain EAB (nursery materials, etc.).
- Recognize the adult insect and larvae.
- Become familiar with EAB signs and symptoms and report any suspected infestation to your community's forestry department and/or the Minnesota Department of Natural Resources.
- Remove any EAB-infested trees.
- Stay informed on current trends of EAB spread in Minnesota.

Sources

1) https://www.mda.state.mn.us/emeraldashborer
2) http://www.dnr.state.mn.us/invasives/terrestrialanimals/eab/index.html

Dutch Elm Disease (DED)

Figure 73. Flagging, a prominent sign of a diseased elm.

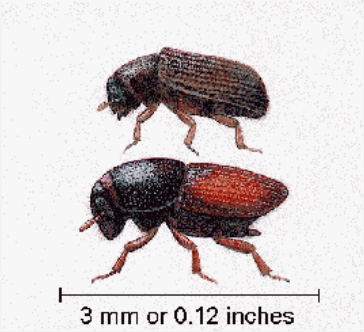


Figure 74. The native elm bark beetle.

https://www.na.fs.fed.us/spfo/pubs/howtos/ht_ded/ht_ded.htm

The Fungi and Insect Vector

Dutch Elm Disease is caused by *Ophiostoma ulmi* or *Ophiostoma novo-ulmi* fungi and spread by the native and European elm bark beetles[1]. All elm species are susceptible, though introduced Asiatic elms and resistant varieties are less susceptible[2].

Signs & Symptoms

- Leaf wilting and premature drop.
- Brown streaking in sapwood.
- Yellowing and browning of foliage, beginning at the canopy or base depending on site of infection.
- Distinctly-shaped galleries under the bark[1,2].

Resistant and Tolerant Elms

Many elm varieties demonstrate resistance or tolerance to DED. These include but are not limited to[3]:

- Accolade™
- Cathedral
- Discovery
- New Harmony
- Patriot
- Prairie Expedition
- Triumph™

Implications for Minnesota

Dutch Elm Disease poses a significant risk to urban communities; an estimated 1 million elms are in urban communities[2].

Management & Control Considerations

- Use insecticide to kill insect vectors (elm bark beetles).
- Break root grafts between elms.
- Apply fungicidal treatments to elms.
- Prune branches immediately that display symptoms or signs of infection.
- Plant noted resistant or tolerant elm varieties.
- Immediately remove confirmed infected trees to prevent further infection.

Sources

1) https://www.na.fs.fed.us/spfo/pubs/howtos/ht_ded/ht_ded.htm
2) http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/dutch-elm-disease/
3) http://www.extension.umn.edu/environment/agroforestry/elm-trees.html

Oak Wilt

The Fungi and Insect Vectors

Ceratocystis fagacearum is the fungus responsible for Oak Wilt and is spread by sap-feeding beetles of the *Nitidulidae* family and oak bark beetles[1]. Oaks in the red oak group are affected more greatly than white oaks[2].

Figure 75. Oak wilt symptoms on leaves.

Figure 72. Oak wilt symptoms in canopy.

https://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm

Signs & Symptoms

- Wilting at the top of tree crown, progressing downward as infection spreads.
- Reddish-brown discoloration of leaves.
- Complete wilting and leaf loss, leading to tree death.
- Fungal mats beneath bark.
- Infected trees can die in as little as 1 to 2 months, but typically within a year.

Risk of Infection by Time of Year

April--Mid-July: **High**
Mid-July-–October: **Low**
November—March: **Safe**[2]

Implications for Minnesota

Oak wilt has been particularly destructive in neighboring Wisconsin, where some areas have seen a 50% mortality rate in oaks[1]. Similar death rates could be seen in Minnesota without proper controls in place.

Management & Control Considerations

- Destroy root grafts between oaks.
- Avoid wounding or pruning oaks in the spring and early summer.
- Do not move firewood from areas with the disease into other areas.
- Remove and destroy infected oaks immediately.

Sources

1) https://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.htm
2) http://www.extension.umn.edu/environment/trees-woodlands/oak-wilt-in-minnesota/

Bur Oak Blight (BOB)

Figure 77. Wedge shaped lesions and necrotic lesions.

Figure 78. Dead leaves remaining.

https://hortnews.extension.iastate.edu/2012/9-12/buroakblight.html

The Fungus

Bur Oak Blight is caused by the fungus, *Tubakia iowensis*, and overwinters in dead leaves that remain on trees[1]. In the Spring, rain carries spores to infect new trees[1]. *Quercus macrocarpa*, bur oak, is the only species affected.

Signs & Symptoms

- Purple lesions develop in the veins on the underside of leaves.
- Wedge-shaped sections of chlorosis and necrosis form on leaves.
- Dead leaves remain on the tree overwinter.
- Black fruiting structures form on leaf veins[2].

Positive Identification

Bur Oak Blight shares many symptoms with other biotic and abiotic diseases, so positive diagnosis is important. Samples can be collected and sent to the University of Minnesota Plant Disease Clinic for positive identification[3].

Implications for Minnesota

There are many old, aesthetically-pleasing bur oak trees in Minnesota that are all susceptible to the disease. Without management and control practices, these trees could succumb to the disease and disrupt Minnesota landscapes.

Management & Control Considerations

- Apply fungicides to reduce risk of infection.
- Boost tree vigor with regular mulching and watering.
- Be wary of secondary invaders such as Two-lined Chestnut Borer and Armillaria that can infect BOB-affected trees.
- Send samples to the Plant Disease Clinic to ensure proper diagnosis of the disease.

Sources

1) http://www.ipm.iastate.edu/ipm/info/plant-diseases/bur-oak-blight
2) https://www.na.fs.fed.us/pubs/palerts/bur_oak_blight/bob_print.pdf
3) https://pdc.umn.edu/

Appendix A: Field Form Example

Citizen Pruner Field Form

City Name (of pruning event):						Start Time:		
Group Member Names & CP Numbers:						End Time:		
						Date:		
				Please check off if you conducted any of the following removals:				
Tree #	Street Address/Location	Species (optional)	Location Description (Boulevard, park, etc.)	Suckers/sprouts	Light pruning (broken/damaged/low branches, deadwood)	Developmental pruning or low branch removal	Materials (wraps, ties, tags, string, mulch)	Reported to City/Staff?
1								
2								
3								
4								
5								
6								
7								
8								
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Appendix B: Tree Owner's Manual Card