STEM GIRDLING ROOTS

THE UNDERGROUND EPIDEMIC KILLING OUR TREES

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INTRODUCTION

30 YEARS IS NOT AN OLD TREE!

How many trees die prematurely each year? Thousands? Millions? Billions? It's almost impossible to pinpoint, but one unseen culprit – dysfunctional (abnormal) root systems – is responsible for an inordinate number of tree failures. It is estimated that one-third to one-half of tree losses during windstorms may be attributed to distorted and dysfunctional roots (University of Minnesota data, 1995-2005). *photo 1*

But not all premature tree loss is sudden. Shortened lifespans, sometimes as little as 20% of a normal lifespan, may be directly related to poor root systems and planting practices. Trees that are ugly above ground are usually uglier below ground. *photo 2*

NORMAL VERSUS ABNORMAL

A normal root system grows away from a tree's stem, similar to the spokes on a bicycle wheel. As the root grows out, the tree becomes stronger and healthier and develops a flare (the area where the stem and root merge). *photo 3*

Some roots become dysfunctional because they were forced to grow in a too-small container for a too-long time. These are referred to as "pot-bound" plants and represent one of the most common dysfunctional root systems. *photo 4* Often, pot-bound plants never develop a normal root system or normal life, even after they are planted in a landscape.

WHAT ARE STEM GIRDLING ROOTS (SGRs)?

A stem girdling root is a type of dysfunctional root that is growing against a tree's stem (the trunk), squeezing or compressing the sapwood. This happens as the root and stem grow radially (enlarge in diameter) and eventually this compression may severely retard or stop the flow of water, nutrients and sap (photosynthates, a.k.a., "food"), both to and from the roots. *photos 5 & 6*

photo 1

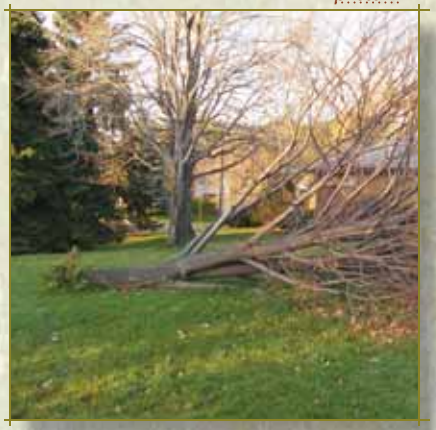


photo 2

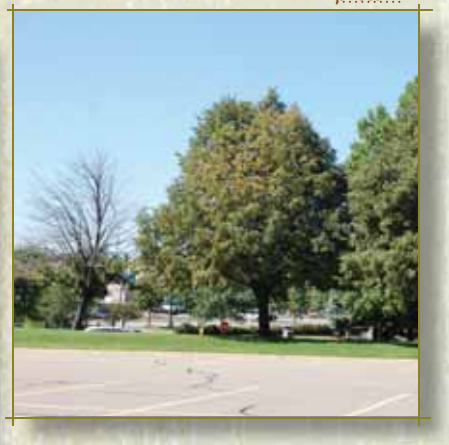


photo 3

photo 4

photo 5

photo 6

Sometimes the stem is so weakened from this compression or “girdling” that trees snap off at this weak point during wind storms, a dramatic and preventable end. *photo 7*

ARE SGRS A PROBLEM?

Indeed, SGRs can create problems in three ways, including safety issues, economic losses, and/or a decline in tree health (vitality).

SAFETY

Trees weakened by SGRs may present significant issues of safety. They often have smaller root systems or root systems that are poorly anchored in the soil, leaving them susceptible to wind-throw (uprooting during storms). If these trees are close to homes, sidewalks or utilities, they become a hidden and unacceptably high safety risk. *photo 8*

The compression of the sapwood tissue often causes branch die back in the tree’s canopy. Depending on the size of the dead branches and their height in the tree, they too can cause injury or property damage when they fall.

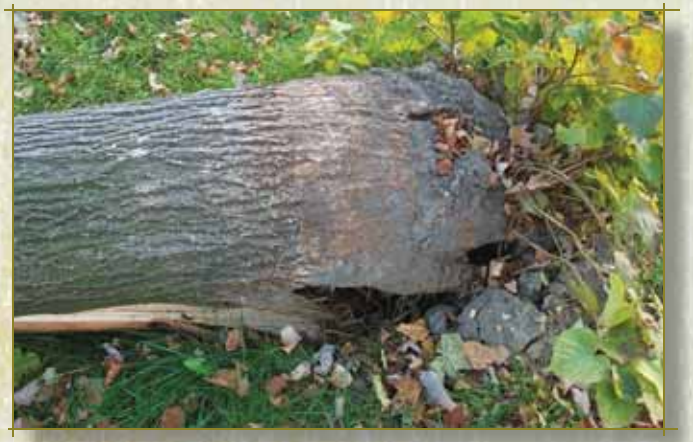
ECONOMIC LOSSES

The presence of high risk trees in any landscape becomes an issue of economics. As the symptoms of SGRs become apparent more frequent inspections, care and pruning of the trees are needed.

Economic losses can be considerable for the property owner forced to remove, clean up and replace toppled or sick trees. *photo 9* Because SGRs often take years to affect a tree enough to cause it to fail – and by then that tree may be 30 feet tall or more – removals can be expensive. Of course, the losses incurred when trees fall onto buildings, vehicles or into utility lines can be substantial.

There are other costs associated with premature or sudden failures, especially during storms. Streets may be blocked, utility services interrupted and temporary shelter may be necessary until repairs can be made.

photo 7



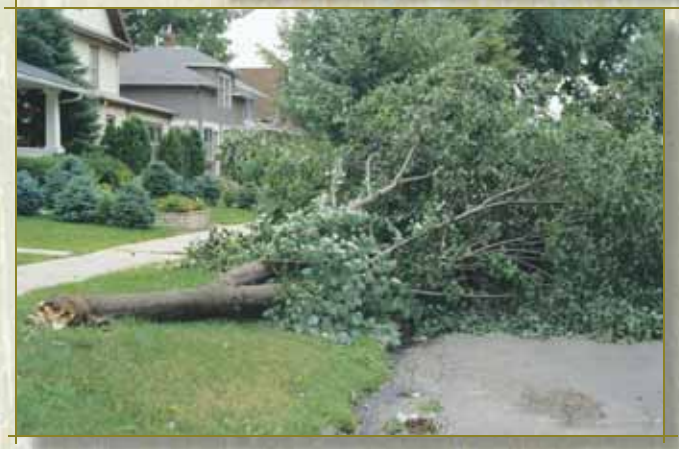


photo 8

photo 9

HEALTH

SGRs can reduce the relative health (vitality) of affected trees. Trees that are in poor health are more susceptible to secondary problems such as seasonal drought, diseases, insect pests and winter damage. Sometimes this leads to the loss of the beauty of the tree, sometimes to its death.

Trees with poor vitality are far less valuable to the landscape and often require increased maintenance, whether they are in a park or a residential lawn. Stressed trees require more disease and insect control treatments, more irrigation and sometimes more fertilization. Even then they still may be less aesthetically desirable than a healthy tree, as is the middle tree in *photo 10*.

EMOTIONAL LOSSES

To many homeowners the greatest losses are emotional. Large trees cannot be easily replaced and it may take many years before the landscape is fully restored.

WHAT DO SGRs LOOK LIKE?

Three types of girdling roots may be present when a tree develops SGRs. The first is tangential girdling, which is a root that only compresses one side of the stem by growing against it. *photo 11* These are usually the more treatable situations, especially when the problem is detected early.

The second and most damaging type is layered girdling of the stem. *photo 12* This occurs when roots are in a sense stacked against the stem at different depths, and often on different sides. The deeper a tree is planted, the more likely this will happen.

The third type is a complete encircling of the stem by, most commonly, two or more girdling roots. *photo 13*

photo 10

photo 11

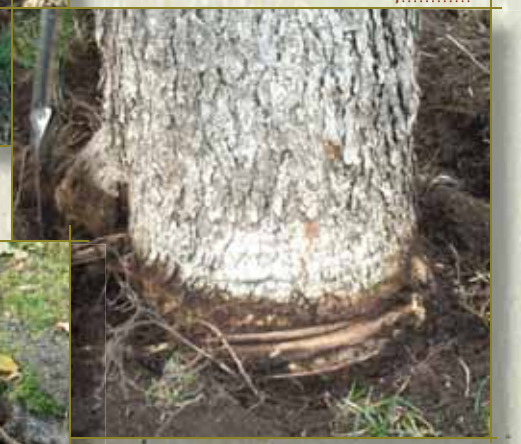


photo 12

photo 13

DIAGNOSIS: ABOVE GROUND SYMPTOMS OF THE PROBLEM

Often, SGRs are only one factor affecting a tree's health. Depending on the extent of sapwood compression, trees may be weakened to the point where other diseases, insects and weather cause further damage to the tree.

SGR "health decline" symptoms are usually slow to develop and may be barely noticeable to the untrained eye. As sapwood becomes more compressed with age, symptoms may occur singly or in combinations. They may not be as obvious every year, nor occur in any particular order.

Early recognition of these symptoms may give you enough time to determine how bad the problem is, develop a treatment plan and hopefully, save the tree.

WHAT TO LOOK FOR IN THE LEAVES:

* *Unusual leaf color*
* *Unusual leaf size (smaller than normal leaf in the middle in photo 14)*
* *Scorched leaves*
* *Early or unusual leaf drop photo 15*

WHAT TO LOOK FOR IN THE CANOPY

(all branches and leaves)

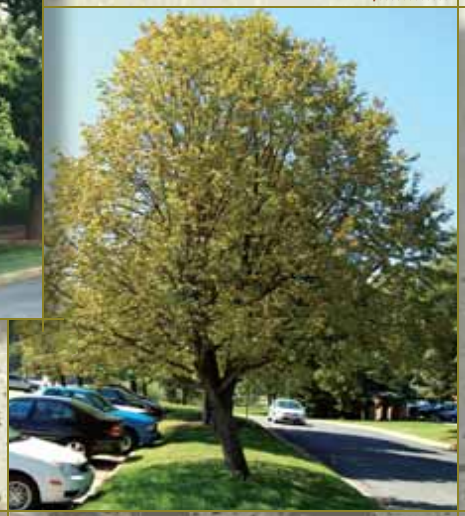
* *Early autumn color photo 16*
* *Dieback (death of 1-2 feet of branch ends)*
* *Thinning canopy density photo 17*
* *Stagheading (death of a major branch/leader)*

photo 14

photo 15

photo 16

photo 17



WHAT TO LOOK FOR IN THE STEM

(the stem is all portions below the first set of branches to the ground)

- *Leaning stems*
- *Lack of characteristic stem taper*
  (stems look like utility poles at the ground line) photo 18
- *Cracking of the stem or bark photo 19*
- *Secondary invaders*
  (especially wood boring insects or fungal cankers)

HOW DO SGRS FORM?

Most stem girdling roots are formed as the result of cultural or planting practices. When main branch roots are cut for any reason (transplanting, excavation for a sidewalk), new roots often form that run tangential (along one side) to the stem, rather than out and away like a normal branch root would. Container-grown trees with encircling roots (a.k.a., pot-bound) often force roots into positions that may eventually cause compression of the sapwood in the stem. *photo 20*

Planting too deep or piling mulch up against stems often encourages adventitious (roots growing out from the stem tissue) to grow in a direction that within a few years causes compression in the stem.

If tree stems are completely above ground, then SGRs are not likely to form. However, ANY practice that places stems below ground (or below mulch as in *photo 21*) puts the tree at-risk for developing stem girdling roots.

Trees that have been planted too deep in containers or dug with excess soil over the root system (often hidden by the burlap around the soil ball) are automatically set up for failure if the excess soil over the roots is not removed at planting time.

photo 18

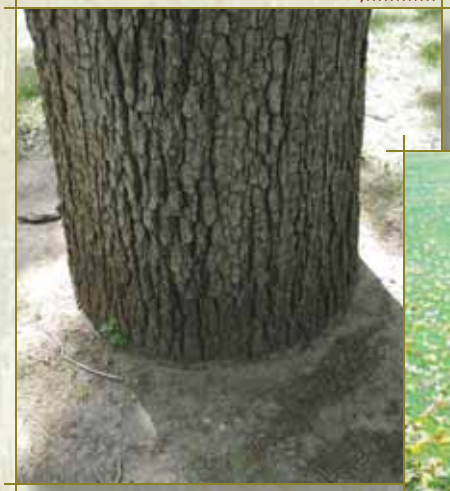
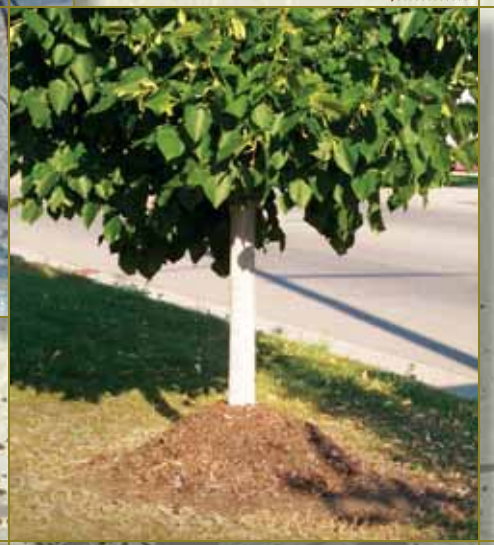


photo 19

photo 20

photo 21



In photo 22, more than 12 inches of excess soil was found over the roots of this hackberry by probing through the burlap with a stiff wire.

There is evidence that at least one tree species (Norway maple) may be genetically prone to the chronic formation of stem girdling roots. There is also an increasing amount of evidence that SGR problems are not just limited to Norway maples. Ashes, lindens, other maples, crabapples and hackberrys are all common victims of this problem. SGRs have been reported on at least 56 different trees in North America.

ROOT COLLAR INSPECTIONS

Recognizing the above-ground symptoms of SGRs is only a clue that there may be below-ground problems. The final diagnostic step should involve a root collar (that area where the stem widens to the first branch roots) inspection to confirm whether or not SGRs are present and the extent of stem compression.

In most cases, a root collar inspection is done in a fairly small area around the tree's stem: excavating 6-12" out from the stem and 4-12" deep. This excavation should be done carefully, preventing the damage to the root system as much as possible.

Inspections may be performed with a small, stout, metal trowel for smaller trees, or with a wet/dry vacuum for larger excavations. The vacuum method is particularly time efficient. In photo 23, this excavation was done in a few minutes with a trowel and wet/dry vacuum with no damage to the roots.

With drier, looser soils, loosen the soil with a trowel and vacuum the loosened soil away. If the soil is particularly hard, soak it thoroughly before and during the vacuuming process. Use a grounded, high quality wet/dry vacuum.

Some tree companies have specialized equipment for non-destructively removing soil over root systems. This equipment uses pressured air to displace the soil without damaging the roots. photo 24

photo 22

photo 23

photo 24

If stem girdling roots are found, they may be removed if the compression is not too severe (less than 1/2 of the stem circumference compressed). In *photo 25*, the white-painted roots could easily be removed after the excavation, preventing any further injury to the tree. If removal of the girdling root would involve severe wounding of the stem, it is not recommended that the root be removed. Instead, cut both ends of the root where it comes in contact with the stem in order to stop its growth.

In *photo 26*, the girdling root was removed without wounding the stem, even though the root had caused some compression to the stem.

DO NOT replace the excavated soil and bury the stem again. Cover the exposed roots with a light application of mulch (2-4"), taking care not to pile the mulch against the stem of the tree.

photo 25

photo 26

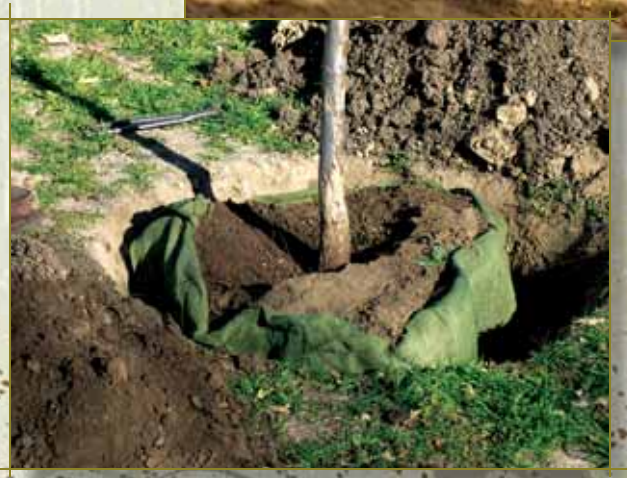


photo 27

PREVENTION = TREATMENT = RECOVERY

PREVENTION

PREVENTION of stem girdling roots is the most effective method of reducing the loss of trees to this problem.

1. DO NOT plant trees too deep. The first true branch roots should be at or barely below the soil surface. Refer back to *photo 3* on page 5 for an example of where to look for the first true branch root.
2. Inspect ALL containerized and balled-and-burlapped trees for the depth to the first branch roots and assume that most trees are buried too deep in their soil balls. A stiff wire may be used to probe down from the surface to locate those roots, as was done with the tree in *photo 22* on page 15.

   If the roots are 4" down from the top of the burlap or container surface, dig the planting hole 4" shallow so the first roots are level with the ground line, as shown in *photo 27*.

After the tree has been placed in the planting hole and partially back-filled, scrape the excess soil off the surface of the root/soil mass until the first branch roots are exposed.

If you are planting containerized trees, the process is a little simpler. With a probe, determine the approximate depth to the first main roots. Then, use an old pruning saw to remove the excess soil and roots as in *photo 28*.

In *photo 29*, the excess soil has been removed (about a 2-3 minute process) and the tree is ready for planting. DO NOT WORRY that you have harmed the tree. On the contrary, you have saved it!

3. Inspect tree root systems for adventitious roots that may be growing against the stem. These roots should be removed prior to planting. Trees with severely pot-bound roots (roots the size of a pencil or larger) should be avoided. They are not likely to ever become normal, healthy root systems.
4. DO NOT pile mulch against the stem of the tree. It's the same as planting too deep.
5. Periodically monitor the stems of your trees. Randomly inspect them with root collar excavations for early signs of the formation of encircling or tangentially placed roots.

TREATMENT

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. In *photo 30*, there are three roots that could cause stem girdling problems. Removing them now at inspection time with a pruner or saw will prevent those future problems.

photo 28

photo 29

photo 30

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.

RECOVERY

Often if compression is severe the only recourse is some treatment and intensive care. Since not all trees with stem girdling roots die young or fail during windstorms, keeping the trees healthy may help them recover or tolerate the stress.

1. Never let them become moisture stressed. Water deep and over the entire root system. Use mulches to retain the soil moisture and reduce competition from turfgrass roots, but don't pile the mulch up against the trunk.
2. If the tree has become nutrient stressed and is growing less than typical for the species and the site, light additions of slow-release nitrogen fertilizers may help. However, do not fertilize so much that excessive above-ground growth further burdens the weakened stem and root system.
3. Stressed trees are more vulnerable to insect and disease problems. All measures to reduce the additional stresses from insect damage and diseases should be taken. Contact a tree care professional to determine if there are any secondary problems developing.
4. Anticipate several years of reduced growth and branch die-back during the recovery process. Regular (every 2-3 years) deadwood removal pruning may be required to reduce risks from branch failures during the recovery period.

You are encouraged to contact a professional for advice or assistance during any stage of the prevention, treatment, or care of SGR-affected trees. Local nurseries are a good starting point. International Society of Arboriculture (ISA)-certified arborists can be found at www.treesaregood.com.

ADDITIONAL PRINT/WEB RESOURCES:

Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines, by Richard Harris, James Clark and Nelda Matheny. Prentice Hall.

A Practitioner's Guide to Stem Girdling Roots, by Richard Hauer and Gary R. Johnson, a U.S. Forest Service publication.

The University of Minnesota, Department of Forest Resources Extension and Outreach web site: www.fr.cfans.umn.edu/extension. Access the Urban and Community Forestry folder and proceed to Stem Girdling Roots.

PHOTOGRAPHY CREDITS:

Photos 5, 18, 20, 24 and 27 are courtesy of Eric Berg, Community Forestry Program Leader, Nebraska Forest Service.

Photo 9 courtesy of Gary Wyatt, University of Minnesota Extension Service

Photo 6 was provided by the University of Minnesota, Facilities Management Department.

All other photos by Gary Johnson, University of Minnesota.

GLOSSARY

Adventitious Root . . . . . *A root growing in an unusual place, e.g., the stem. Rooted cuttings depend on adventitious roots.*

First True Branch Root . . . *The uppermost branch root that is large enough to be considered a permanent root. On a nursery-grown tree, this will be at least as big in diameter as a pencil, and often as large as a carrot. Don't confuse this with a smaller, adventitious root that could have formed from soil or mulch piled against the stem.*

Sapwood . . . . . *A tree's stem is either wood or bark. Wood may be either sapwood or heartwood. Sapwood is the lighter colored wood closest to the bark, and is the wood that moves "sap" throughout the tree.*

Stem Encircling Root . . . . . *(SER) A root that grows next to or around a buried stem. In time, SERs can enlarge, begin compressing stem tissue and become Stem Girdling Roots.*

Stress . . . . . *Any disruption of normal health. Stress is normal and plants usually recover if their overall health is adequate. Leaf loss due to hail storms, roots exposed to flooding and deicing salt spray on pine needles are all examples of common stresses to trees.*

Symptom . . . . . *A plant's reaction to a problem that is affecting its health. For instance, wilting, browning of needles (in evergreens) and stunted growth.*

HELP YOUR TREES LIVE LONG HEALTHY LIVES

1. **DO NOT PLANT TOO DEEP.**
2. **INSPECT ALL TREES AND SHRUBS BEFORE YOU BUY. FIRST ROOTS SHOULD BE NEAR THE SURFACE.**
3. **AVOID BUYING TREES THAT ARE SEVERELY POT-BOUND AND BURIED TOO DEEP IN CONTAINERS.**
4. **DO NOT PILE MULCH AGAINST STEMS.**
5. **PERIODICALLY CHECK YOUR TREES FOR PROBLEMS. INTERVENE EARLY.**

See Pages 16-20 for more detailed instructions on preventing Stem Girdling Roots, and for additional tips on the treatment and recovery for trees already afflicted with SGRs.