6 Steps to Landscape Diversity

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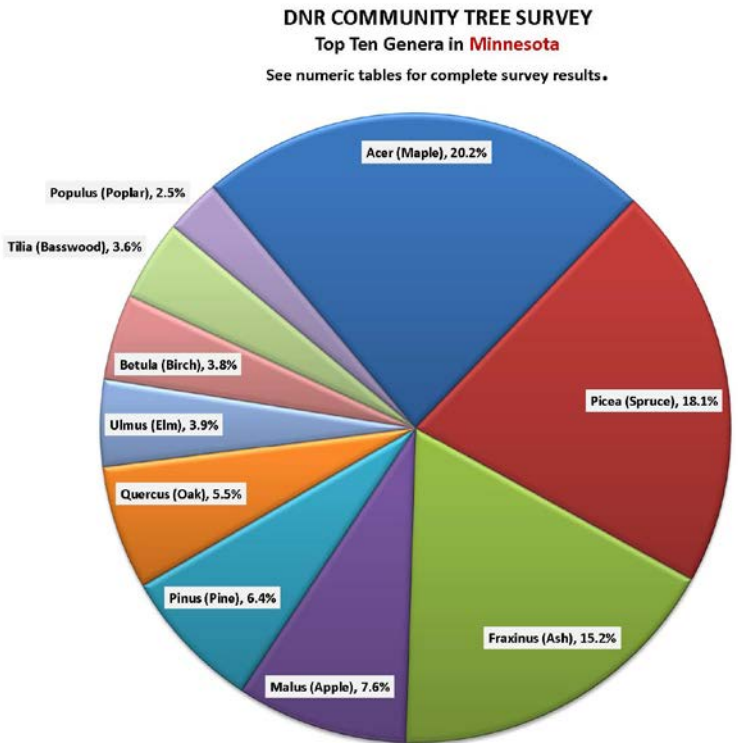
1. Taking Inventory

Before determining any steps to take, what is your community dealing with? Taking an inventory of the species, age class/trunk size, and conditions of street and park trees allows for a plan to include the issues that are most prevalent within your community.

2. What Are You Willing to Lose?

The standard for genetic diversity within an urban environment has been proposed by the 30-20-10 rule: no greater than 30 per cent of trees from a single botanical family, no greater than 20 per cent from the same genus, and no greater than 10 per cent of the same species (*Diversity in Planting Trees*, Morton Arboretum). For example, *Fraxinus pennsylvanica* is a species, green ash. *Fraxinus* (ash) is the genera, and it is in the *Oleaceae* (olive) family. To explore the many families, genera and species of plants, check out The Plant List at http://www.theplantlist.org/.



Data from 2010 survey, Minnesota DNR

The 30-20-10 rule still leaves a lot of potential for massive losses given the right (or wrong) circumstances, and may be an outdated approach for creating diverse urban forests. Is any community willing to lose 30 per cent of your tree population to a disease such as Dutch elm disease or an invasive pest such as the Emerald Ash Borer? What if the ratio of the genetic make-up a tree population was changed to something like 5-2-1, or even 5-5-5? Would 5 per cent of a tree population be an acceptable loss? Once the percentage of trees a community is comfortable losing at once is determined, planting different families and genera to increase the genetic diversity of trees throughout community to match the desired ratio can begin.

Trees in nursery setting

3. Diversify Age-classes

When tree populations are aging past maturity the chances of failure of trees during weather loading events such as wind, rain, or snow are much higher. A fairly simple and inclusive method of addressing issues associated with a largely aging tree population is holding an annual community wide tree sale, introducing a new

age-class of young trees to the community every year. A number of cities in Minnesota already hold annual tree and plant sales, such as Blaine, Hendricks Saint Paul, and Minnetonka. The sale not only allows for community members to be involved in the selection process, but also can be an opportunity for providing information on best planting and maintenance practices.

A tree sale can also offer cities and organizations a controlled way of increasing the genetic diversity of trees within the community. Given an inclusive inventory of what trees are already present, organizers can select species from different genera and families than are present within the community, excluding species that may already be overabundant.

Trees in a street setting

4. 4. Considering Space, Above and Below

Still before selecting a tree for a site, the amount of space needed by the species of the tree and the amount of space available at the site need to be paired up. Naturally, looking up and observing the potential obstacles to a tree canopy is important. Being aware of the height and distance requirements for utility lines, or the proximity of a building or landmark should help you decide what size and shape tree you want for that site.

The space available below ground is also critical, a trees root spread influences how well a tree can obtain water and nutrients as well as the anchoring stability of a tree. James Urban, author of *Up by Roots – Healthy Soils and Trees in the Built Environment* recommends an ideal minimum of 20 feet in diameter in soil space around the tree, however in most urban environments this is near impossible (158). A quick and easy tool for determining how much underground space a tree will need is a simple math equation: **the square feet of desired canopy spread multiplied by two is equal to the number of cubic feet required for root space/volume**. Using this formula, you can determine whether or not a site even has enough space for the root system of the size tree you want.

5. Knowing the Site Limitations

Limitations above and below ground have been noted, but what other site limitations need to be considered?

Trees in a park setting

- **Compaction:** In urban areas, compaction is one of the greatest and most common limitations to tree growth. Compacted soils not only make it difficult for roots to penetrate and grow outward, but they also limit the availability of oxygen and water. Testing the compaction of a soil can be as simple as using a shovel to break the surface, or it can be measured more objectively using a tool like a penetrometer, which measures the amount of resistance as you penetrate the soil with its sensor.
- **Alkalinity:** Another factor in urban areas is the soil pH, which is likely to be alkaline. Species such as red maple or white ash do not tolerate alkaline soils well, whereas black maple or bur oak are more tolerant to a high pH. To test pH, you can bring soil samples

to the University of Minnesota Soils Lab (http://soiltest.cfans.umn.edu/), or buy your own soil pH test kit from most garden stores.

- **Drainage:** The percolation rate (drainage) of a soil is another important limiting factor to be aware of in terms of oxygen availability, and it is fairly easy to test. Detailed directions on how to test soil percolation rate can be found on the following website http://www.extension.umn.edu/environment/housing-technology/moisture-management/how-to-run-a-percolation-test/

Different species are better suited to deal with different limitations and conditions, so understanding the preferences of a specific species is very important. The University of Minnesota Extension site has a chart (http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/tough-trees-and-shrubs-for-tough-sites) showing which species are tolerant of common site limitations in Minnesota. The list includes both native and non-native species, with numbers indicating which species are native (bur oak, ironwood, honey locust, etc.).

6. Giving Trees a Head Start

Volunteer planting in Rochester, MN

After having gone through all of the necessary steps of to determine goals for landscape diversity and narrowing down which species is best suited for the site, a tree must be planted correctly. That is, it cannot be buried, as many street and landscape trees often are. To correctly plant a tree the first major root should be at the soil surface, which means any excess soil from the pot or soil ball needs to be removed at planting time. This is also the best time to inspect the root system, and remove any encircling roots, those against the stem of the tree, or in any odd direction that may become problematic later. After planting, trees must be watered for the first year. The soil should be checked once a week, and watered only as needed. Correctly planting a tree and correcting any problem roots early can prevent failure of the tree in the future, as well as reduce future maintenance costs by giving the tree the best growing conditions from the very beginning.

More information on best planting practices can be found on the following website: http://trees.umn.edu/files/2013/07/Best-Planting-Practices.pdf

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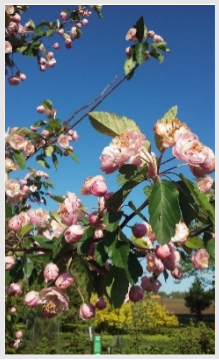
Nursery Research Projects



Flowering crabapple

2016 in the UFore Nursery

Monica Randazzo - Undergraduate Research Assistant, Nursery Manager

In-ground gravel bed after installation of trees

Gravel Beds:

The large, permanent gravel beds of various mixtures (pea-stone, pea-stone and sand, large b-stone) are nearly filled with large and small caliper bare root trees. The pots of gravel mixtures are filled with small caliper bare root trees, and the most recently constructed temporary gravel bed is filled with a variety of trees as well. For the species there are enough duplicates of, we will be inspecting the root systems of the individual bare root trees and how they differ from the root systems of trees of the same species from different gravel mixtures.

In the first few weeks after installing bare root trees in gravel beds, we discovered severe rodent damage on the stems of the trees. Smaller caliper trees were completely browsed off either at the ground line or a few inches above. River birch were the hardest hit by rodent damage, nearly all of the sixty three-foot tall trees were browsed to four or five inches off the ground within just a few days of installation. Chicken wire fencing was quickly put up around the gravel beds holding trees at the time, and small cages were made for potted trees. Small rodents such as the thirteen-lined ground squirrel are still able to crawl through this type of fencing, so for extra reinforcement we regularly spray the trees around the nursery with Liquid Fence, a repellent with a very strong scent that drives deer and rodents away from browsing on plant material. Where there is heavy irrigation, Liquid Fence has to be applied more frequently.

Gravel bed trees after wind loading event in July, 2016

The gravel bed trees also are susceptible to wind throw during weather loading events, particularly the larger caliper trees. Many of the large bare root trees have fairly minimal root systems when they are installed, and their location exposes them to strong winds. Some of the less anchored trees have been staked for extra support, others are buried deeper into the gravel. For a few individuals, they must be moved to a location better suited for wind protection.

Jersey barrier gravel bed

This season a new gravel bed made of jersey barriers and cement bricks was installed beneath a large hackberry and an amur maakia. The jersey barriers are pushed against a row of metal stakes for some support, and filled with water (with room for antifreeze for winter weather) to weigh them down, and mesh is lining the edges to contain the gravel. Gravel and trees were installed on the same day, gravel being dumped in by a skid loader over the roots of trees being held upright by nursery staff. Once enough gravel had been dumped to fill the area as well as cover the roots, the open end of the bed was lined with cement bricks. The bed itself requires a pretty minimal amount of labor, as well as being a potentially temporary installment. The location itself also offers the trees greater protection of weather loading events, the larger trees above and surrounding offer a wind break as well as enough shade to reduce the need of irrigation.

Gravel in Pot:

The most recently installed research project in the nursery is using a space that had been dedicated to similar projects in the past. 72 pots in the ground with various mixtures of gravel or soil control.

The gravel in pot rows in the UFORE Nursery

The research question is how will different mixtures of gravel affect the growth of roots of three different species over a single growing season?

White pine, bur oak, and white oak are the three species being tested. There are also three different gravel mixtures, modeled after those most used in communities throughout Minnesota. 18 pots are filled with 100% pea stone gravel, 18 are filled with 90% pea stone gravel and 10% sand, 18 are filled with 70% pea stone gravel and 30% turface, and the last 18 pots are filled with soil as the control. Each pot is stocked with either 2 or 3 trees, and each tree is assigned a 3-digit ID number corresponding to its location in regards to the row, column, and placement in the pot.

Before planting, the root system of each tree was photographed against a grid and a note of its species and ID number, as is pictured to the right. After this growing season, the trees will be removed from their pots and photographed against the same grid, so that after one season in their given gravel mixture the area covered by the root system by the same tree can be quantified.

The roots of a white pine against grid before installing in pot

Pleached Elms & Precision Organics C20 Application:

About 10 months ago, fourteen 'Valley Forge' American elms were planted at the base of each of the 14 poles that support the large shade house in the northern area of the UFore nursery. The elms were all approximately .75" calipered at the time of planting, with light branching and seven feet tall. They were all harvested from the UFore gravel beds, so they were bare rooted. Each tree was zip-locked to the pole from the ground up, following the curved form of the poles. They are being used for the arboricultural practice called pleaching, a practice which has been popularly used throughout history, and is known to have been used in medieval times. Pleaching creates a natural arc out of trees or shrubs, and in the case of the nursery provides a living shade house.

Pleached elms in UFORE Nursery

Half of these elms have also been included in the testing of a soil amendment, which has greatly increased their growth over this last growing season. They have been treated with C20 from Precision Organics, which increases the soil microbial activity, root growth and proliferation, photosynthesis, and a number of other benefits to plant growth. It is a carbon food source for soil microbial populations, which promotes tree canopy and root health through creating a more productive living soil. Applied on top of the soil surface and below wood mulch, it is to correspond with the root zone size. For a 6" root zone radius a 6" band of C20 is equal to 3lbs of C20.

Less than a year later, the elms have grown a great deal, and many already have branches reaching those of their neighbors. To encourage lateral branching, wires were installed perpendicular to the poles for the branches to be attached to as they grow. The zip locks have to frequently be checked and loosened to avoid girdling the stem of the trees. For any branches that need to grow more perpendicularly, massaging those limbs helps them bend to the wire as

needed. Branches that are not conducive to flexibility may need to be pruned as well, such as codominant leaders. Pleaching is a very time intensive project, particularly with a fast growing species.

Dachplatane example in UFORE Nursery

Dachplatane:

Another example of alternative tree form/pruning in the UFore Nursery is on a honey locust in a corner of the pruning area. Dachplatane is a German pruning practice which creates a single plane within a tree, forming a roof like structure out of a woody tree or shrub. This summer, the structure being used to support the level branches of the tree was expanded to support the lengthening limbs outward.

Another fairly time intensive technique, the structure used to support the young limbs needs to be sturdy enough to also withstand weather and maintenance loading events. In addition, trouble branches must be pruned and small branches must be bent into shape early on.

Low Maintenance Turf Pollinator Plots:

Three squares of flowering turf mixtures

In the northeastern section of the UFore Nursery area there are multiple squares of low-maintenance turf pollinator plants mixed in with the usual turf grass mixture. By increasing the number of flowering plants and biodiversity within a landscape, the quality of habitat for wildlife is increased. The three plants growing within the turf in the UFORE nursery are lanceleaf self-heal (*Prunella vulgaris ssp. Lanceolate*), Dutch white clover (*trifolium repens*), and creeping thyme (*Thymus serpyllum*). Both the lanceleaf self-heal and creeping thyme bloom best when the mowing heights are at or above 3.5 inches above the ground. The University of Minnesota Bee Lab has put in a great deal of research in flowering bee lawns, and more information can be found at http://www.beelab.umn.edu/bees/beelawn.

Nursery String Decomposition Rate Study – www.trees.umn.edu

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July 6, 2015 to August 5, 2016

How long does it take for nursery strings that are using to secure wire baskets to tree trunks, tie up branches or provide any type of support for newly planted trees to decompose to the point where there is no danger of damage to the host trees? A simple question that had not been specifically addressed in an experimentally design study, one with multiple treatments and built-in controls.

In late autumn of 2014, 72 trees, many with multiple stems (aka, clump forms) were planted at the UFore nursery. These 72 trees provided 97 individual tree trunks and represented four different tree genera: Populus (fast growing), Betula (fast but not as fast as Populus), Ginkgo (slow growing) and Pinus (moderate growth rate and a conifer). All trees were grown in #2 smooth plastic containers and were severely pot-bound. All tree root systems were "boxed" to remove any bias from dysfunctional root systems.

The nursery ropes or twines used were selected based on the frequency of their use in wholesale and retail nurseries. Six nursery strings were selected for this study:

1. Bailing Twine – orange, photodegradable resistant
2. 3-ply Jute – natural
3. 3-ply Green Jute – dyed for aesthetics
4. 2-ply Sisal - Copper Naphthenate Treated
5. 1-ply Sisal – natural
6. 3-ply Sisal – natural

2-ply Treated Sisal, 5 months after installation

On July 6, 2015, the various ropes or twines were installed on the surviving trees from the autumn planting. The research design was a randomized block design with 14 replicates per treatment (type of rope or twine). All trees were caliper measured at 15 cm. above ground and at points 2.5 cm above and below the caliper measurement. Each tree then received the rope/twine treatment. The installation was at the caliper measurement point, three wraps of the rope or twine around the stem and secured with a knot.

Observations were made at monthly intervals through November, 2015 and then starting again in April, 2016. "Pull-tests" were made on the ropes/twines to determine if any decomposition had occurred. All pull-tests were conducted by the same researcher. Also noted was whether the rope or twine had become imbedded in the tree trunks (aka, girdling) and whether the trees had died or snapped off in wind-loading events.

Preliminary Results – August 10, 2016

Failure during wind-loading event at point of rope imbedded in trunk. 3-ply untreated sisal, 10 months after installation.

Decomposed Ropes or Twines: 17 treatments: 6 - 3-ply untreated jute, 7 – 3-ply green jute, 1 – 2-ply treated sisal, 3 – 1-ply natural sisal.

Number of Trees with imbedded ropes or twines that are showing some degree of girdling: 72 treatments.

Number of Trees that snapped off at points of rope or twine girdling compression points during wind-loading events: 31

This study will conclude when all ropes and twines have completely decomposed or are completely imbedded with no obvious negative effect on the trees.