Introduction

In the late 1990’s, The Morton Arboretum constructed a permeable parking lot, concurrent with re-construction of the adjacent Meadow Lake. 2 Permeable parking lots have been shown to reduce runoff quantity while improving rainwater runoff. 1,2,3 One aspect of the Arboretum’s permeable lot is its 9’ median bioswales, which utilize shrubs and trees to further filter and purify water. The purpose of this project is to research the health and productivity of trees in these bioswales. Hypotheses addressed include:

1. Bioswale soils are drier and have lower nutrient supply capacities, thus may be more challenging for substrates for trees.
2. Certain tree species may be better suited to the bioswale environment.

Methods

Seven commonly planted urban tree species were selected for this study. Six trees of each species were selected, taking landscape position, relative age, and overall health into account. Three were in the bioswales with three matches elsewhere in collections (minus one tree). In total 41 trees were monitored from mid June to late August of 2014.

Three leaves, one in the shade and two in sunlight, of each tree were assessed once a week with a leaf porometer (SC-1 Leaf Porometer, Decagon Devices, Pullman, WA). Bireural time domain reflectometry-probes were installed to 20 cm depth half between the trunk and the dip line, in the southern quadrant (when possible). These measured soil moisture content once per week from mid June to late August - (6050X1 Tare System, Soil moisture Equipment Corp., Santa Barbara, CA).

On July 1st and 30th, leaf greenness was measured on 10 leaves per tree (SPAD 502 Plus Chlorophyll Meter, Spectrum Technologies, Aurora, IL). Five-core composite soil samples were taken to the 20 cm depth using an Oakland core sampler (2.5 cm in width) on July 15th. Soils were analyzed for gravimetric soil moisture 1, pH in a 1:1 (soil: deionized water) 2, electrical conductivity in a 1:4 (soil: deionized water) 3, and loss on ignition soil organic matter. 4

Results

• The bioswales were shown to contain less moisture, less organic matter, and a more basic pH than the control soils.
• Carpinus caroliniana and Cercis canadensis displayed leaf chlorosis and necrosis in the parking lot. Even further, Cercis canadensis was significantly greener and had a higher stomatal conductance in the control setting.
• Quercus macrocarpa had the highest stomatal conductance out of all species in both settings, parking lot and control.

Conclusions

Both initial hypotheses were confirmed:

1. Bioswale soils were shown to be drier and hold less organic matter than control soils, making them a more challenging substrate for trees.
2. Certain tree species are better suited to living in the bioswale environment.
   • Quercus macrocarpa had significantly higher stomatal conductance than other trees, indicating it is healthy and active at removing soil moisture. Quercus macrocarpa is well suited for urban conditions, and is tolerant of different moisture conditions. 6
   • Carpinus caroliniana and Cercis canadensis were observably healthier in the control setting, indicating they are not well suited for bioswales. Both are understory trees, so poor health in the bioswales may be attributed to too much sunlight or intolerance to dry soil conditions. 5,6

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References

4. Stomatal conductivity in the control setting.
5. Conclusions
6. Quercus macrocarpa had the highest stomatal conductance out of all species in both settings.