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SCHOOL OF ENVIRONMENT NATURAL RESOURCES

A Literature Review of Sustainable Urban Tree Management for Worthington Tree Nursery

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Background

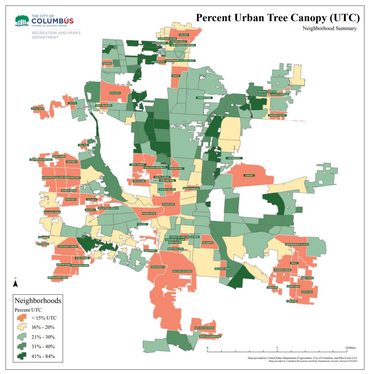

Figure 1. Percent Urban Tree Canopy for Columbus, Ohio

- Urban trees benefits moderating climate change, mitigating runoff, improving air and water quality, conserving energy, reducing the urban heat island effect, etc.
- However, rapid urbanization has decreased urban tree canopy dramatically.
- From 2009 to 2014, 44 states show net urban canopy cover decline, including Ohio, where total tree cover in the urban area has a net loss of 0.36% or 10,180 acres annually (Fig1).
- Reforestation in urban areas can be challenging due to compacted soil, lower nutrient availability, intensive human activities, etc. In Columbus, Ohio, deer browsing is another issue altered urban forest ecosystem health.
- Our study was focused on how to improve irrigation methods, reduce deer browsing issue and recommend tree species to achieve sustainable management for Worthington Tree Nursery Site (fig2).

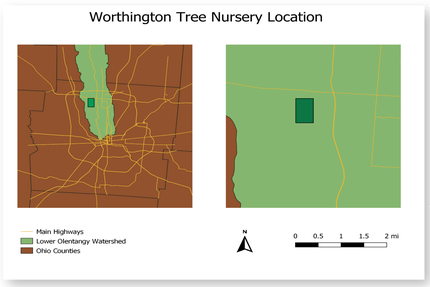

Figure 2. GIS map of Worthington Tree Nursery Location, shown as the dark green rectangle.

Methods

Figure 3. Photo of Worthington Tree Nursery

Site Evaluation

Our study area located at Godown Park in Worthington, Ohio is a 10-acre dog park that contains a tree nursery owned by the Worthington Parks & Recreation Department.

Literature Review & Tree Atlas Analysis

- A literature review was conducted for nursery irrigation, nursery deer browsing by using Scopus and Google Scholar.
- Results of the literature review led to a total of 22 paper for all the topics.
- Using USFS Climate Change Atlas for urban tree summary of Columbus to select the climate-resilient tree species.
- Scoring the selected tree species based on species growing rate, ecological benefits and wildlife values to provide the final tree species recommendations.

Results

Irrigation

Irrigation Method	Usage in Literature	Water Usage Rate	Growth Results
Drip	Most common	Efficient	Shows much growth
Spray Stake	Somewhat common	Most efficient	Shows much growth
Overhead	Common	Efficient	Shows growth
Sprinkler	Common	Not very efficient	Shows growth

Deer browsing

Methods used in the literature	Socially Acceptable from studies in the literature?	Economically Feasible For Worthington Nursery?	Effective at reducing deer herbivory?
Contraceptives/sterilization of deer	Yes	No	No
Deer repellent vegetation	Yes	No	Yes
Natural extracts/ essential oils	Yes	No	Intermediate
Commercial chemical products	Yes	Dependent on brand	Intermediate
Physical exclosures	Yes	No	Yes
Visual deterrents	Yes	No	No
Auditory scare devices	Dependent on type	No	No
Applications of tannins	Yes	Dependent on brand	Yes
Manual removal/hunting	No	No	Yes

Tree species selection

Tree species common name	Climate Adaptability	Growth rate	Ecological benefits	Wildlife benefits	Total
Silver maple	High	3	3	2	8
Sycamore	Medium	3	3	2	8
Honey locust	High	3	3	1	7
Hackberry	High	2	3	1	6
Black walnut	Medium	2	3	1	6

Recommendations

Figure 4. Current irrigation method at Worthington Tree Nursery

Irrigation Systems:

Recommended Irrigation System: Drip Irrigation – controlled irrigation method, which delivers water through tubes, valves, and emitters directly to the root zone. Additionally, less cost and water usage as well.

Figure 5. Current methods to avoid deer drowsing by using tree tubes as protections.

Deer browsing

Recommended method: the combination of planting deer repellent flora and the application of tannins on nursery trees would be the most impactful and socially and economically feasible.

- Recommended herbs to plant to at Worthington Nursery include catmint, chives, lavender, mind, sage, and thyme.
- Recommended trees known to be generally resistant to damaging deer herbivory are spruce, pines, honey locust, river birch, and buckeyes.

Tree species and final recommendations

- We recommended silver maple, sycamore, honey locust, hackberry, and black walnut to be planted at Worthington Tree Nursery site along with a combination of deer repellent flora to avoid deer browsing young trees.
- Deer herbivory can further be reduced by the application of tannins on nursery trees, or by choosing more resistant tree species, honey locust and river birch.
- The recommended irrigation method would be drip irrigation as the most cost-effective one.
- Since the trees will later be transplanted to riverside, it is important to consider trees species with ecological benefits, like prevent soil erosion.
- Suitable tree species must be chosen based on the current and future site conditions, as well as followed by intended proper aftercare, which is related to deer browse and irrigation methods, to achieve the sustainable urban forestry management on Godown Park,

Acknowledgements

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