Determining Minimum Planting Widths for the Small-Stature Trees in Compact Developments

PI: ANDREW KOESER, Gulf Coast REC (GCREC)
Co-PIs: DEB HILBERT (GCREC)
DREW MCLEAN (GCREC)

ABSTRACT

Trees, as part of the larger developed landscape, do a lot of good for the state of Florida. In a recent canopy assessment of Florida's 29 metro- and micropolitan areas, it was determined that the state's urban forests reduce stormwater flow by 50 billion gallons annually. In addition, Florida's urban trees filter 600,000 tons of air pollutants each year, reducing respiratory health care costs in the state by $605 million. Finally, the yearly growth of the state's urban trees captures the same amount of CO2e as is emitted by 15 power plants. While the ecosystem services noted above are most commonly attributed to large-stature tree species such as live oak (Quercus virginiana), many new developments lack the space required to sustain growth while avoiding root conflicts with the built infrastructure. In these situations, small stature trees may be a better option when one considers the balances of ecosystem services and disservices (e.g., concrete lifting or cracking). In this study we measured the diameters of 260 small stature trees to predict trunk flare diameter at the ground level. We found a strong relationship between stem diameter, species, measurement height and our response, trunk flare diameter (R2 = 0.84). Interestingly, we found that the small stature trees tested in this study tended to have larger trunk flare diameters relative to stem diameter compared to our earlier results with shade tree species. Despite this, small stature trees could be planted twice as close to paved surfaces as large stature trees and have the same likelihood of causing damage.

OBJECTIVES

1. Develop an equation that can be used to estimate root space requirements for small stature urban tree species.
2. Determine the minimum allowable planting space for trees typically selected for space-limiting planting conditions.

METHODS

Working with local urban foresters, we located and measured trees in Lakeland, Sarasota, Tampa, Venice, Pinellas County, and Hillsborough County, Florida. We collected data on 42 crapemyrtles (*Lagerstroemia indica*), 28 East Palatka hollies (*Ilex x attenuata*) 29 Geiger trees (*Cordia sebestana*), 26 Japanese privets (*Ligustrum japonicum*), 22 Pink Trumpet trees (*Handroanthus impetiginosus*), 33 Silver-Leafed Golden Trumpet trees (*Tabebuia aurea*), 18 Simpson's stoppers (*Myrcianthes fragrans*), 25 yaupon hollies (*Ilex vomitoria*), and 37 yew plum pines (*Podocarpus macrophyllus*). The trees represented a range of diameters spanning from the newly established to the largest specimens found in the respective locations.

To measure trunk flare diameter, we used flags to delineate the points at which trunk tissue transitioned to root tissue and to guide a measuring tape around the base of the tree in an approximately circular shape (**Figure 1**). We converted the circumference to diameter afterwards. In addition to measuring diameters, we recorded planting space dimensions, tree defects, and infrastructure damage. We also noted characteristics that might influence circumference such as girdling roots or deep plantings. As it is not always possible to measure diameter at breast height (DBH, nominally 4.5 feet), diameter measurements were collected at one of three locations on the tree. If the tree was of sufficient height and pruned to elevate the crown, then diameter was measured at DBH. If the tree's stem split at or below DBH, but the stems merged above ground, then the diameter was measured at caliper height (6 inches). If the tree was multi-stemmed or the pith merged below ground, then the diameter was recorded at the base of the tree, at ground level.

Figure 1. Image of the field method for measuring the circumference of the trunk flare.

RESULTS

Our linear regression model had relatively high predictive power with an adjusted R^2 of 0.84. Species was a significant factor (min *P*-value = 0.04). Similarly, diameter and measurement height were significant predictors of TFD (both *P*-value < 0.001). For practical purposes, a simplified model factoring in just diameter and height of measurement is shown in **Figure 2.**

Diameter Measurement Height	TFD Conversion
DBH (4.5 ft)	Dx*3.7+8.6
Caliper (6 in)	Dx*3.7+1
Ground Level	Dx*3.7

Figure 2. Formulas to predict trunk flare diameter at DBH, Caliper, and Ground Level depending on the form of the tree being measured.

In modelling damage to infrastructure, both stem diameter and distance to hardscape were significant predictors of pavement cracking or lifting. However, including both in the initial model would lead one to drop out given non-significance. As such we adopted a final model with distance to hardscape as the sole predictor as this was the more easily controlled aspect of tree planting and management.

Figure 3 shows how the odds of avoiding hardscape damage increase as spacing increases. In this figure we overlay a similar analysis conducted on large oaks (Quercus spp.) for a previous FNGLA project. As one can see, a small stature tree planted with 100 cm (~3 feet) of spacing is as likely to avoid causing damage to nearby pavement as 200 cm (`6.5 feet) of spacing for a large tree.

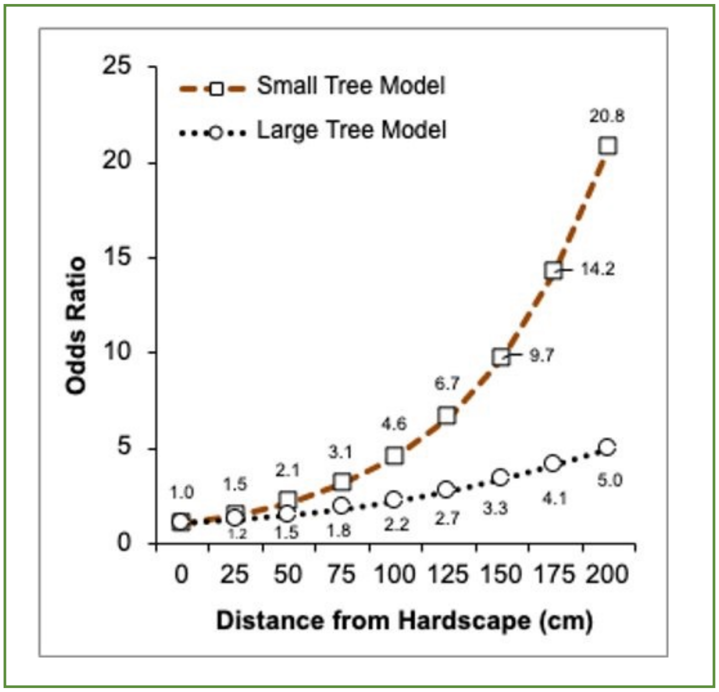

Figure 3. Odds of avoiding hardscape conflicts as the distance between the tree and paved surface increase. For example, a small tree is ~20 times less like to cause damage when 200 cm away from pavement as compared to when the roots are right up against the neighboring hardscape (0 cm).

CONCLUSIONS

Findings from this work are currently being drafted for peer-review. The equations generated will be used to predict TFD for species featured in municipal and county planting lists. As summary table will be published as an EDIS Factsheet and will provide actionable planting space guidelines for practitioners and those mandating tree planting as part of urban development. Future research regarding tree roots and development will investigate the costs and benefits associated with non-traditional construction practices that are less likely to lead to belowground conflict. Additionally, we will be looking into the impacts of root loss, which often results when trees are planted too close to hardscape and repairs are needed to maintain accessibility.