Urban Horticultural Ecology Project

Effects of Commercial Parking lots on Size of Six Landscape Trees

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Introduction

Parking lots are a common urban land use that is dominated by impervious surfaces such as asphalt. Trees are often planted in parking lots to provide shade and improve landscape aesthetics. However, while many different tree species are planted in parking lot medians most are planted for their form and aesthetic attributes without special consideration of their heat stress tolerance. Because of the high absorptive and re-radiative properties of asphalt, it is probable that parking lots have surface and rhizosphere temperature regimes that are elevated to above optimum for normal plant functioning (Kjelgren, 1998). These effects are likely to be amplified during the summer when increased temperatures may have adverse effects on physiological processes such as photosynthesis, transpiration and nitrogen accumulation (Martin, 1989). The objective of this study was to characterize the thermal environment of parking lot medians, as well as evaluate the extent to which parking lot medians affect tree growth in the Phoenix metropolitan area.

Material and Methods

During the summer of 2001, data was collected on six tree species (*Brachychiton populneus, Fraxinus velutina, Pinus canariensis, Pinus halapensis, Prosopis chilensis,* and *Ulmus parvifolia*) at 15 parking lots in the Phoenix metro area. Tree size measurements of canopy diameter, canopy base height, tree height and trunk diameter at breast height (DBH) were recorded on 4-5 trees in parking lot medians and in adjacent perimeter landscape beds to determine the extent to which planting location has affected tree productivity. Canopy volumes were modeled using tree size measurements and standard geometric shape factors: cylinder (*P. canariensis, P. halapensis*), cone (*B. populneus*), and ½ sphere (*F. velutina, P. chilensis, U. parvifolia*). An infrared thermometer (IRT: Oakton InfroPro 3, model 35629-20, Vernon Hills, IL) was used to measure summer mid-day temperatures of ground surfaces underneath canopies of all trees. Temperatures were recorded on asphalt, concrete, pervious (decomposing granite, gravel, soil) and turf surfaces along gradient transects (0.46m, 1.22m, 3.05m, and 7.62m) from the base of each tree in four directions (north, east, south, west).

Results

- Mean percent reduction of tree height in parking lot medians ranged from 12% to 59%, compared to adjacent perimeter landscape beds (Table 1).
- Mean percent reduction of DBH in parking lot medians ranged from 20% to 49%, compared to adjacent perimeter landscape beds (Table 1).
- Mean percent reduction of canopy volume in parking lot medians ranged from 43% to 87%, compared to adjacent perimeter landscape beds (Table 1).
- *P. chilensis* shows no significant reduction in height, DBH or canopy volume (Table 1).
- *P. halapensis* has the highest relative percent reduction in tree size (Table 1).
- Mean summer mid-day asphalt surface temperatures were 12, 15, and 27ºC higher than concrete, pervious and turf surfaces respectively (Table 2).

Table 1. Effects of commercial parking lots on height, diameter at breast height (DBH), and canopy volume of six southwest landscape trees.

Species	Median	Perimeter	Relative Percent Reduction^{x}
Brachychiton populneus			
Height (m)	5.8^{z}a^{y}	7.1a	18
DBH (cm)	19.3b	27.4a	30
Canopy volume (m^3)	26.3a	46.4a	43
Fraxinus velutina			
Height (m)	6.1b	8.9a	32
DBH (cm)	17.8b	30.6a	42
Canopy volume (m^3)	92.7b	317.6a	71
Pinus canariensis			
Height (m)	6.8b	9.6a	28
DBH (cm)	14.0b	21.5a	35
Canopy volume (m^3)	7.4b	17.0a	57
Prosopis chilensis			
Height (m)	6.1a	6.9a	12
DBH (cm)	15.8a	19.7a	20
Canopy volume (m^3)	132.2a	238.0a	44
Pinus halapensis			
Height (m)	6.5b	15.9a	59
DBH (cm)	26.4b	49.0a	46
Canopy volume (m^3)	107.0b	853.3a	87
Ulmus parvifolia			
Height (m)	4.7b	7.9a	41
DBH (cm)	10.8b	21.0a	49
Canopy volume (m^3)	47.7b	277.2a	83

^{x} Relative percent reduction, (perimeter-median)/perimeter x 100.
^{z} Values are treatment means, n=5 *B. populneus*; n=9 perimeter or n=10 median, *F. velutina*; n=5 *P. canariensis*; n=10 *P. chilensis*; n=15 *P. halapensis*; n=27 perimeter or n=33 median *U. parvifolia*.
^{y} Treatment means followed by the same letter within rows are not significantly different, Fisher's LSD test, α =0.05.

Table 2. Mean summer 2001 mid-day temperatures of ground surfaces in commercial parking lots around six southwest landscape trees.

Ground Surface	Temperature (ºC)
Asphalt	59.4^{z}a^{y}
Concrete	47.5b
Pervious	44.1c
Turf	32.8d

^{z} Values are means, n=319 asphalt, n=25 concrete, n=558 pervious, n=58 turf.
^{y} Means followed by the same letter within a column are not significantly different, Fisher's LSD test, α = 0.05.

Pinus halapensis a parking lot median and adjacent perimeter landscape bed.

Brachychiton populneus in parking lot medians

Conclusions

These data suggest, for most tree species, median planting location has a negative effect on tree growth. One factor that may have contributed to this reduction in tree growth is supraoptimal ground surface temperatures around medians.

Literature Cited

Kjelgren, R. and Montague, T. (1998) Urban tree transpiration over turf and asphalt surfaces. Atmospheric Environment 32(1):35-41.

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