Irrigation volume and pruning frequency affect water use efficiency of two southwest landscape shrubs

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Introduction

The principle ecological service provided by landscape plants is to visually enhance the environment surrounding human activity. Drip irrigation of amenity landscape plants to maintain vigor and aesthetic quality is common in Southwest cities like Phoenix, even though the general public is increasingly concerned about the viability of long-term fresh water resources. In response to this concern, recent regional landscaping trends include the use of desert or drought-adapted plants in low water use or xeric landscape planting designs. Paradoxically, these xeric planting designs often consist of excessively dense plantings that are over irrigated and frequently pruned in order to promote a lush yet neat landscape appearance. We hypothesized that increased irrigation volume and pruning frequency might have a negative impact on water use efficiency (WUE) of drought-adapted shrubs in amenity landscapes. Data presented here convey results from the first year of an intensive, long-term field study of the effects of maintenance practices on amenity landscape performance and ecological function.

Materials and Methods

During May, 1999, we established 14-100 m^2 landscape plots, each planted with six clones of two common southwest landscape shrubs, *Nerium oleander* 'Sister Agnes' (oleander) and *Leucophyllum frutescens* var. green cloud (Texas sage) (Figure 1). For six months after transplanting, plants in all plots received similar irrigation volumes, after which a 2x3 factorial treatment of irrigation volume (high or low volume) and shrub pruning frequency (every 6 weeks, 6 months, or unpruned) was established. High volume irrigation treatment plots received twice as much water as the low volume plots, with volume applied to each ramped seasonally and based on typical high and low volume application rates measured in local residential landscapes (Martin and Stabler, 2001). Volume of water applied to each plot was monitored using Precision® totalizing water meters. Within each irrigation treatment, shrubs in 2 plots were pruned every 6 weeks, 2 plots were pruned every 6 months, and 3 plots were left unpruned. Biovolume (height x north/south width x east/west width) of all shrubs was measured every 3 months and before and after each pruning event. All pruned material removed was dried in a 60° C convection oven for 5 days and dry weights recorded. After one year, 12 unpruned control plants of each species and irrigation treatment were harvested to determine allometric relationships between standing biovolume and biomass. Standing biomass of remaining shrubs was estimated based on those relationships. Total biomass production was calculated as estimated standing biomass plus all biomass removed during the course of the year. Plant WUE was calculated as the ratio of total biomass production to total volume of irrigation water applied for one year.

Results

1. The average volume of irrigation water applied was 2505 and 963 liters/shrub for high and low volume treatments, respectively.

2. When given high irrigation volumes, both oleanders left unpruned and those pruned infrequently produced about 1.7 times more shoot mass than did oleanders that were frequently pruned (Table 1).

3. When given low irrigation volumes, unpruned oleanders produced about 1.5 times more shoot mass than did oleanders that were either frequently or infrequently pruned (Table 1).

4. Texas sage given high volumes of water produced about 1.5 times more shoot mass than for those given low irrigation volumes (Table 1).

5. Texas sage left unpruned produced about 1.5 times more total shoot mass than for those that were either infrequently or frequently pruned (Table 1).

6. For the high volume irrigation treatment, WUE of all shrubs left unpruned or pruned infrequently was about 2.0 or 1.6 times greater, respectively, than for all shrubs pruned frequently (Fig. 2).

7. For the low volume irrigation treatment, WUE of all shrubs left unpruned was about 2.1 or 2.2 times greater than for all shrubs pruned frequently or infrequently (Fig. 2).

Table 1. Interactive effects of drip irrigation volume and pruning frequency on total shoot mass produced by *Nerium oleander* 'Sister Agnes" (oleander) and main effects on *Leucophyllum frutescens* var. green cloud (Texas sage) during one year.

		Total shoot mass (kg)
Oleander		
Irrigation Volume	Pruning Frequency	
High		
	6-week	1.43b
	6-month	2.38a
	Control	2.48a
Low		
	6-week	0.98b
	6-month	1.13b
	Control	2.12a
Texas sage		
Irrigation Volume		
High		1.01a
Low		0.68b
Pruning Frequency		
6-week		0.58b
6-month		0. 65b
Unpruned control		1.16a

[z]Values are treatment means and those followed by the same letter are not significantly different by Duncan's Multiple Range Test at α=0.05. For irrigation treatments, n=42 for each species at each level. For pruning treatments, n=36 for each species for controls, n=24 for each species for 6-month and 6-week treatments.

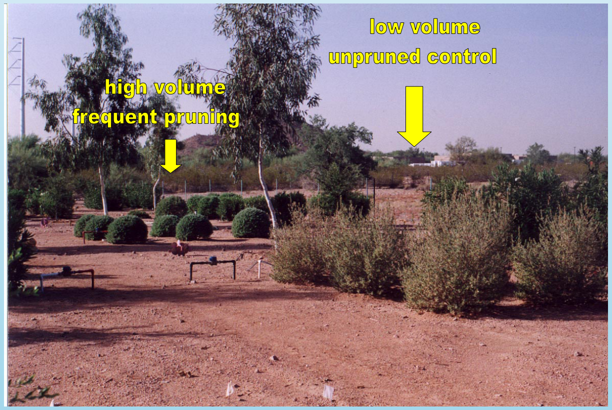

Figure 1. Example experimental plots. Shrubs in the foreground are low volume irrigation, unpruned control Texas sage (high WUE), and those in the background are Texas sage given high irrigation volume and pruned every six weeks (low WUE).

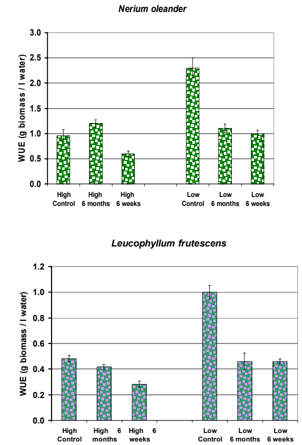

Figure 2. Interactive effects of irrigation volume and pruning frequency on WUE of *Nerium oleander* 'Sister Agnes' (oleander) and *Leucophyllum frutescens* var. green cloud (Texas sage).

Discussion

Though plants given the lower volumes of water did not grow as much as those given the higher volumes, these shrubs also showed no symptoms of drought stress or unacceptable appearance. Our data suggest that irrigation requirements of shrubs like oleander and Texas sage might be considerably lower than the amounts typically applied by local homeowners (Martin and Stabler, 2001). Rather than frequently pruning these shrubs, irrigation scheduling might be more appropriately managed to control shrub size and allow a more natural form requiring less maintenance while increasing WUE in drip-irrigated landscapes. Our data provide evidence that the interaction of over irrigation and frequent pruning can lower WUE, suggesting that landscape management practices observed in Southwest cities like Phoenix might not be as water conservative as intended.

References

Martin, C.A. and L.B. Stabler (2002). Plant gas exchange and water status in urban desert landscapes. Journal of Arid Environments (in press).