Growth of Two Landscape Shrubs Following Severe Pruning: Evidence of a Hysteretic Effect of Former Irrigation and Pruning Practices

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INTRODUCTION

One important characteristic shared by many plants is the ability to regenerate aboveground biomass (such as stems and leaves) that have been lost as a result of a defoliation event, such as herbivory or fire (Herms and Mattson 1992). This regeneration is made possible through the metabolism of stored carbon and nutrient reserves from undamaged parts of the the plant, usually from belowground parts such as roots or tubers. However, the size of these stores can vary between plants, even within a species. This variation is often a result of site-specific resource availability. However, several studies have shown that repeated defoliation events can greatly reduce the amount of carbon and nutrient stored within the plant as a result of the continual need to regenerate growth (Avice et al, 1997).

In the southwest United States, contemporary urban spaces for landscape plantings are extremely limited in size. These urban spaces are often landscaped using design schemes that include excessively close spacing of desert and desert-adapted plants, which are subsequently chronically over irrigated to encourage lush growth and frequently sheared to control their size (Martin and Stabler, 2003). In time, frequently sheared plants are often cut down to the ground, in order to stimulate more attractive new growth, and rejuvenate the plant. Called severe renewal pruning (SRP), this practice is stressful, and the rate growth after SRP might be related to the amount of carbon and nutrients stored within plant root systems. The objective of this research was to determine if former irrigation and pruning practices affect growth rates following SRP of two regionally common landscape shrubs following severe pruning.

MATERIALS AND METHODS

Two shrub taxa, ***Leucophyllum frutescens*** var. green cloud, and ***Nerium oleander*** 'Sister Agnes' were grown from May 1999 until March 2003 in a factorial matrix of two drip irrigation rates (high and low) and four pruning frequencies (every 6 weeks, every 6 months, once yearly and unpruned control) (Stabler, 2003).

In April 2003, all shrubs were subjected to SRP. Subsequently all pruning treatments were stopped, but irrigation treatments were maintained. Every 14 days following SRP, measurements of height, along with canopy spread in 2 diameters (N-S and E-W) were recorded until 196 days after SRP (DAP).

Size measurements were used to calculate plant volume, based on geometric formulas for each plant. ***L. frutescens*** was treated as a truncated sphere, and ***N. oleander*** was treated as an upright cylinder (Fig. 1). Time trend analyses of volume increases as a measure of growth rate after SRP were then analyzed for a hysteretic effect of former irrigation and pruning practices using JMP 5.0.1 (SAS Institute).

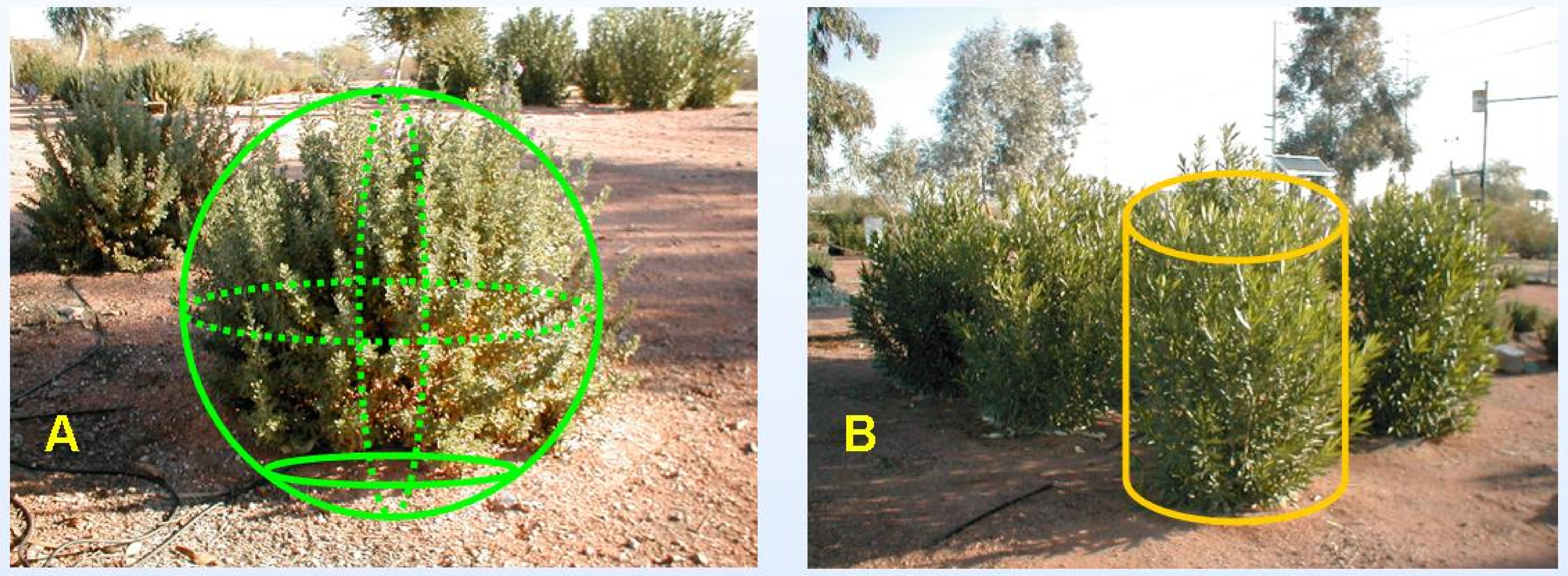

Figure 1 - Individual shrubs of *Leucophyllum frutescens* (A) and *Nerium oleander* (B) showing how volume of plant can be described using basic geometric shapes.

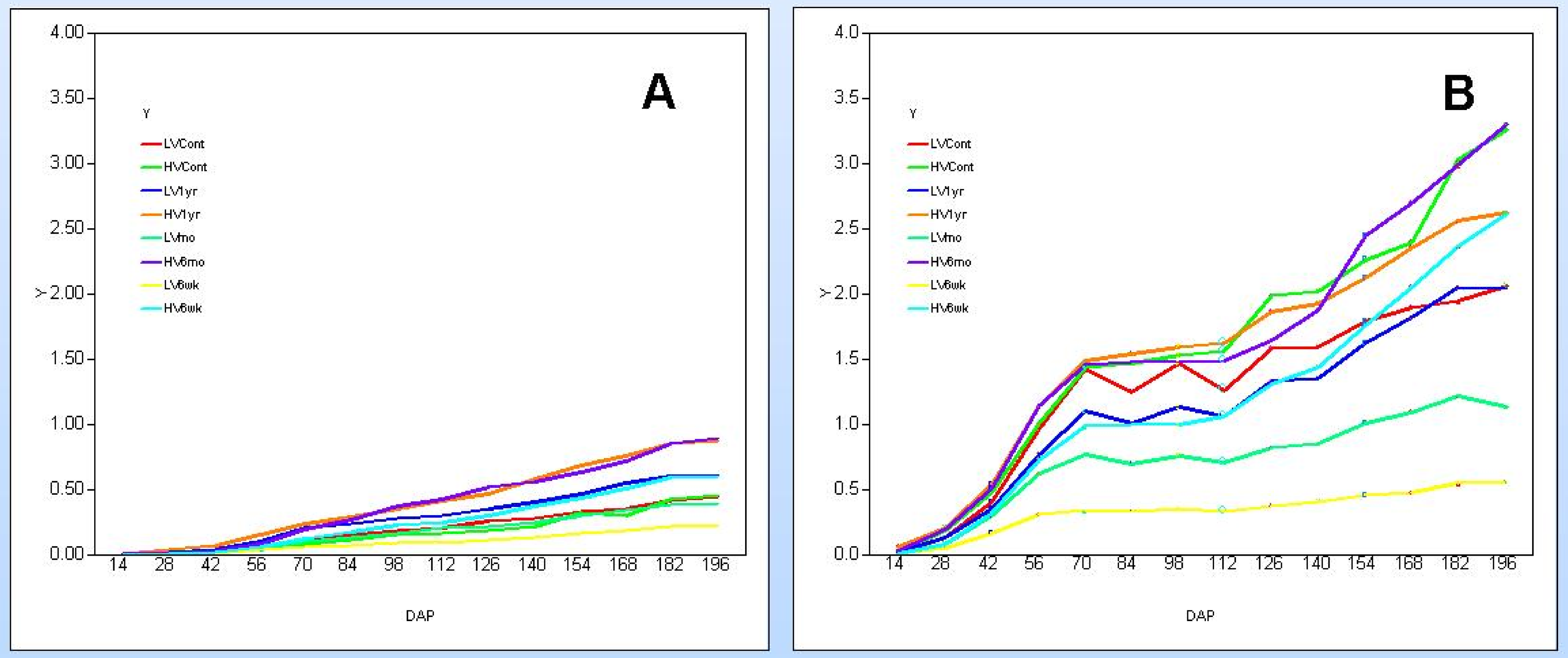

Figure 2 - Line graphs showing trends in calculated plant volumes for each irrigation* prune combination, measured every 14 DAP of (A) *Leucophyllum frutescens and* (B) *Nerium oleander*

Table 1. Treatment contrasts for time*irrigation*prune interaction in *L. frutescens*, using Repeated Measures Analysis. All contrasts are made using F-tests and corrected using the Greenhouse Geyer Episilon value of 0.0986179, num DF = 1.282, den DF=93.588

Treatment Contrast	Exact F	P>F
HV6wk vs. HVC	6.4176	0.0080
HV6mo vs. HVC	10.1451	0.0008
HV6wk vs. HV6mo	6.7979	0.0063
LVC vs. HV1yr	6.6521	0.0069
LVC vs. HV6mo	8.3682	0.0024
LV1yr vs HV6mo	6.6480	0.0069
LV6mo vs. HV6mo	12.3161	0.0002
LV6wk vs. HV1yr	5.7319	0.0124
LV6wk vs. HV6mo	24.0179	<0.0001
LV6wk vs. HV6wk	9.9165	0.0009
LV6wk vs. LV1yr	6.5517	0.0073

Table 2. Treatment contrasts for time*irrigation*prune interaction in *N. oleander*, using Repeated Measures Analysis. All contrasts are made using F-tests and corrected using the Greenhouse Geyer Episilon value of 0.0993028, num DF = 1.2909, den DF=96.82

Treatment Contrast	Exact F	P>F
HV6wk vs. HVC	5.6969	0.0124
HV6wk vs. HV1yr	8.4762	0.0022
HV6wk vs. HV6mo	3.7429	0.0454
LVC vs. HVC	5.2092	0.0170
LVC vs. HV1yr	6.7393	0.0064
LVC vs. HV6mo	12.5109	0.0002
LVC vs. HV6wk	16.6959	<0.0001
LV1yr vs. HV6wk	4.4410	0.0346
LV1yr vs. LVC	9.6750	0.0010
LV6mo vs. HV6wk	3.8119	0.0433
LV6mo vs. LVC	7.4936	0.0040
LV6wk vs. HV6wk	5.9020	0.0109
LV6wk vs. LVC	5.1025	0.0183

RESULTS

- For *Nerium oleander*, there were significant differences in the growth response over time for each irrigation*prune treatment (G-G ε = 0.0993028, approx F = 3.9140, num DF = 3.8728, den DF = 96.82, P>F=0.0069).
- For *Leucophyllum frutescens*, there were significant differences in the growth response over time for each irrigation*prune treatment (G-G ε = 0.0986179, approx F = 2.5674, num DF = 3.8461, den DF = 993.588, P>F=0.0452).
- For both shrubs, the largest plant volumes at the end of the study period were found in the high rate, 6 month pruning treatments.
- For both shrubs, the smallest plant volumes at the end of the study period were found in the low rate, 6 week pruning treatments.

CONCLUSIONS

- These data indicate that at low irrigation rates, frequent pruning can lead to decreased regeneration potential.
- Our preliminary studies have shown that in *Nerium oleander*, leaf area was significantly reduced at high pruning frequencies. (unpublished data). When exhaustion of reserves is coupled with reduced leaf area for light capture, regrowth potential of frequently pruned shrubs is likely severely limited
- Frequently pruned plants likely have smaller root systems, and may be unable to acquire the resources necessary for rapid regrowth, especially in dry soil where nutrient availability is likely limiting

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Acknowledgments

This research was funded in part by the NSF CAP LTER grant no. DEB-9714833 and the International Society of Arboriculture.

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