Leaf Morphological Plasticity of Two Landscape Shrub Taxa in Response to a Change in Shrub Pruning Practices.

Darin K. Mahkee and Chris A. Martin
Department of Applied Biological Sciences, Arizona State University East
7001 East Williams Field Road, Mesa, Arizona, USA 85212

INTRODUCTION

Plant adaptations to various environmental conditions are often related to the morphology of leaves. For instance, reduced leaf area and increased thickness can be beneficial to plants in dry climates, by reducing leaf area for water loss. In addition, plants growing in nutrient limited environments can benefit from tougher, thicker leaves, which live longer, allowing for maximal carbon gain with limited resources. As a result, plants with thicker, tougher leaves may be more efficient in their use of water and nutrient resources (Aerts, 1995).

Different aspects of leaf morphology, such as lamina surface area and thickness, can show different levels of plasticity in response to a change in an environmental condition. This plasticity may be related to the plant's adaptation to environmental conditions before the change event.

In the urban southwest, landscapes are often managed in ways that necessitate frequent pruning (Stabler and Martin 2003). Over time, shrubs maintained in such a manner can become unattractive. As a result, pruning strategies of landscape shrubs are sometimes changed suddenly, as in the case of severe renewal pruning (SRP) to rejuvenate shrub vigor and enhance plant appearance. The purpose of this study was to determine if there was a change in leaf morphological plasticity, in response to a sudden change in pruning frequency, in two regionally common landscape shrubs with disparate leaf types.

MATERIALS AND METHODS

We measured the leaves of two landscape shrub taxa, *Leucophyllum frutescens* var. green cloud, and *Nerium oleander* 'Sister Agnes,' growing in fourteen 4-year old established landscape plots in Phoenix, Arizona Replicate plantings of both shrub taxa were grown from May 1999 to April 2003, under a factorial combination of two irrigation rates (high or low) and four pruning frequencies (every six weeks, six months, once yearly or unpruned) (Stabler 2003). In April 2003, all shrubs were severely pruned to ground level, and allowed to grow back for an additional six months without pruning

For each taxon x treatment combination, we randomly sampled 50 leaves, six months before and six months after SRP. These leaves were placed in plastic bags, and kept cool until the sampling for that day was complete. The leaves were then taken back to the laboratory, where the fresh mass and leaf area (LA) of each individual leaf was measured and recorded. After measurement of fresh mass and leaf area, each leaf was then placed in a labeled envelope, and placed in a drying oven set at 60°C for at least 48 hours. After drying was complete, the dry mass (LM) of each leaf was measured again, and recorded as well. The specific leaf mass (SLM) was then calculated as the ratio of leaf dry mass to leaf area (LM/LA). Values for SLM and LA were then analyzed using JMP 5.0.1 (SAS Institute)

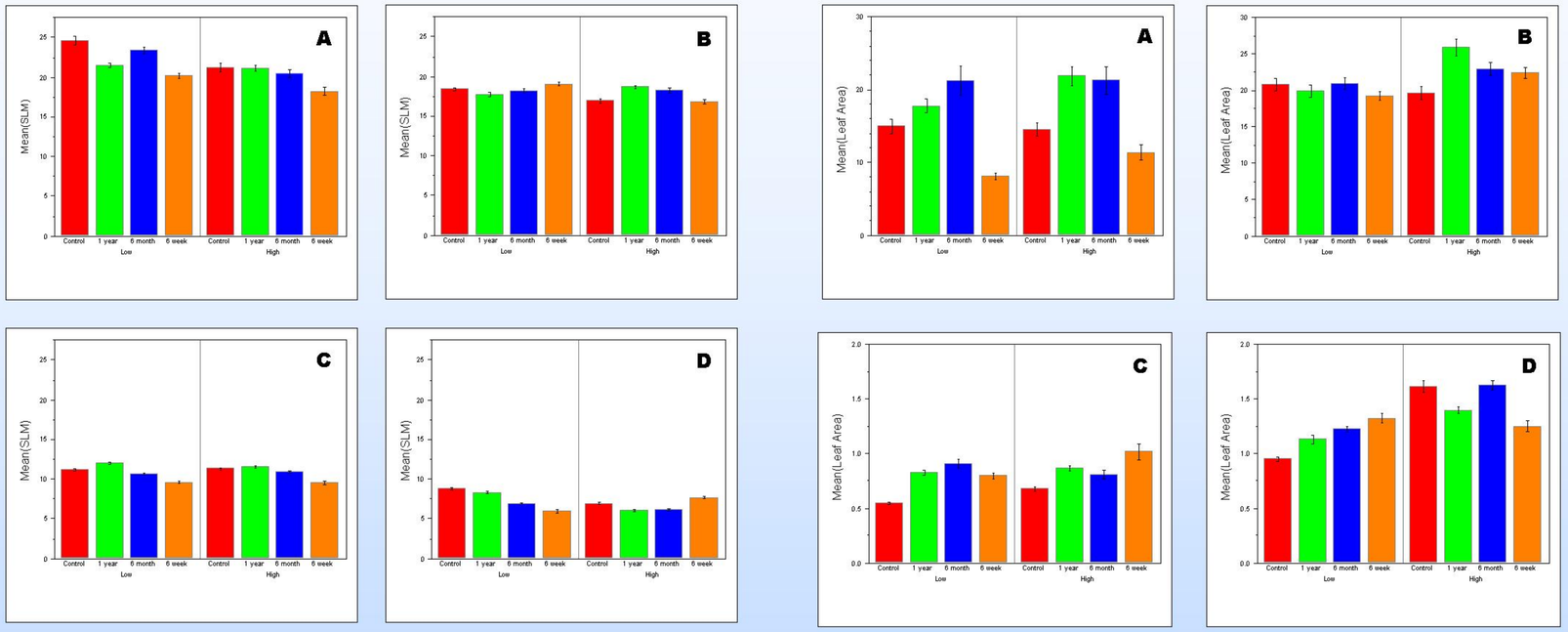

Figure 1A-D Relationships between irrigation volume, pruning treatment and specific leaf mass (SLM) for shrub taxa. **A.** SLM of *Nerium* by irrigation and pruning treatment ***before*** SRP. **B**. SLM of *Nerium* by irrigation and pruning treatment ***after*** SRP. **C.** SLM of *Leucophyllum* by irrigation and pruning treatment ***before*** SRP. **D**. SLM of *Leucophyllum* by irrigation and pruning treatment ***after*** SRP.

Figure 2A-D Relationships between irrigation volume, pruning treatment andLeaf area (LA) for shrub taxa. **A.** LA of *Nerium* by irrigation and pruning treatment ***before*** SRP. **B**. LA of *Nerium* by irrigation and pruning treatment ***after*** SRP. **C.** LA of *Leucophyllum* by irrigation and pruning treatment ***before*** SRP. **D**. LA of *Leucophyllum* by irrigation and pruning treatment ***after*** SRP.

RESULTS

- Before SRP, *Leucophyllum* SLM was affected by only by pruning (P>F <0.0001), while *Nerium* SLM was affected by an interaction of irrigation and pruning frequency (P>F 0.0043).
- Before SRP, *Nerium* shrubs pruned every 6 weeks showed large decreases in leaf area (LA) compared to other pruning treatments (Figure 2A).
- After SRP, SLM of both taxa was affected by an interaction of irrigation volume and previous pruning frequency (both taxa P>F <0.0001)
- SLM of *Leucophyllum* was more responsive to SRP than SLM of *Nerium*
- After SRP, LA of *Nerium* shrubs previously pruned every 6 weeks were comparable to the other pruning treatments (Figure 2B)

CONCLUSIONS

- *Leucophyllum frutescens* showed a greater range of SLM in after SRP than *Nerium oleander*, suggesting that it's leaf morphological plasticity is more responsive to SRP than that of *Nerium oleander*
- Shrubs of *Nerium oleander* pruned every 6 weeks had larger leaf areas after SRP than before SRP.
- SLM and LA in *Nerium* after SRP was comparable across all groups, suggesting that Nerium responds similarly to SRP, regardless of past pruning frequencies.

REFERENCES

Aerts, Rien. 1995. The advantages of being evergreen. *Trends in Ecology and Evolution* 10:402-407
Stabler, LB and CA Martin. 2003. Irrigation and pruning affect growth and water use efficiency of two desert-adapted shrubs. *Acta Horticulturae* (in press)
Stabler, LB. 2003. Ecosystem response of urban plants in response to landscape management. PhD Dissertation, Arizona State University.

Acknowledgments
This research was funded in part by the NSF CAP LTER grant no. DEB-9714833 and the International Society of Arboriculture.
Learn more about research in the Urban Horticultural Ecology Lab at http://cactus.east.asu.edu/~cmartin/martinlab.html