Leaf morphology of four landscape taxa in response to irrigation volume and pruning frequency

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INTRODUCTION

One indicator of a plants ability to tolerate stress is it's specific leaf mass (SLM), which is the ratio of dry mass per unit leaf area. Leaves with a high SLM are often thick and tough, which can help minimize water loss for plants growing in dry climates. In addition, a high SLM may be advantageous to plants growing in nutrient poor or nutrient limited environments, by increasing the lifespan of leaves, allowing for maximal carbon gain with limited resources. Plants with a high SLM can be more efficient in the use of both water and nutrients, which may allow them to tolerate stress better than plants with a low SLM.

In some landscapes, many plants are pruned quite frequently, as often as every 6 weeks. This removal of biomass affects the plant because it removes photosynthetic tissue, and any nutrients within that tissue. In addition, the removal of leaves and stems exposes inner leaves and stems to more intense sunlight than before. These types of effects may result in changes in the leaf morphology of new leaf growth, in order to compensate for nutritional losses, or higher light availability. These changes may affect the plants ability to tolerate stress, and the efficiency of their use of resources, such as water and nutrients.

MATERIALS AND METHODS

We measured the leaves of four landscape taxa, two shrub taxa (*Leucophyllum frutescens* var. green cloud, and *Nerium oleander* 'Sister Agnes'), and two tree taxa (*Eucalyptus microtheca* 'Blue Ghost' and *Quercus virginiana* 'Heritage') growing in fourteen 4-year old established landscape plots in Phoenix, Arizona (Stabler and Martin 2003). Tree taxa in each plot were subjected to either a high or low irrigation rate, whereas shrub taxa in each plot were subjected to a single combination of a factorial of two irrigation rates (high or low) and four pruning treatments (every six weeks, every six months, once yearly, unpruned).

For each taxon x treatment combination, we randomly sampled 50 leaves. 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 of each individual leaf was measured and recorded. All measurements were made within 3 hours of collection. 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 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)

RESULTS

- SLM for *Nerium* was affected by an interaction of irrigation and pruning (P>F 0.0004) (Figure 2A)
- *Nerium* shrubs pruned every 6 weeks showed large decreases in LA (Figures 1 and 2B)
- Specific leaf mass (SLM) of *Leucophyllum* was affected only by pruning (P>F 0.0001) (Figure 2C)
- For *Leucophyllum*, pruning resulted in increases in LA (Figure 2D).
- SLM of *Eucalyptus* was not affected by irrigation rate (P>F 0.6805) (Figure 3A)
- SLM of *Quercus* was higher for trees grown at high irrigation volume than trees grown under low irrigation volume (P>F 0.0001) (Figure 3C)

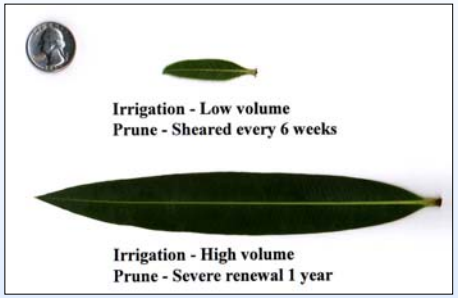

Figure 1 Comparison of leaves of *Nerium* showing two extremes in leaf area.

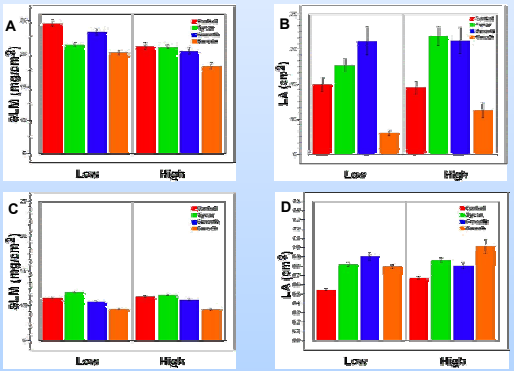

Figure 2A-D Relationships between irrigation volume, pruning treatment and specific leaf area (SLM) and leaf area (LA) for shrub taxa. **A** SLM of *Nerium* by irrigation and pruning treatment. **B** LA of *Nerium* by irrigation volume and pruning treatment. **C** SLM of *Leucophyllum* by irrigation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

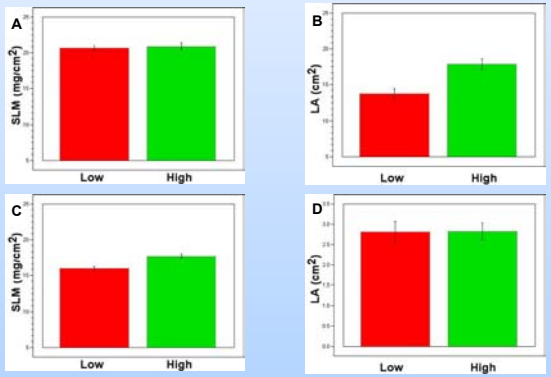

Figure 3A-D Relationships between irrigation volume and specific leaf area (SLM) and leaf area (LA) for tree taxa. **A** SLM of *Eucalyptus* by irrigation volume. **B** LA of *Eucalyptus* by irrigation volume. **C** SLM of *Quercus* by irrigation volume. **D** LA of *Quercus* by irrigation volume

CONCLUSIONS

- *Leucophyllum frutescens* shows a decrease in SLM in response to pruning, while increasing LA, suggesting that pruned *Leucophyllum* may be trying to regain carbon lost though pruning, by producing larger leaves to maximize photosynthesis.
- The large decrease in LA in *Nerium* pruned every 6 weeks suggests that pruning at that frequency may greatly affect the ability to regenerate new growth, possibly through the exhaustion of carbon and nutrient reserves in the plant. The extreme reduction in leaf size may also be a result of hormonal changes produced by the continual removal of apical meristems.

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