Physiological and morphological responses of pampas grass (*Cortaderia selloana*) to variations in water table and soil nitrogen content

Joanna L Kroon and George L Vourlitis
Background

- Once-popular landscape plant that is native to Argentina, Brazil, and Uruguay.
- Escaped and become invasive in sandy coastal regions in southern California.
- Large plants can create dense thickets, outcompete native seedlings, and create a fire hazard.
- Grows rapidly in relatively infertile soil.
Invasion and global change?

**Climate change**: Future warming and drying (Lobell et al., 2006).

**Atmospheric change**: N-deposition significantly enriches N availability of chaparral and coastal sage scrub soil (Vourlitis & Zorba, 2007; Vourlitis et al., 2007a & b). Additional enrichment is expected (Tonneson et al., 2007).
Objectives

Assess the importance of soil N and water availability on the growth and physiology of C. selloana juveniles including:

• Water use
• Leaf gas exchange
• Above-ground live and dead biomass production.
• Below-ground biomass production
• Biomass allocation (R:S ratio)
• Plant height/width
• Leaf area development
• Tissue N and P content
Methods

• Juvenile *C. selloana* individuals were obtained from a local nursery.

• Individuals had 2-4 leaves/plant, ca. 8 cm tall.

• Grown in the CSUSM greenhouse for 6 months in tree-pots filled with riverbed sand.
Plants were exposed to a fully-random, 2 x 3 factorial design with N and water table depth as fixed-effects.

**Added N**: 0, 5, and 10 ugN/g dry soil added as granular NH$_4$NO$_3$ applied once at the beginning of the 6 month experiment.

**Water table**: 10 and 30 cm below the soil surface.

n = 13 plants per treatment combination

Significant treatment effects on response variables were assessed using either repeated measures ANOVA or MANOVA.
Results: Growth

- N-availability and water table depth significantly increased plant height and tiller production, and there was a significant N*W interaction.
Results:

Biomass production

- N-availability significantly increased biomass production. However, addition rates > 5ugN/g failed to increase biomass production.
- Water table depth did not significantly affect biomass production.
Results: Biomass allocation

- N-availability caused a significant increase in biomass allocation to above-ground tissues. However, addition rates > 5ugN/g failed to increase biomass production.
- Water table depth did not significantly affect biomass allocation.
Results: Total water use

- N- availability and water table depth significantly increased total water use.
Results: Tissue N and P

- N- availability significantly increased tissue N but significantly decreased tissue P.
- Water table depth did not significantly affect tissue N and P.
Results: Tissue N and P

- An increase in N-availability lead to P-limitation.
- Water table depth did not significantly affect tissue N:P ratio.
Conclusions

• Experimental increases in N availability stimulated biomass production, biomass allocation to above-ground tissues, growth and tiller production, and water use.

• Most of the N-induced growth increases were observed between the 0 and 5 ugN/g treatment levels, indicating possible limitations by other non-N resources.

• Water table depth significantly affected water use, growth, and tiller production, but was less important for the growth and physiology of C. selloana juveniles than N availability.
Implications

Relatively small increases in N deposition will likely increase the growth, survivorship, and invasiveness of *C. selloana*; however, P (or other) limitation may reduce the N-induced stimulation.

- Enhanced water use and the potential to exacerbate drought stress for native flora.

- Increased shading of native seedlings.

- Increase sequestration of available nutrients.

While future warming and drying in response to climate change may limit the growth and physiology of *C. selloana*, these limitations may be compensated if accompanied by even modest N-enrichment.