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

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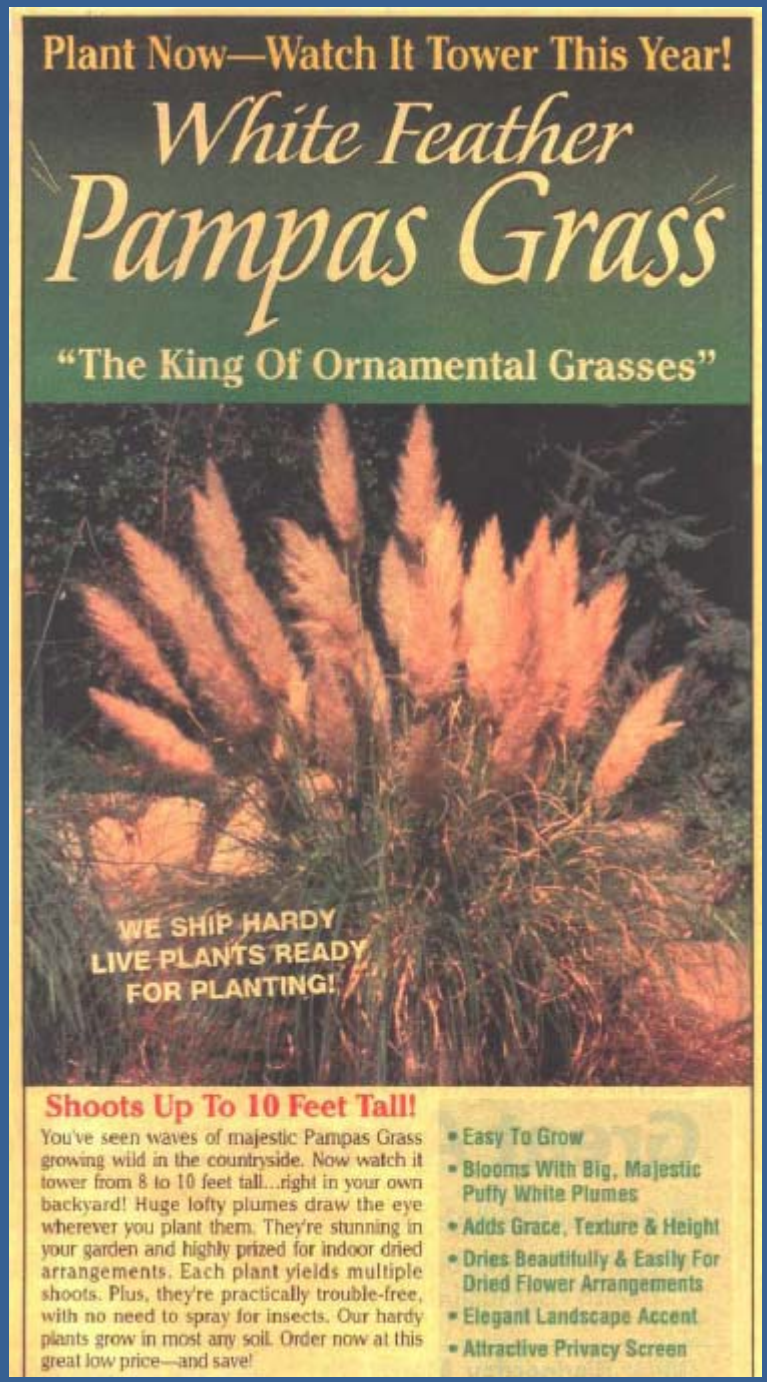
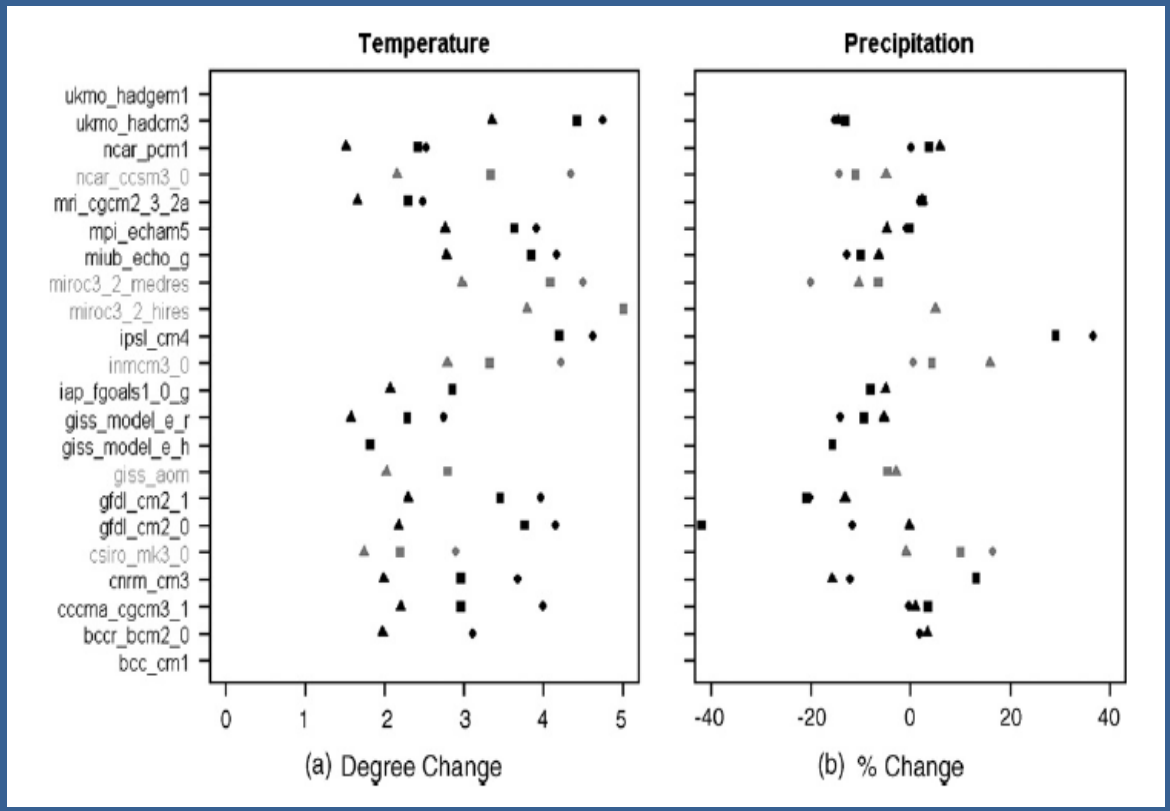


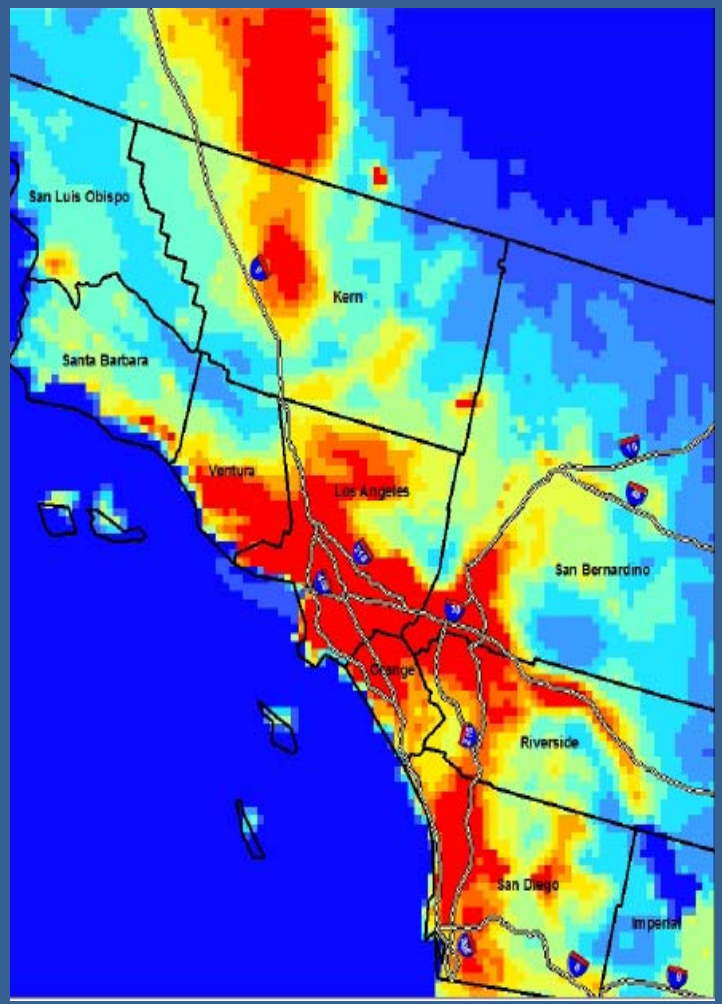
Background

- 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.

Experiment layout

Low water table (30 cm)

High water table (10 cm)

Plants were exposed to a fully-random, 2 x 3 factorial design with N and water table depth as fixed-effects.

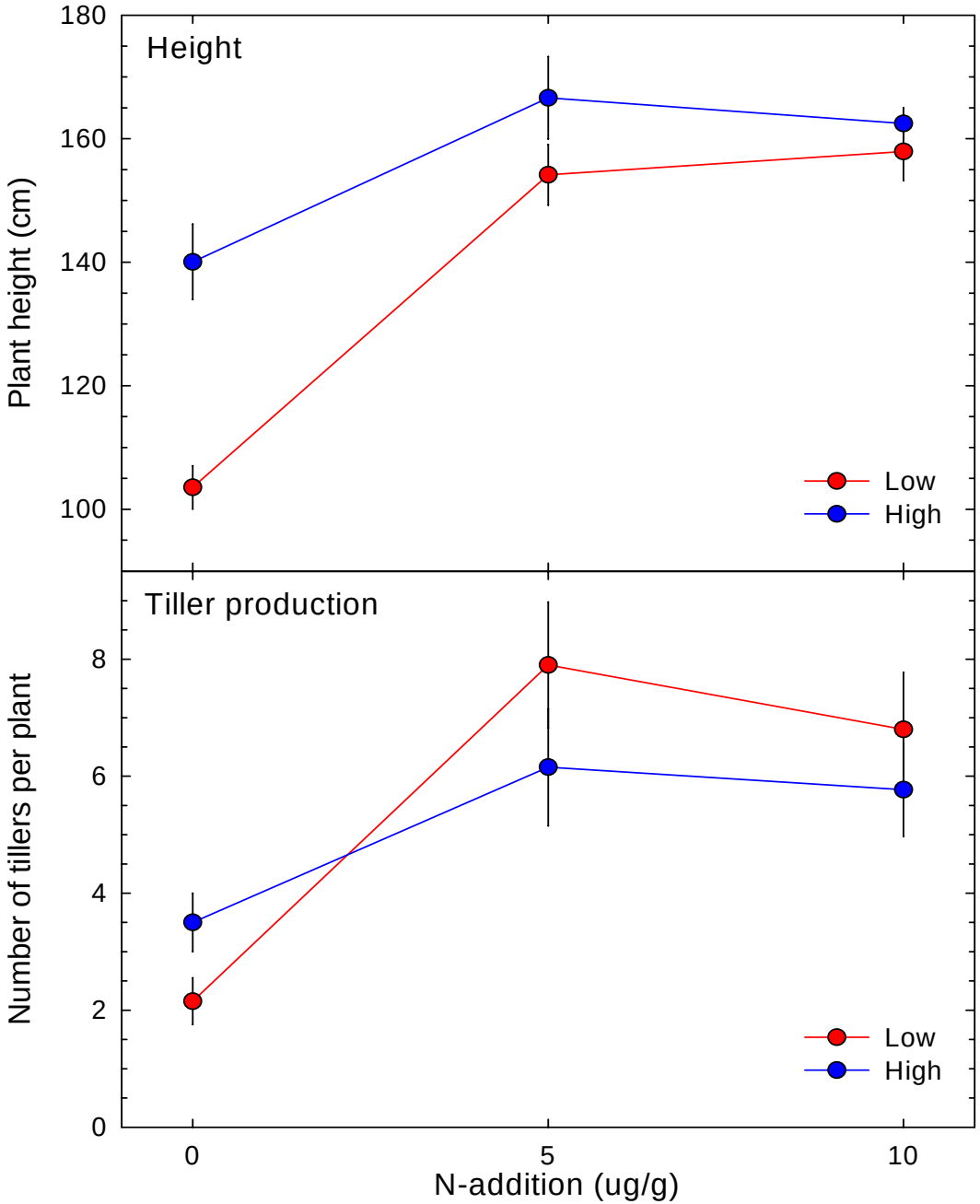
Added N: 0, 5, and 10 ugN/g dry soil added as granular NH_4NO_3 applied once at the beginning of the 6 month experiment.

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

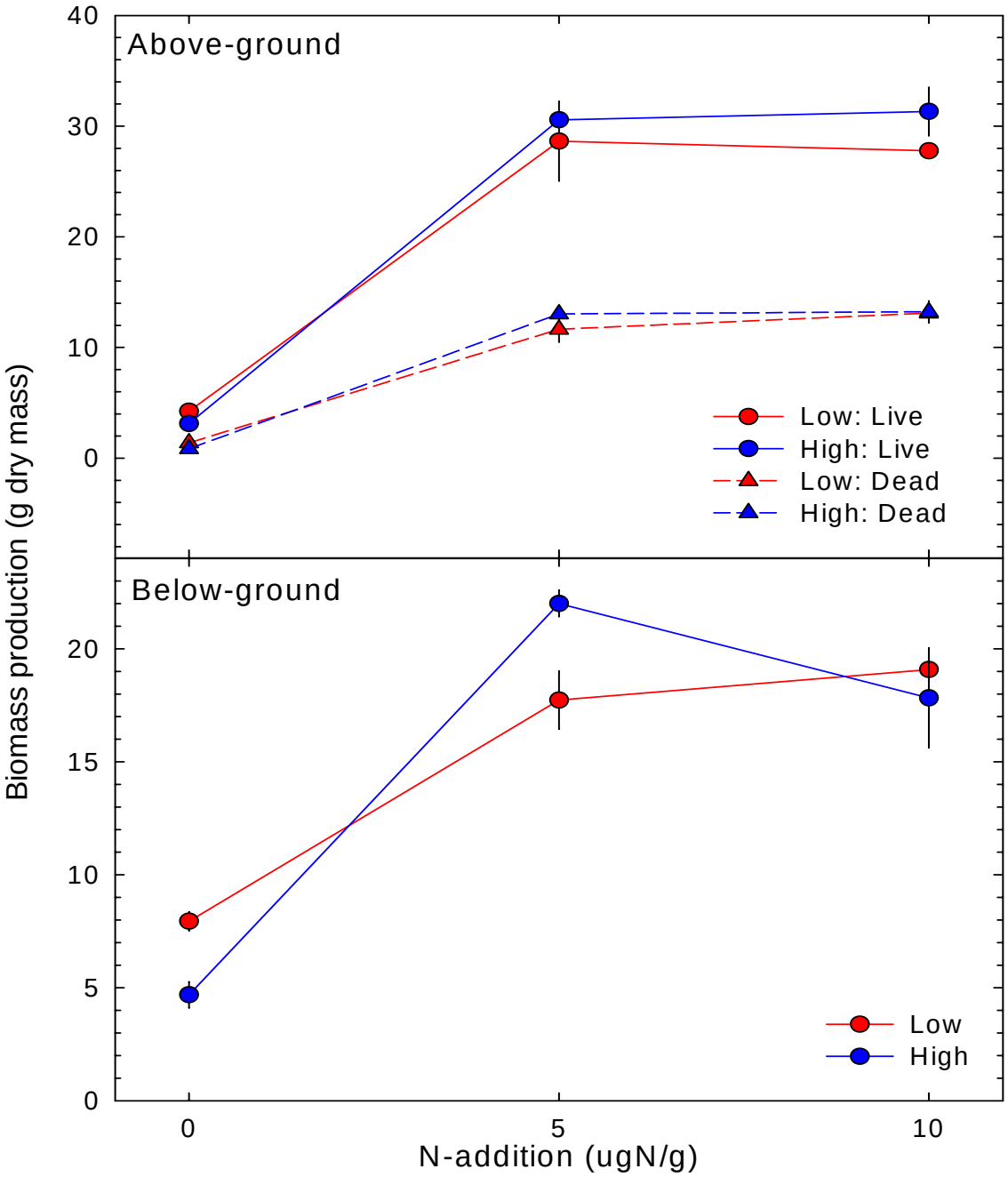
n = 13 plants per treatment combination

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

Results: Growth



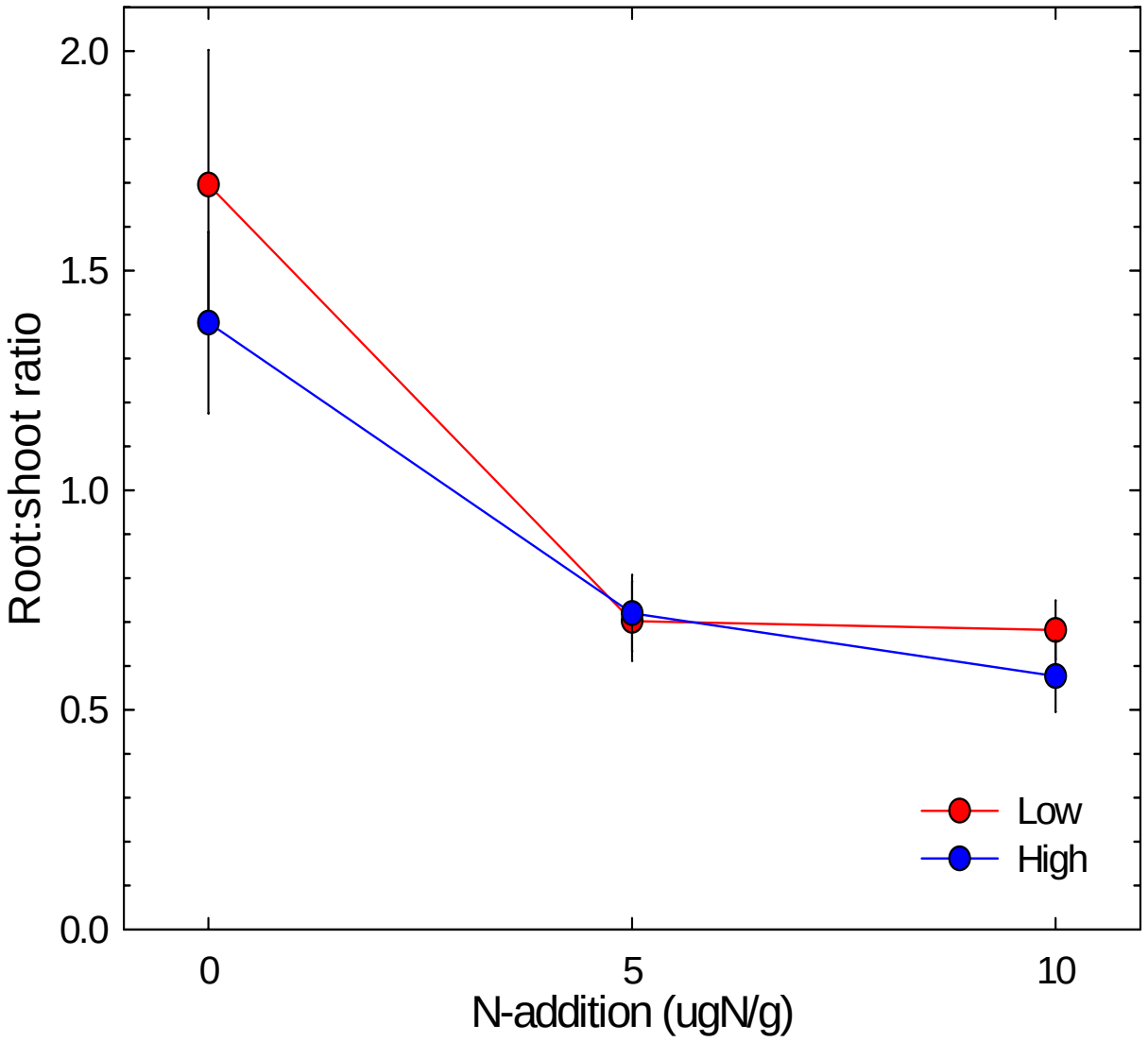
- N- availability and water table depth significantly increased plant height and tiller production, and there was a significant N*W interaction.



Results: Biomass production

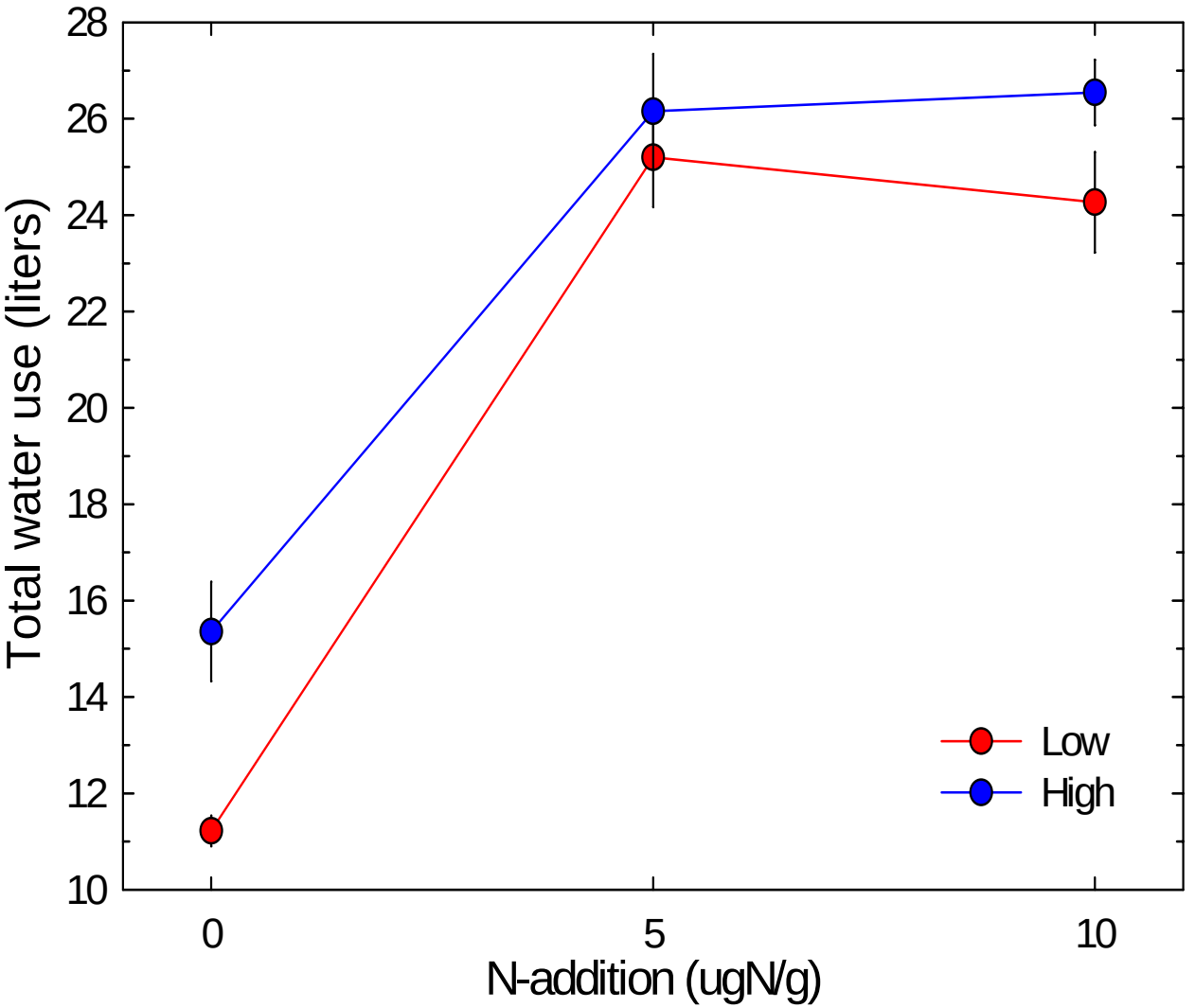
- N-availability significantly increased biomass production. However, addition rates > 5ugN/g failed to increase biomass production.
- Water table depth did not significantly affect biomass production.

Results: Biomass allocation



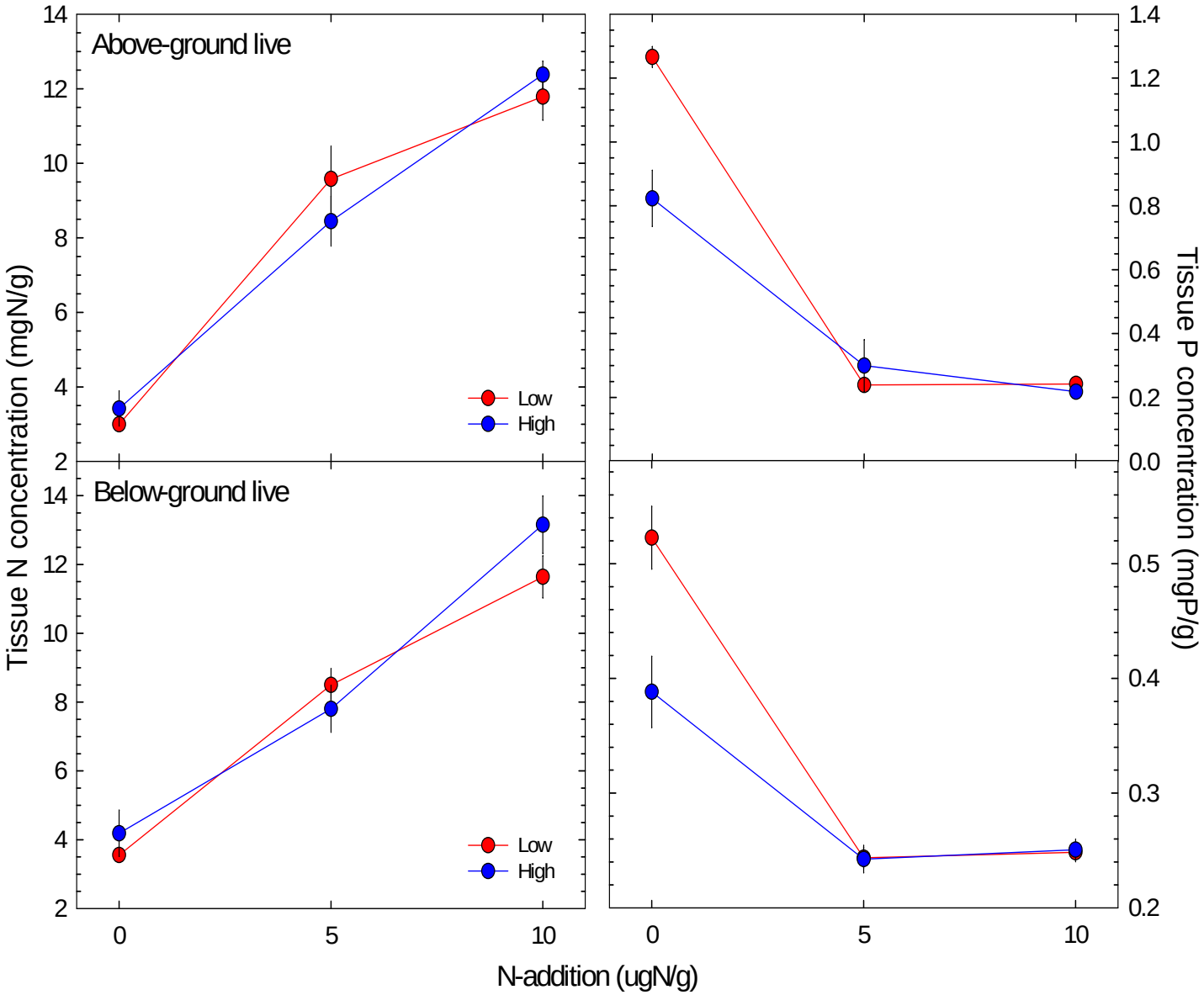
- N-availability caused a significant increase in biomass allocation to above-ground tissues. However, addition rates > 5ugN/g failed to increase biomass production.
- Water table depth did not significantly affect biomass allocation.

Results: Total water use



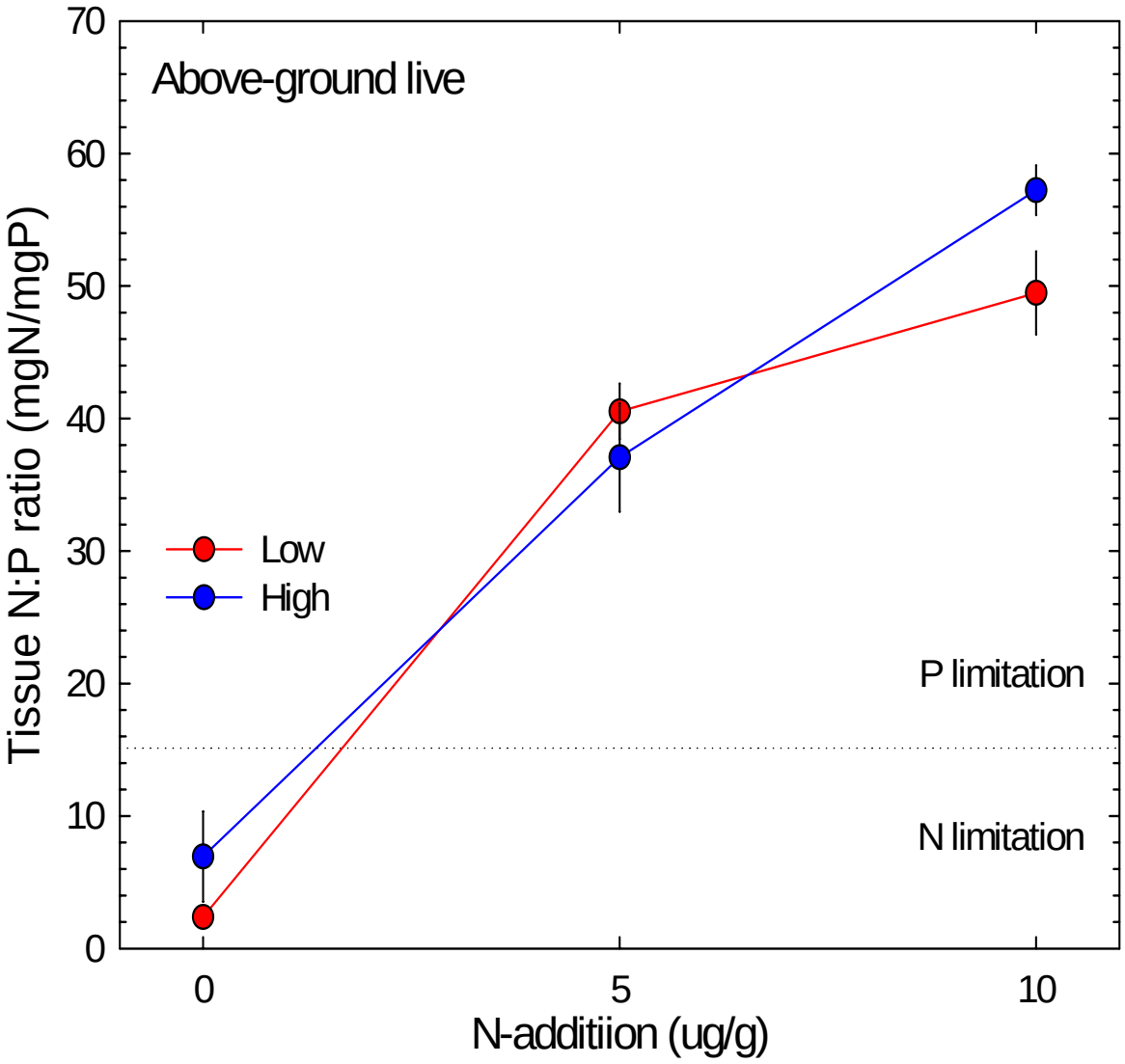
- N- availability and water table depth significantly increased total water use.

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