Growth and Physiological Responses of Perennial Ryegrass to Low Nitrogen Stress

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Introduction

Nitrogen (N) is a macronutrient that has great impact on plant growth and development. N deficiency can cause chlorosis, loss of shoot density and decrease in growth. However, over utilization of nitrogenous fertilizers may pollute soil and water. Perennial ryegrass (*Lolium perenne L.*) is a widely used cool-season forage and turf species, but growth and physiological mechanisms of this species to high and low N are not well understood.

Objective

To investigate growth and physiological responses of perennial ryegrass exposed to low N stress.

Materials & Methods

- Two accessions: 11 (tolerant) and 99 (sensitive)
- Tillers were propagated and grown in small pots with sands and irrigated every other day with half-strength Hoagland solution (7.5 mM N).
- Plants were received low N and high N treatments in growth chamber for 20 days under 20/15 ℃, 400 µmol m^{-2} s^{-1} for 12 h.
- Treatments
  - **High:** control, 7.5 mM N
  - **Low:** 0.75 mM N
- Shoot fresh and dry weight, chlorophyll content, antioxidants and N content were measured.
- Experimental design: split plot

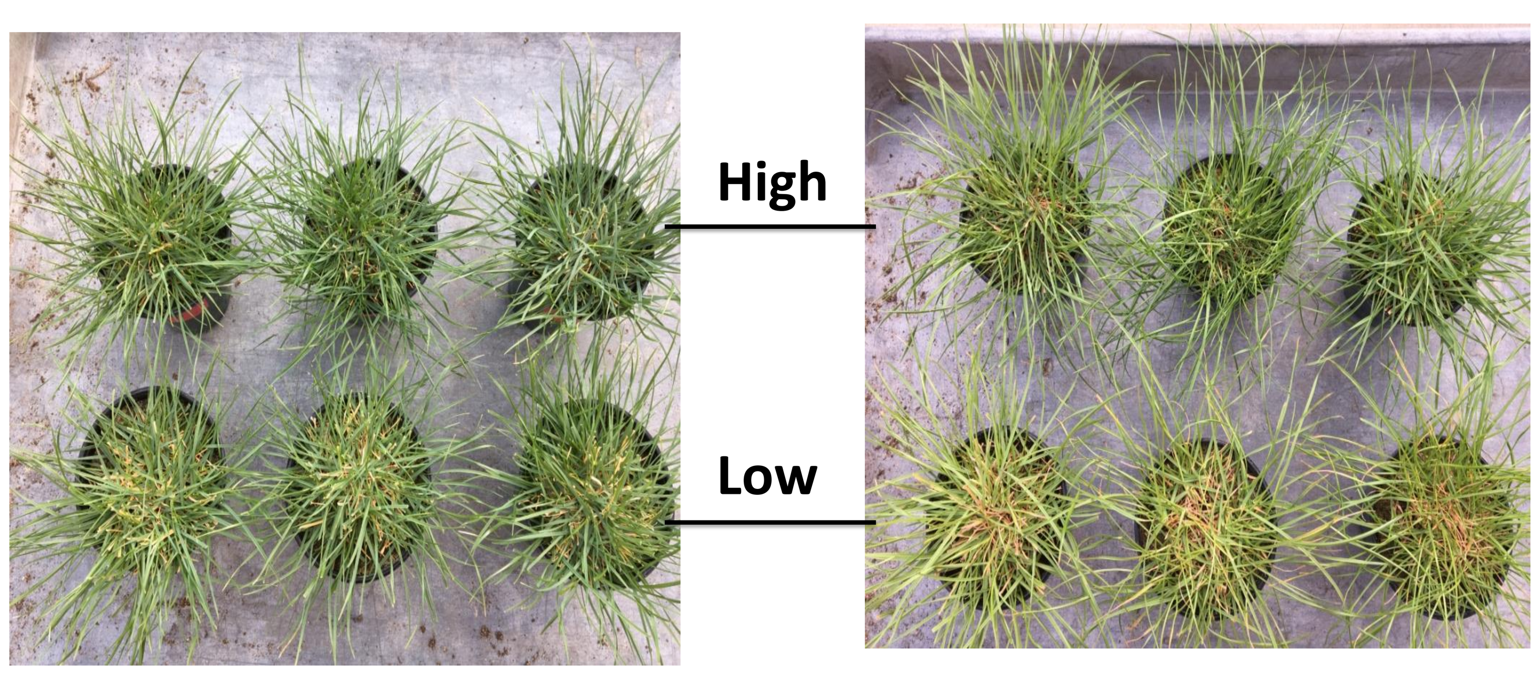

Figure 1. The tolerant accession 11 (left) and the sensitive accession 99 (right) at 20 d of high and low N treatments.

Results

- Significant decreases in chlorophyll content (Chl) were found in both accessions after 20 d under low N, but the sensitive 99 showed a greater reduction in Chl **(Figure 2).**

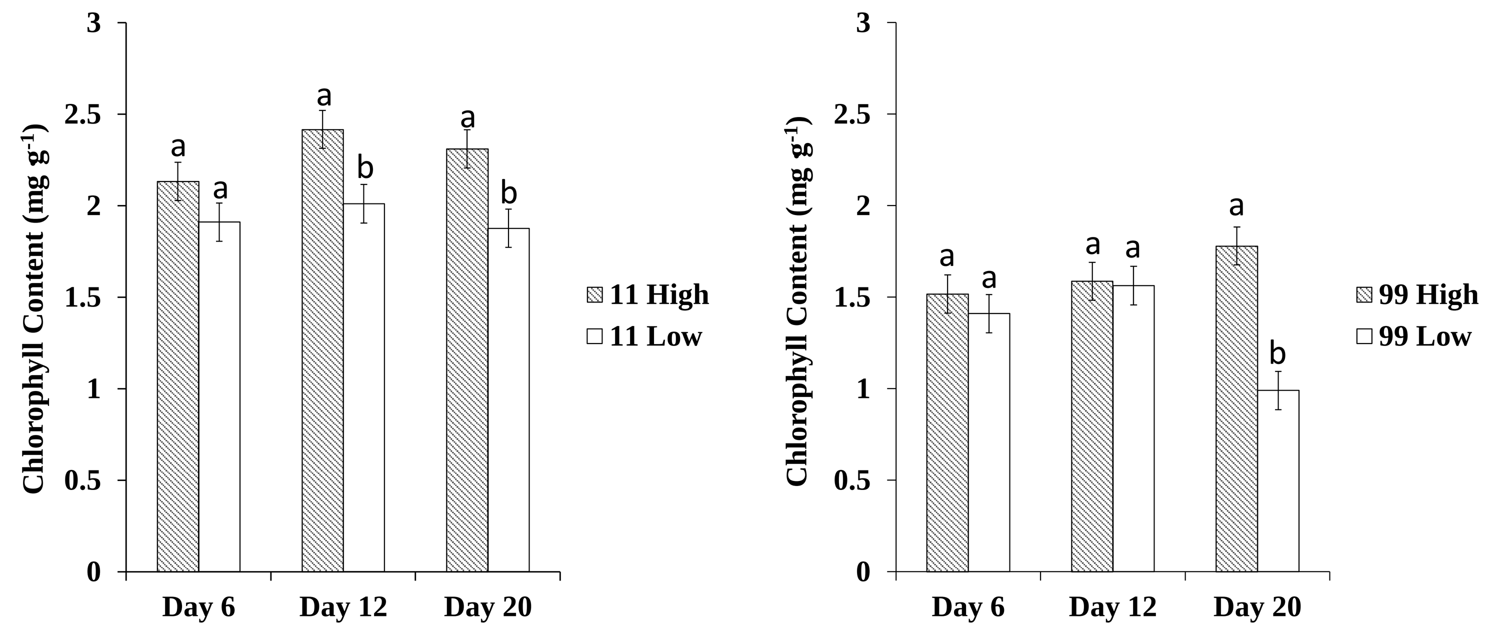

Figure 2. Chlorophyll content as affected by low and high N at 6 d, 12 d and 20 d.

- Shoot fresh weight (SFW) did not change in the tolerant 11, but decreased significantly in the sensitive 99 after 20 d of low N **(Figure 3).**

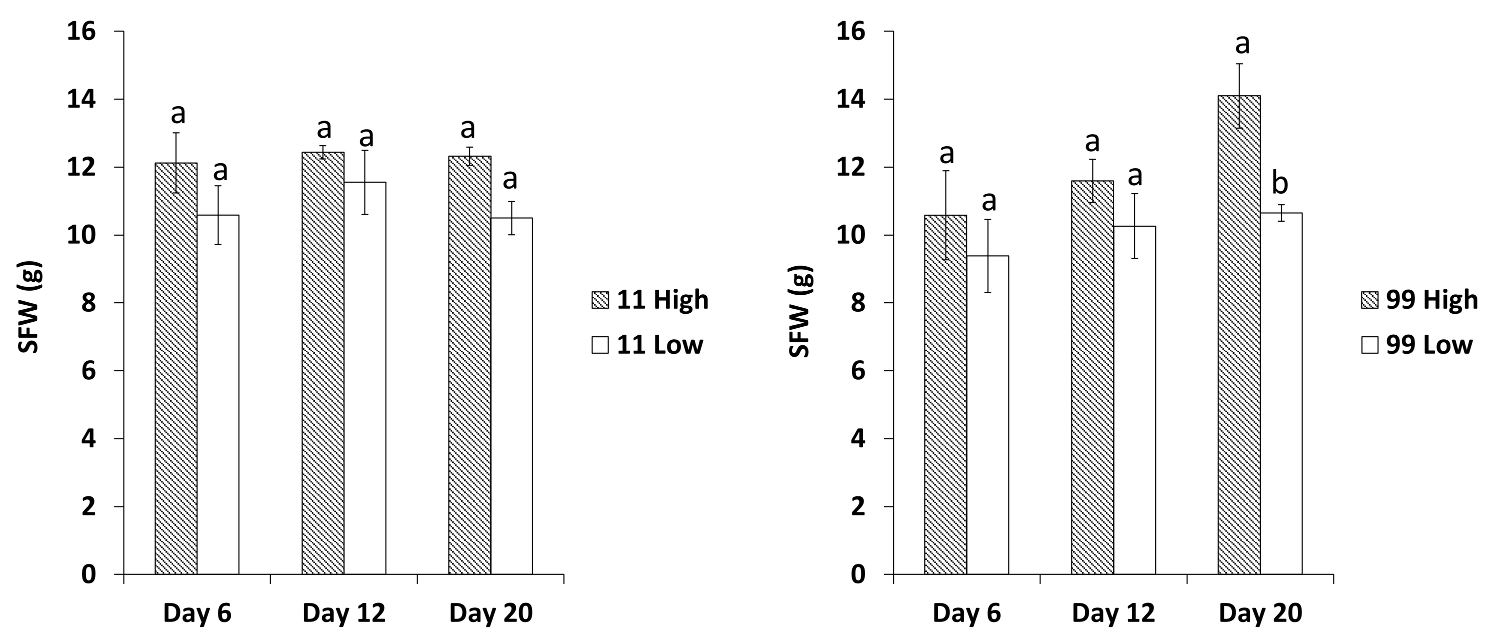

Figure 3. Shoot fresh weight as affected by low and high N at 6 d, 12 d and 20 d of treatments.

- Shoot N content generally decreased, but to a greater extent in the sensitive 99 after 20 d of low N **(Figure 4).**

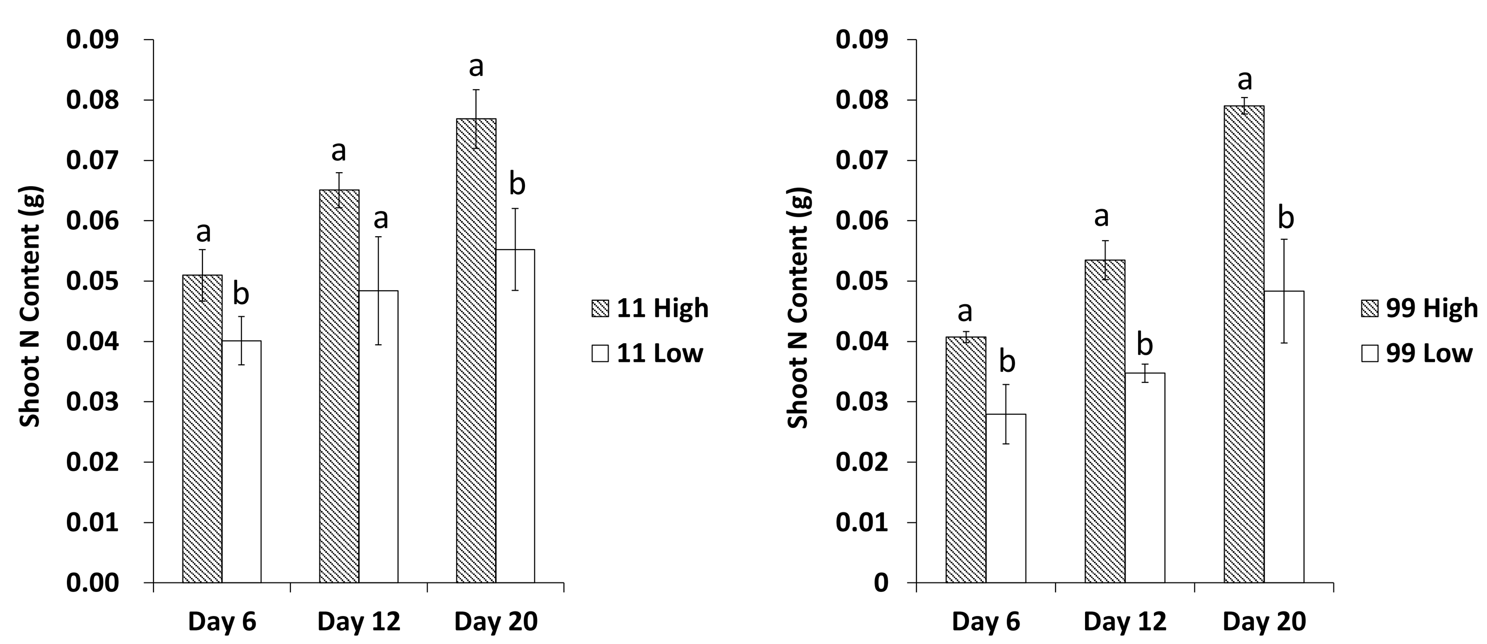

Figure 4. Shoot N content as affected by low and high N at 6 d, 12 d and 20 d of treatments.

Results

- Shoot total soluble protein (TSP) did not change in the tolerant 11, but decreased significantly in the sensitive 99 after 20 d of low N **(Figure 5A)**. Activity of ascorbate peroxidase (APX) significantly increased in both accessions under 20 d of low N **(Figure 5B)**.

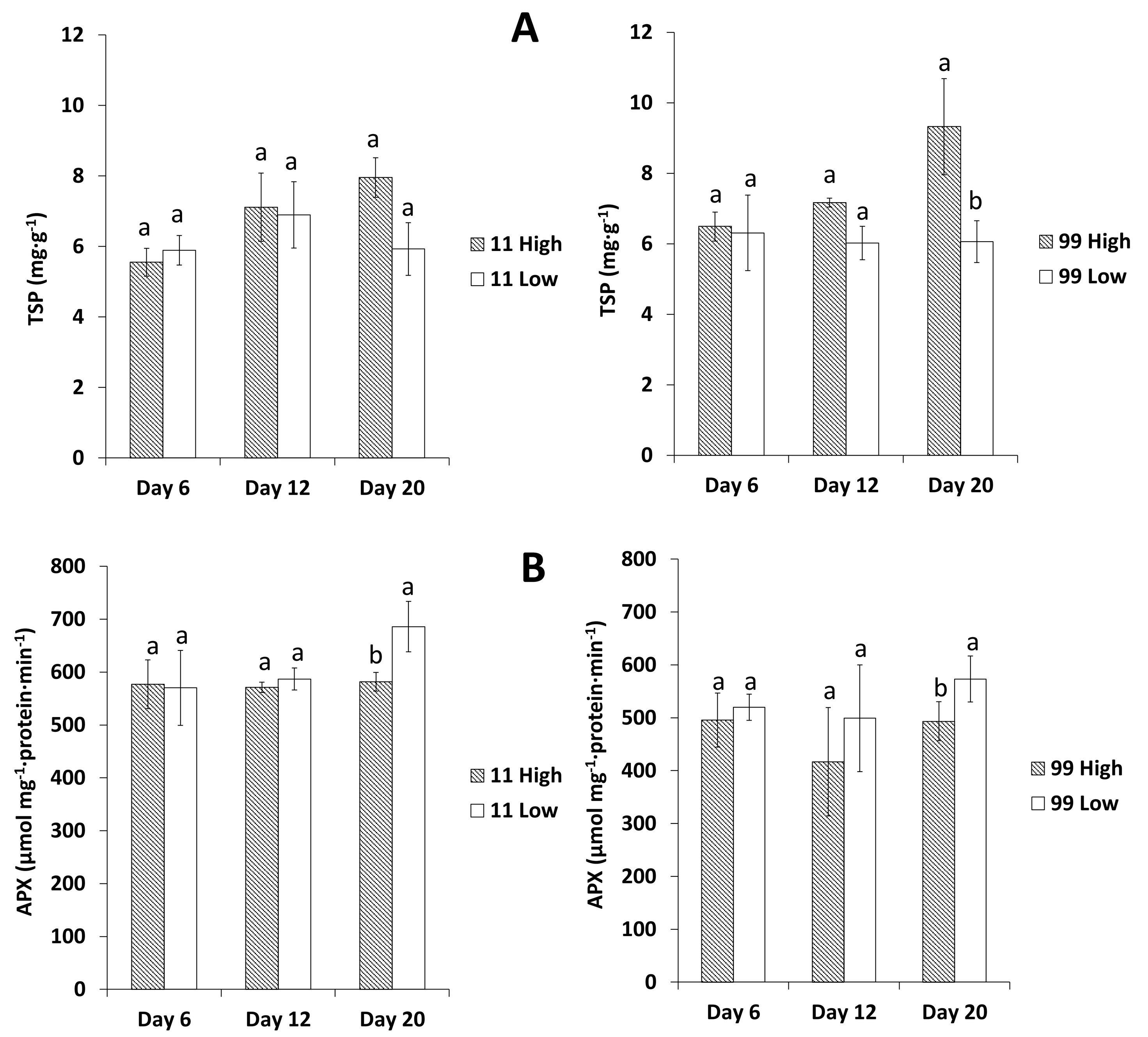

Figure 5. Shoot total soluble protein content and activity of APX as affected by low and high N at 6 d, 12 d and 20 d of treatments.

Ongoing work

Expression of genes that regulate uptake or utilization of N are being analyzed for further revealing the mechanisms of low N tolerance in perennial ryegrass.

Acknowledgement

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Reference

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