

Nitrogen source affecting the competitiveness between lowland rice and weeds under low and high vapor pressure deficit

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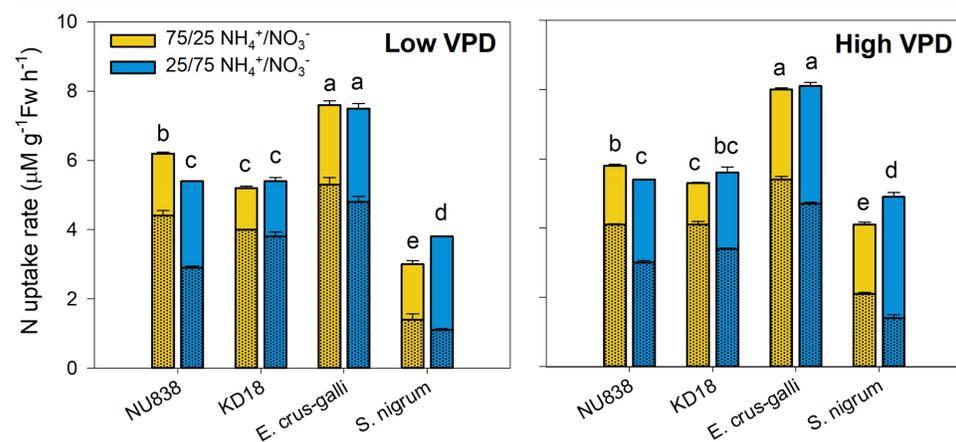
Introduction

Implementation of water-saving irrigation practices in lowland rice results in increased availability of nitrate (NO_3^-) in the soil and favors germination of upland weeds. Since plant species show a specific preference for either ammonium (NH_4^+) or NO_3^- as nitrogen (N) source, changes in both soil NO_3^- concentration and weed flora may affect the competition between rice and weeds. Further, the transpirational demand of the atmosphere might affect growth and competitiveness of lowland and upland weeds differently. The study was conducted to evaluate the effects of N source on competition between lowland rice and two weed species (*Echinochloa crus-galli* – a common lowland weed and *Solanum nigrum* – a common upland weed) at low and high vapor pressure deficit (VPD).

Conclusion

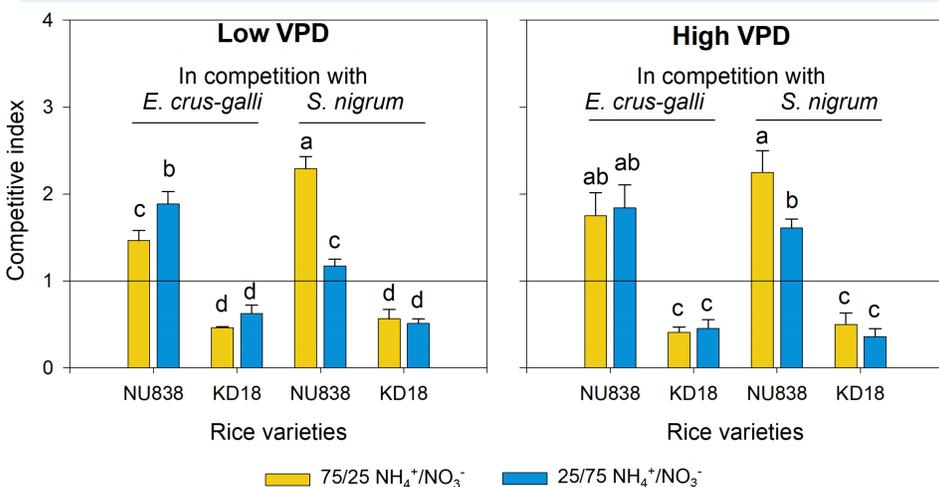
- ❖ N uptake of rice and *E. crus-galli* was hardly affected by N source, whereas high NO_3^- led to significantly higher N uptake of *S. nigrum*.
- ❖ High NO_3^- decreased the competitiveness of *E. crus-galli* against rice but increased the competitiveness of *S. nigrum* against rice.
- ❖ High VPD did not affect DM but increased N uptake of *S. nigrum*, leading to increased competitiveness of the weed at high transpirational demand.
- ❖ Increased availability of NO_3^- in the soils may be advantageous for the competitiveness of upland weeds, especially at high VPD, whereas, it may be disadvantageous for common lowland weeds.

Results and Discussion

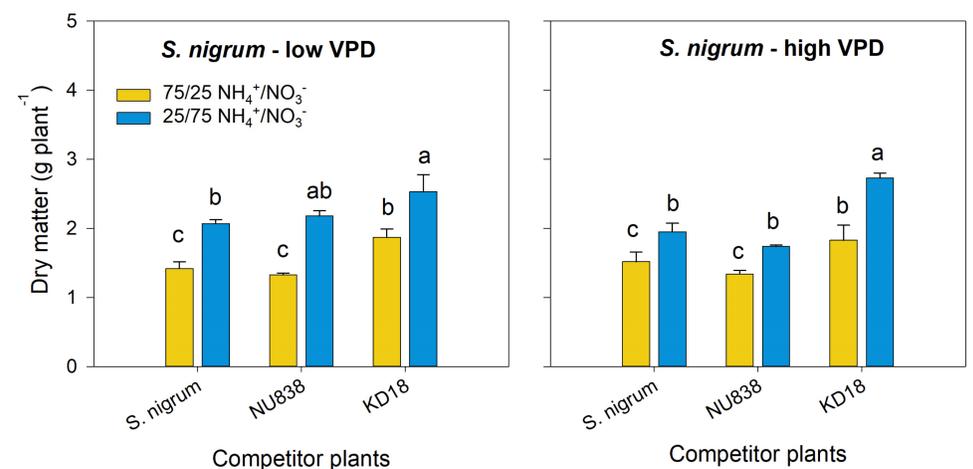
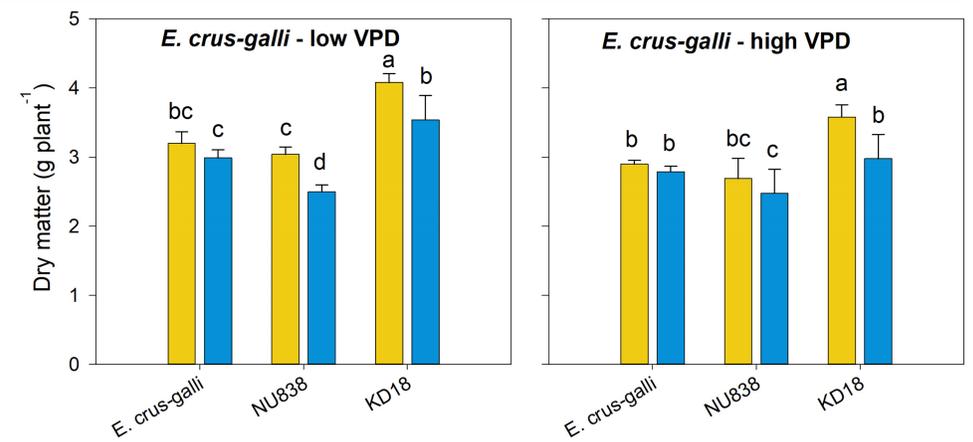


(Patterned bar: NH_4^+ uptake rate. Clear bar: NO_3^- uptake rate).

- Independent of N source, rice and *E. crus-galli* took up a larger share of NH_4^+ , *S. nigrum* took up a larger share of NO_3^- .
- N uptake rate of *S. nigrum* was stimulated at high NO_3^- and high VPD.
- High NO_3^- and high VPD increase N uptake of upland weeds.



- High NO_3^- increased the competitiveness of NU838 against *E. crus-galli* but decreased its competitiveness against *S. nigrum*.
- High NO_3^- may be disadvantageous for rice in competition with upland weeds.



- N sources did not affect DM of *E. crus-galli* in monoculture.
- In competition with rice, DM of *E. crus-galli* was significantly lower at high NO_3^- than at high NH_4^+ .
- Higher NO_3^- led to significantly higher DM in *S. nigrum* in all plant combinations.
- DM of *S. nigrum* did not differ between the two VPD conditions.
- High NO_3^- reduces growth of *E. crus-galli* in competition with rice, but increases growth of *S. nigrum*.

Materials and Methods

Rice and weeds were grown hydroponically as monoculture or mixed culture in 1 L pots containing modified nutrient solution with a N concentration of 2.86 mM, differing in the ratio of N forms (75/25 or 25/75 $\text{NH}_4^+/\text{NO}_3^-$). The nutrient solution was renewed every 7 days, while the pH was adjusted daily to 5.8 ± 0.1 with 1N NaOH or HCl. Pots were placed in two separate self-constructed VPD chambers: low VPD (0.5/0.2 kPa day/night) or high VPD (2.2/1.6 kPa day/night). Day and night cycles were set to a 12-h photoperiod from 7 am to 7 pm. N uptake rates were consecutively measured during the first 4 days, while dry matter (DM), total N uptake were determined 2 weeks after the onset of treatments, and then competitiveness index was calculated.

