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Nitrogen Source Affecting the Competitiveness between Lowland Rice and Weeds under Low and High Vapour Pressure Deficit

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Abstract

Implementation of water-saving irrigation practices in lowland rice results in increased availability of nitrate (NO_3^-) in the soil and favours 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. In addition, vapour pressure deficit (VPD) affects leaf gas exchange and plant growth, which may alter the N uptake of plants. The study was conducted to evaluate the effects of N source on the competition between two rice varieties (NU838 and KD18) and two weed species (*Echinochloa crus-galli* and *Solanum nigrum*) at low and high VPD. Rice and weeds were grown hydroponically as monoculture or mixed culture with different N sources (75%/25% or 25%/75% $\text{NH}_4^+/\text{NO}_3^-$). Independent of N source, rice and *E. crus-galli* took up a larger share of NH_4^+ , whereas *S. nigrum* took up a larger share of NO_3^- . A high correlation between water uptake rate and total N uptake rate was found in *S. nigrum* and *E. crus-galli* but not in rice. Moreover, in contrast to the other species, growth of *S. nigrum* was not reduced at high VPD, resulting in increased competitiveness and total N uptake of the weed. In competition, high NO_3^- increased the competitiveness of NU838 against *E. crus-galli*, but decreased the competitiveness of NU838 against *S. nigrum*. Our results suggest that increased availability of NO_3^- in aerobic rice soils may be disadvantageous for rice in competition with upland weeds, especially at high VPD, whereas, it may reduce pressure of common lowland weeds.

Keywords: Alternative wetting and drying, nitrogen source, plant competitiveness, water-saving irrigation, weeds in lowland rice