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Nitrate Reductase Activity in Rice as Related to Weed Competitiveness

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Abstract

Traditional and improved rice cultivars (*Oryza sativa* L.) belonging to two groups of Asian rice (japonica-upland and indica-lowland), were studied for weed competitiveness. Rice was grown under controlled conditions in hydroponics using a modified Yoshida nutrient solution. As an indicator for weed competitiveness we used the activity of the enzyme nitrate reductase (NRA) which allows the rice to take up nitrogen under aerobic upland conditions. NRA of the 4 rice genotypes was tested under different nitrogen nutrition regimes representing upland (40 ppm of NO_3), lowland (40 ppm NH_4) and hydromorphic (20 ppm NH_4 and 20 ppm NO_3) rice cropping systems.

Rice varieties appeared to be adapted to the ecological conditions for which they were selected. The upland adapted genotypes showed higher NRA under NO_3 nutrition and little NRA with NH_4 nutrition whereas the lowland adapted varieties showed relatively low NRA with both NH_4 nutrition and NO_3 nutrition.

Improved lowland types showed low NRA when grown in either NH_4 or NO_3 mediums, however very high levels of enzyme activity were observed for improved upland adapted types.

Lowland weed types such as *Echinochloa crus-gavonis* and *Crotolaria* spp. show limited NRA under NH_4 or NO_3 nutrition, with slightly higher activity observed when the medium contained both NO_3 and NH_4 . Those weeds adapted to upland conditions such as *Euphorbia heterophylla* and *Zea mays* showed relatively high NRA in NO_3 medium as compared to NH_4 . However, in all cases the NRA of the traditional rice cultivars was higher than that of the weeds. The NH_4NO_3 treatment resulted in highest NRA for the broad leafed weeds, while the in the narrow leafed varieties NRA responded to NO_3 treatments. All enzyme activity was measured in vivo in leaf tissue.

In all cases, higher RNA resulted in greater accumulation of plant biomass indicating better nutrient acquisition efficiency. This study concludes that it is possible to relate leaf NRA to plant biomass accumulation, giving NRA the potential of a screening tool for weed competitiveness in rice.

Keywords: Enzyme activity, rice cropping systems, screening, selection, upland weeds