Early growth stage water management effects on the fate of inorganic N, growth and yield in rice

Abstract

Water and nitrogen (N) play vital roles in rice (Oryza sativa L.) production. Water-saving management decisions can influence soil conditions (oxidation and reduction), and these soil conditions affect the fate of N in paddy soil. We designed three irrigation regimes, namely, conventional irrigation (Flooding), shallow water depth (SWD), and a Non-flooding treatment, for our study. For the Flooding treatment, a ponding water depth of 0.05–0.06 m was maintained for 99 days after transplanting (DAT), and the water was drained 20 d before harvesting. For the SWD treatment, a ponding water depth of 0.01–0.02 m was maintained from 20 DAT to 99 DAT, and water was drained 20 d before harvesting. For the Non-flooding treatment, the plots were saturated (not flooded) from 20 to 57 DAT. After 57 DAT, a ponded water depth of 0.01–0.02 m was maintained until 99 DAT, and the water was drained 20 d before harvesting. The N fate and rice growth did not differ between the treatments during the early growth stages in response to the differences inwater management.Rice root activity during the middle growth stage was higher for SWD, whichwas possibly because of the above-ground biomass and other factors during the middle growth stage of the rice. We found that the recovery efficiencies for N fertilizer, N uptake and above-ground biomass at the heading stage were higher for SWD than for the other two treatments. Although the soil status (reduction or aerobic conditions) was the same for the different water treatments up to the maximum tiller number stage, either the SWD or Non-flooding option could be used to conserve water. In addition, the fate of the N fertilizer, the N use efficiency, the rice growth and the rice yield were the same or higher with these two treatments than with the Flooding water management treatment.

Key words: Water-saving irrigation, shallow water depth, non-flooding, recovery efficiency, xylem exudation, yield.