ABSTRACT

Sustainable agricultural intensification with high resource use efficiency is gaining importance for increasing global food grain production. There is a need to assess the feasibility of drip irrigation in improving rice production with high resource use efficiency under climate change scenarios in subtropical India. Hence, the present investigation was undertaken using the field experiment and simulation to study the effect of subsurface drip irrigation with varying N fertilizer levels on yield, water productivity, and N use efficiency of rice and to evaluate agro-adaptations to the climate change. The field experiments included two drip lateral spacings (40 cm and 60 cm) and four N fertilizer levels i.e. 0 (N0), 50, 75 and 100% of normal N recommendation with three replications. Experiments were conducted at Kharagpur, India in dry and wet seasons during 2012 to 2014. Both the lateral spacings resulted in similar growth and yield of rice due to uniform distribution and movement of water and N fertilizer through subsurface drip emitters. Under the drip irrigation, increasing the N fertilizer level from N0 to N50 and N75 increased the grain yield and water productivity of rice significantly and no significant changes were observed with further N fertilizer addition. Also, the N recovery of rice at N75 was 72% in dry and 64% in wet season, which were significantly higher than that of N100. Increasing N fertilizer level significantly increased NH_4^+-N and NO_3^--N contents in top soil layer at 12 h and 24 h after the fertigation and decreased significantly with increasing soil depth. The drip irrigation saved 32% irrigation water in dry season as compared to the conventional puddled transplanting with marginally reduced yield (8%) as averaged over the two years. Simulation using CERES model stated the rice grain yield reduction by 3-10%, 7-16% and 9-15% in RCP 4.5 and 11-16%, 13-15% and 38-41% in RCP 8.5 scenarios during 2020, 2050 and 2080, respectively compared to the base period (1961-1990) yield under drip irrigation in subtropical India. Increasing the N application level by 25% higher than the normal recommended dose and early sowing were able to compensate the adverse impact of rising temperature (up to +3.3 °C) in future climate on the rice production.

Keywords: Agro-adaptations, CERES model, Climate change, Drip irrigation, Resource use efficiency, Rice yield, Soil N dynamics