ASSESSMENT OF CLIMATE CHANGE IMPACT ON RICE AND WHEAT YIELD AND ADAPTATION FOR SUSTAINABLE PRODUCTION

ABSTRACT

Climate change has been established as a factual reality. It becomes crucial to assess the climate change impact and the suitability of adaptation options to sustain agricultural production. Rice and wheat, two staple food grain crops on which most individuals depend for their food security, contribute substantially to food grain production. In the current investigation, field experiments and model simulations were performed to determine the climate change impact on rice (*cv-IR36*) and wheat (*cv-Sonalika*) and to evaluate easily practicable agro-adaptation options. Furthermore, the impact of climate change on the optimum nitrogen dose for both crops was examined. A process-based crop model CERES was calibrated and validated using field experiment observations and further enforced by climate projections to analyse the climate change impact on rice and wheat crops. The climatic projections of daily rainfall, solar radiation, and maximum and minimum temperature for historical (1976-2005) and future periods (2006-2100) from eight global climate models (GCM) are used. A distribution-based correction method (DBCM) is used to reduce systematic biases of climate projections which finally has been used for driving CERES-Rice and CERES-Wheat models for yield simulations. Simulation results reveal that rice yield is expected to reduce by 7–9% in the 2020s, 8–14% in the 2050s, and 8–15% in the 2080s, whereas wheat yield is expected to go down by 18–20% in the 2020s, 20–28% in the 2050s and 18–33% in the 2080s. Six mathematical models, Quadratic model (QM), Square root model (SRM), Linear plateau model (LPM), Quadratic plateau model (QPM), Square root plateau model (SRPM), and Mitscherlich model (MM), are evaluated to optimize N-fertilizer for rice and wheat under climate change condition. QPM performs better than other models in representing the yield response to fertilizer application. The estimated optimum-N dose (OND) is anticipated to get increased from the average historical 121 kg/ha to 138, 143, and 146 kg/ha for rice, and from average historical 98 kg/ha to 119, 124, and 127 kg/ha for wheat in the 2020s, 2050s, and 2080s, respectively, under all RCPs scenarios. Further, different adaptation options, transplanting date, seedling age, and fertilizer management (rate and split of fertilizer) for rice, and sowing date, fertilizer management, and deficit irrigation scheduling for wheat, were evaluated in different agro-climatic regions of West Bengal using simulation modelling. Findings show that shifting transplanting/sowing date and nitrogen fertilizer application at 120% of recommended nitrogen dose with four splits could be an effective adaptation for rice and wheat. Results also emphasize that transplanting 18 days older seedlings may be beneficial in rice cultivation. On the other hand, irrigation at a 30% to 40% deficit of maximum available water would sustain the wheat yield under climate change conditions.

Keywords: *Climate change impact, GCM, CERES, Optimum nitrogen dose, Agro-adaptation options, Rice, Wheat*