ABSTRACT

The productivity of rice-wheat cropping system is on the decline due to depletion of soil organic carbon, low recovery of water and N and drastic changes in soil environment due to contrasting soil and water management adopted for rice and wheat crops. In an attempt to identify the best combination of management options for sustainable production of rice-wheat system in the Red and laterite agroclimatic zone of West Bengal, the yield responses of rice and wheat crops to different management options were assessed through field experiments and crop simulation studies. Field experiments aimed at evaluating the effects of tillage, crop residue application, fertilizer N application rate on yield and nitrogen use efficiency of transplanted and direct seeded rice as well as of wheat under different irrigation water regimes. The crop simulation study aimed at calibrating and validating DSSAT3.5 in predicting the yield potential of rice and wheat crops under different levels of management options: crop residue application, N application rate and irrigation water regime; deciding the suitable levels of these management options for the maximum yield of rice and wheat crops and finally at identifying the best combination of management options for stable production of rice-wheat system.

The results of the field experiments indicated that application of rice and wheat crop residues along with the high level of fertilizer N helped maintain high level of soil organic carbon, mitigated the adverse effects of soil puddling and enhanced N uptake by both rice and wheat crops. As a result the yields of transplanted and direct seeded rainfed rice crops were maximum when the residues of both rice and wheat crop were applied along with fertilizer N @ 120 kg N/ha under high intensity of puddling for transplanted rice and high intensity of dryland tillage for direct seeded rice. The maximum yield of wheat following both transplanted rice and direct seeded rice could be attained by tilling the soil with cultivator followed by disc harrow and by applying residues of both rice and wheat crops and fertilizer N @ 120 kg N/ha under wet irrigation water regime.

The results of crop simulation studies signified that the yields of both transplanted and direct seeded rice in response to crop residue and fertilizer N applications could be reasonably predicted by CERES-rice model. The CERES-wheat model reasonably predicted the yield response of wheat to crop residue application, fertilizer N application rate and irrigation water regime. High R^2 values of linear regression and spearman correlation coefficients and low values of RMSD and MBE indicated high predictability of CERES-rice and CERES-wheat models for respectively rice and wheat yields in response to crop residue and fertilizer N application rates. The seasonal analysis showed that the application of fertilizer N @ 120 kg N/ha and residues of both rice and wheat crops are the best levels for the maximum production of both transplanted and direct seeded rainfed rice under subhumid subtropical climate. Under the same climate, the maximum production of wheat could be obtained by applying fertilizer N @ 80 kg N/ha, crop residues of rice and wheat crops and relatively dry irrigation water regime. The sequence analysis forecasted that long term stable production of rainfed rice-irrigated wheat rotation under subhumid subtropical climate could be attained by applying fertilizer N @ 100 kg N/ha for rice and 80 kg N/ha for wheat, the residues of both rice and wheat crops and drier irrigation water regime for wheat.