FERTILISER AND LEGUME RESIDUES EFFECT ON THE PRODUCTIVITY OF IRRIGATED RICE-WHEAT SYSTEMS IN BANGLADESH

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Abstract

Experiments were conducted at two sites in Bangladesh to look at the effect of fertilizer (fertilizer based on soil-test based recommendation, farmers' fertilizer management, and zero N), legume residues (grains and residues removed, grains removed residues retained), and maize cropping on the wheat-rice-mungbean/maize sequences. The first year results indicated no effect of legume residues on the subsequent rice yield. There was however a fertilizer effect on wheat but not on rice. Total system yield was higher under high N at one site, but under zero N it was higher at a second site. Contribution of nitrogen from soils, especially to rice and to the total system productivity, which was manifested in grain yield, was evident in both sites. The results demonstrate increased system productivity from the rice-wheat sequence. These data will be used to validate and apply simulation models in Australia and Bangladesh.

Key words: Rice, wheat, sequence, system productivity, fertilizer management, irrigation, legume residues, Bangladesh

Rice followed by wheat is one of the major cropping sequence in irrigated lowlands of Bangladesh. The sequence is further intensified by growing a legume or a maize crop in some areas to meet the food demands of this heavily populated country. Due to the nutrient extractive nature of these cereals and with their differing water requirement, the rice-wheat sequence requires careful management of nutrients and water. Experiments have been carried out at three sites in Bangladesh to investigate the effect of nutrients on the productivity of irrigated rice-wheat systems. This paper presents preliminary results on grain yield of rice and wheat and the total system productivity for a year from two of the sites. The ultimate goal of these experiments is to validate and apply simulation models in Australia and Bangladesh.

Materials and methods

Experiments, involving wheat-mungbean-rice (mung bean residues either removed or retained) and wheat-maize-rice under two fertiliser management practices, were conducted at the Bangladesh Agricultural Research Institute (BARI) at Joydebpur (24^{o}N lat., 90^{o} 26_E long., 8 m elev.) and the Wheat Research Center (WRC) at Nashipur (25^{o}48'N, 88^{o}4'E, 30 m elev.) during 1995-96 and 1996-97. Fertiliser treatments were based on the soil-test recommendations, farmers' fertiliser management, and zero N. In wheat, three irrigation (during pre-sowing, crown root initiation (CRI) and during maximum tillering stages) were applied, while the rice was flooded until physiological maturity. Two-thirds of N and all other fertilisers were applied at sowing while the remaining N was top-dressed after the irrigation at CRI. In rice, two-thirds of N and all other fertilizers were applied during transplanting and the remaining N was top-dressed after the irrigation at panicle initiation stage. Grain yield was recorded from all crops during both years and total system productivity was calculated.

Results and discussion

There was no significant effect of legume residues (either removed or retained) or fertilizer treatment on the subsequent rice crop at either site. However, the soil-test based fertiliser treatment produced higher wheat yield than the farmers' fertiliser management (Table 1). Total system yield under high N was higher at Joydebpur but under zero N, it was higher at Nashipur. Contribution of nitrogen from soils, especially to the rice crop (shown by grain yield), was thus evident at both sites. Soil N also contributed to the increase of total system product-ivity. Timsina *et al*. (1) have previously observed high contribution of soil N to rice

at Nashipur. Though bunds were prepared and water loss through seepage and percolation in rice was controlled, the losses were not measured. It is possible that there were higher seepage and percolation losses from high N plots, compared to the zero N plots in these experiments. On-going experi-ments at all sites are aimed at measuring these losses. Results demonstrate increased system productivity from rice-wheat sequence, which may contribute to meeting the increasing food requirements of heavily populated Bangladesh.

Though rice-wheat sequence is not yet a common practice in Australia, the results have tremendous implications to the irrigated rice and wheat cropping because rice areas in southern New South Wales are threatened by increased water tables and soil salinity. Proper residue management or wheat cropping after rice may be an alternative measure to reduce percolation losses of water and nutrients and soil salinity. Current work also involves collation of secondary data from rice and irrigated wheat in Australia. Australian data plus the data generated from Bangladesh will help validate the rice and wheat models that could be applied to irrigated rice and wheat cropping in Australia and Bangladesh.

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Treatment*	Joydebpur						Nashipur					
	High N			Zero N			High N			Zero N		
	Wheat	Rice	System Yield	Wheat	Rice	System Yield	Wheat	Rice	System Yield	Wheat	Rice	System Yield
MRem ST	3.3	4.8	8.1	1.2	3.2	4.4	2.3	3.5	5.8	1.9	3.6	5.5
MRem FM	2.8	3.8	6.6	1.2	2.7	3.9	2.3	3.8	6.1	1.5	3.2	4.7
MRet ST	3.8	4.7	8.5	1.2	3.1	4.3	2.7	4.1	6.8	2.0	3.4	5.4
MRet FM	2.6	3.9	6.5	1.2	3.0	4.2	2.5	3.7	6.2	1.6	3.7	5.3
MC ST	3.6	4.6	8.2	1.3	3.0	4.3	2.4	4.1	6.5	1.7	3.0	4.7
MC FM	2.9	3.7	6.6	1.1	2.8	3.9	2.4	3.9	6.3	1.8	3.0	4.8
SE	0.26	0.09		0.20	0.25		0.19	0.24		0.11	0.23	

*MRem- mungbean residues removed; MRet- mungbean residues retained; MC- maize cropping; ST- fertilizer according to soil test; FM- fertilizer according to farmer management practice

Reference

1. Timsina, J., U. Singh, M. Badaruddin, C. Meisner, 1998. Cultivar, nitrogen, and moisture effects on a rice-wheat sequence: experimentation and simulation. *Agron. J.* (in press).