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On-farm assessment of management practices on the productivity of rice (*Oryza sativa*)–wheat (*Triticum aestivum*) system

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ABSTRACT

On-farm trials were conducted from 1990–91 to 1992–93 to study the effect of different management practices on the productivity of rice (*Oryza sativa* L.)–wheat (*Triticum aestivum* L. emend. Fiori & Paol.) system. Productivity of rice and wheat as individual crops and total productivity of rice–wheat system could be incresased by 24.76, 20.68 and 22.74% respectively over farmer's practice by adopting integrated approach of recommended NPK + chemical weed control + need-based plant-protection measures. Among different management practices, chemical weed control showed highest contribution of 0.37 tonne/ha to rice yield, whereas application of balanced fertilizer (NPK) made greater contribution of 0.35 tonne/ha to wheat yield. Similarly, contribution of recommended NPK was higher (0.52 tonne/ha), followed by chemical weed control (0.48 tonne/ha) to the total productivity of rice–wheat system.

Rice (*Oryza sativa* L.)–wheat (*Triticum aestivum* L. emend. Fiori & Paol.) system is the most widely adopted cropping system in the country and has become mainstay of cereal production. Since the area under cultivation cannot be increased, the increase in crop productivity is only the possibility. Average productivity of 2.5 tonnes/ha of rice and 2.2 tonnes/ha of wheat has been realized in the country. However, often much lower yield has been reported on farmers' fields. Therefore a need was felt to identify constraints responsible for low productivity of rice–wheat system. Keeping this in view a diagnostic survey was conducted and constraints such as inadequate and imbalanced fertilizer use, suboptimal plant population, inefficient water use, poor plant protection, use of local varieties and traditional production technology were identified as major production constrainsts limiting productivity of this system in the region. Trials were therefore conducted on farmers' fields involving farmers as active participants to develop technology for increasing the productivity of rice–wheat system through better management of farmer's resources.

MATERIALS AND METHODS

The trials were conducted for 3 consecutive years (1990–91 to 1992–93) on farmers' fields in 5 selected villages of Rohta block of district Meerut. The soil of the area was sandy loam with pH ranging from 7.2 to 7.6. These soils were low in nitrogen (180–200 kg/ha), low to medium

in phosphorus (8–12 kg P_2O_5/ha) and medium to rich in potassium (290–340 kg/ha). The annual average rainfall of the area was about 815 mm with peak rainfall from July to August and few scattered showers during winter months from south–west monsoon. In all, 4 treatments, viz. T_1, farmer's practice (100 kg N/ha, 50 kg P_2O_5/ha and no potassium and plant-protection measures); T_2, recommended NPK (120 kg N/ha, 60 kg P_2O_5/ha and 40 kg K_2O/ha); T_3, recommended NKP as in T_2 and chemical weed control (butachlor @ 1.5 kg ai/ha within a week of rice transplanting and isoproturon @ 0.75 kg ai/ha 30 days after wheat sowing); T_4, recommended NPK and chemical weed control as in T_3 and need-based plant protection (HCH @ 25 kg/ha used for the control of *gundhi* bug in rice and termite in wheat), were tested in randomized block design on 6 farmers' fields considering each farmer as 1 replicate. Rice variety 'Saket 4' and wheat variety 'HD 2329' were planted at optimmum spacing in 200 m^2 plot size on 10 July and 20 November and harvested on 20 October and 25 April respectively during all the years of study.

RESULTS AND DISCUSSION

Yield components

Yield components such as tillers/m^2, panicles/m^2 and 1,000-grain weight in rice and tillers/m^2 and ear length in wheat were affected significantly due to different management practices individually and in association (Table 1). Use of recommended NKP, chemical weed control and plant-protection measures improved the yield components of both the crops and significantly higher values of these yield components were recorded where recommended NPK was applied in conjunction with chemical weed control + plant protection. This is because of the substantial boost to growth of rice and wheat provided by the integration of different management practices which could significantly increase these yield components over farmers' practice. Increase in yield components of rice and wheat due to fertilizer application was also reported by Singh and Singh (1991) respectively under late-sown condition in western Uttar Pradesh.

Productivity of system

The productivity of rice and wheat in

Table 1. Yield attributes of rice and wheat under rice–wheat system as influenced by management practices (pooled data of 3 years)

Management practice	Yield attributes						
	Rice			Wheat			
	Tillers/ m^2	Panicles/ m^2	1,000-grain weight (g)	Tillers/ m^2	Ear length (cm)	Grains/ ear	1,000-grain weight (g)
T_1	317	262	20.00	377	9.5	51	40.5
T_2	322	267	20.62	384	9.7	53	40.8
T_3	335	281	21.00	398	10.2	53	41.0
T_4	343	291	22.14	415	10.2	54	41.2
CD (P = 0.05)	8.8	6.8	0.75	8.0	0.5	NS	NS

Details of treatments are given in text

Table 2. Productivity of rice and wheat in rice–wheat system as influenced by management practices

Management practice	Productivity (tonnes/ha)								Total (rice + wheat)
	Rice				Wheat				
	1990	1991	1992	Mean	1990–91	1991–92	1992–93	Mean	
T_1	3.23	3.47	3.00	3.23	3.34	3.22	3.03	3.19	6.42
T_2	3.59	3.51	3.12	3.40	3.99	3.40	3.24	3.54	6.94
T_3	4.18	3.75	3.38	3.77	4.04	3.41	3.51	3.65	7.42
T_4	4.72	3.88	3.50	4.03	4.23	3.53	3.80	3.85	7.88
CD (P = 0.05)	0.29	0.17	0.43		0.07	0.04	0.13		

Details of treatments are given in text

rice–wheat system was influenced significantly due to different management practices (Table 2). The higher productivity of rice and wheat irrespective of management practices was recorded in the first year compared with second and third years on account of high and well-distributed rainfall received during both the crop seasons of first year. The highest mean productivity of rice (4.03 tonnes/ha) and wheat (3.85 tonnes/ha) and total productivity of rice–wheat system (7.88 tonnes/ha) was registered in the treatment where different crop-management practices (recommended NPK + chemical weed control + need-based plant protection) were followed in the integrated manner. However, lowest productivity of both rice and wheat was recorded under farmer's practice. The higher productivity of rice and wheat is attributable to higher values of yield components recorded under integrated approach of crop-management practices. Soni and Bhatia (1989) also reported that fertilizer application at recommended levels coupled with optimum plant population for rice and irrigation levels for wheat increased the productivity level of rice–wheat sequence.

Among different management practices, chemical weed control had made a greater contribution to the productivity of rice. Patel *et al.* (1987) also reported the higher contribution from weed control in rice under wetland conditions. In wheat greater contribution was made by recommended NPK. The results confirm the findings of Singh and Singh (1991).

It was concluded that balanced fertilization coupled with chemical weed control and need-based plant protection are essential for increasing the productivity of rice–wheat system on farmers' fields, chemical weed control alone for rice and balanced fertilizer application for wheat were found the vital component of input.

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