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Effect of crop establishment methods on performance of rice (*Oryza sativa*) cultivars and their effect on succeeding wheat (*Triticum aestivum*)

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ABSTRACT

A field experiment was conducted during 1999–2000 and 2000–2001 to evaluate the performance of rice (*Oryza sativa* L.) cultivars under different crop establishment methods and their effect on succeeding wheat (*Triticum aestivum* L. emend. Fiori & Paol.) at the Project Directorate for Cropping Systems Research, Modipuram, Meerut, Uttar Pradesh. Rice grown under unpuddled conditions gave higher systems productivity than rice transplanted after puddling. However, productivity of rice and wheat and system as a whole under unpuddled and transplanted conditions did not differ significantly. Similar trend was observed in basmati rice-equivalent yield (BREY). Net returns were also not influenced significantly by crop establishment methods. Among rice varieties, 'IET 15339' gave superior performance followed by wheat variety 'PBW 226' in respect of yield and net returns.

Key words : Unpuddled, Transplanted, Rice cultivars, Basmati rice equivalent yield, Wheat, Economics

Rice–wheat system is very important cropping system, covering an area of about 10.5 million ha in India (Pandey, 1992). Rice is grown in different agro-ecological environment suited to each location. Non-availability of irrigation water, insufficient labour and high wages during the peak period of farm operations invariably delay planting of rice. To mitigate this problem many rice farmers are switching to direct seeding. Direct seeding (unpuddled) can reduce the labour requirement, shorten the duration of crop by 7–10 days and provide comparable grain yield with transplanting. Rice is transplanted in the first fortnight of July in puddled soil which leads to destruction of macro-pores and reduction in permeability because it reduces the need for irrigation water; however, puddling leaves the soil in poor physical condition for the following wheat crop. It is inevitable to formulate research strategies in selection of varieties suitable for different crop establishment methods. Choice of appropriate cultivars for transplanting as well as direct seeding under unpuddled conditions may help in improving the growth, productivity and profitability of succeeding wheat in rice–wheat system. Therefore, an experiment was designed to evaluate scented and non-scented rice varieties for these conditions and their effect on succeeding wheat crop.

MATERIALS AND METHODS

A field experiment was conducted during 1999–2000 and 2000–2001 at Research Farm of Project Directorate for Cropping Systems Research, Modipuram, Meerut, Uttar Pradesh. The soil was sandy loam, consisting of 64.2, 18.5 and 17.3% sand, silt and clay respectively. The soil pH, electrical conductivity, organic carbon, available P and available K, were 8.20, 0.48 dS/m, 0.4%, 3.5 mg/kg and 37 mg/kg soil respectively. Two methods of crop establishment (unpuddled and transplanting after puddling) and 8 varieties (4 non-scented and 4 scented) were sown in the third week of June by direct seeding under unpuddled conditions. Non-scented varieties were : 'Krishna Hamsa', Trigeena', 'Saket 4' and 'IET 15339'. Among scented group, 'IET 15391' and 'IET 15392' were tall growing, whereas 'IET 13549' and 'Pusa Basmati 1' were dwarf varieties. The nursery of same varieties was sown simultaneously and 25 days old seedlings were transplanted in the same field after puddling. The experiment was planted in split-plot design with 3 replications. Transplanting of rice seedlings was done at a spacing of 20 cm × 10 cm with 2–3 seedlings/hill. In direct seeding, dry seed of rice was sown in lines 20 cm apart and seed rate of all rice varieties was used @ 60 kg/ha. To control weeds, Pendimethalin 35% @ 4 litres/ha in 800 litres water was sprayed at 1–4 days after sowing in direct-seeded crop and Butachlor was applied @ 1.5 kg a.i./ha at 3 days after planting in transplanted crop. One hand-weeding was also done 25–30 days after sowing for providing weed-free environment to the crop. The rice crop was fertilized with 150 kg N, 60 kg P_2O_5, 60 kg K_2O and 25 kg $ZnSO_4$/ha. The P, K and Zn were applied as basal and N was applied in 3 equal splits. In direct-seeded

experiment, N was applied in 3 equal doses at sowing, 30 and 50 days after sowing, whereas under transplanted conditions, N was applied in 3 equal splits at transplanting, 20 and 45 days after transplanting. Wheat 'PBW 226' was sown at 23 cm row spacing on 20 November and uniform dose of fertilizer was applied @ 150 kg N, 60 kg P_2O_5 and 60 kg K_2O. One-third N, full dose of P and K as basal and rest of N was applied in 2 equal splits at tillering and panicle-initiation stages.

RESULTS AND DISCUSSION

Crop establishment method

Unpuddled and transplanted methods of crop establishment of rice did not influence the rice and wheat yield attributes during both the years (Table 1). Unpuddled and transplanted rice gave similar yield during both the years (Table 2) probably owing to almost equal crop stand under unpuddled and transplanted condition. Slightly higher grain yield was recorded under unpuddled conditions, which was on account of higher mother shoots per unit area. The findings confirm the results of Singh and Pillai (1996). In succeeding wheat, higher yield was obtained under unpuddled than transplanted conditions, as also reported by Sharma *et al.* (2002) and Rath *et al.* (2000). Unpuddled rice–wheat system gave similar basmati rice-equivalent yield (BREY) to that of transplanted rice–wheat system. Interaction was found to be non-significant between cultivars × crop establishment methods. Direct seeded rice–wheat system resulted in higher net returns but at par with transplanted rice–wheat system.

Variety

Among non-basmati varieties, 'IET 15339' gave significantly higher pooled yield than other varieties tested. 'Krishna Hamsa' was the second best during study (Table 2). In Basmati group, 'IET 13549', 'IET 15391' and 'Pusa Basmati 1' gave more or less equal yield, but significantly lower than non-basmati group. Interestingly, higher yield variety of rice resulted in low yield of wheat. Among non-basmati varieties, 'IET 15339'–'PBW 226' recorded the highest values of BREY followed by 'Krishna Hamsa'–'PBW 226'. In basmati group 'IET 15391'–'PBW 226', 'Pusa Basmati 1'–'PBW 226' and 'IET 13549' – 'PBW 226' gave more or less same BREY but higher than 'IET 15392'. Among rice varieties, significantly higher plant height was recorded with 'IET 15392', 'IET 15391' and 'IET 15339' than rest of the varieties, while higher plant height was recorded in wheat grown after 'IET 13549'. Number of effective tillers/m was significantly higher in 'Saket 4' followed by 'Pusa Basmati 1', whereas wheat resulted in significantly higher number of effective tillers/m grown after 'Pusa Basamti 1', 'IET 15392', 'IET 15391' and 'IET 13549'. Significantly highest panicle length was noticed in 'IET 15392' followed by 'Pusa Basmati 1', however higher panicle length was recorded in wheat after 'Pusa Basmati 1'. Panicle weight (g) was recorded to be higher in 'IET 15339' followed by 'Saket 4'. Significantly highest panicle weight was recorded in wheat grown after 'IET 15391', 'Pusa Basmati 1' and 'IET 15392'. The 1,000-grain weight was recorded to be higher in 'Trigeena', 'IET 15391', 'IET

Table 1. Yield-contributing characters of rice and wheat as influenced by cultivars and crop establishment methods in rice–wheat system (pooled data of 1999 to 2001)

Treatment	Rice					Wheat				
	Plant height (cm)	Effective tillers/m	Panicle length (cm)	Panicle weight (g)	1,000-grain weight (g)	Plant height (cm)	Effective tillers/m	Panicle length (cm)	Panicle weight (g)	1,000-grain weight (g)
Crop establishment										
Unpuddled	109.9	71.5	27.6	2.9	22.8	100.8	81.3	16.0	3.1	35.0
Transplanted	111.6	72.1	27.8	3.1	23.2	100.1	79.9	16.0	3.1	34.9
CD (P= 0.05)	NS	NS	NS	0.1	0.1	0.4	NS	NS	NS	NS
Cultivar										
'Krishna Hamsa'	104.4	78.1	26.5	3.1	22.8	99.8	75.9	15.6	3.0	34.8
'IET 15391'	116.4	62.5	27.6	2.9	23.1	100.3	84.4	16.4	3.2	35.2
'IET 15392'	131.9	59.7	29.7	2.7	22.6	100.6	85.2	16.2	3.2	35.2
'Trigeena'	102.7	70.0	25.9	3.0	26.5	100.6	79.8	16.1	3.1	34.9
'Pusa Basmati 1'	104.7	81.0	29.5	2.7	22.1	100.6	85.8	16.6	3.2	35.2
'IET 13549'	102.5	65.8	28.5	2.8	22.5	100.8	84.2	16.2	3.2	35.1
'Saket 4'	102.3	83.8	26.3	3.2	21.6	100.6	74.8	15.7	3.0	34.8
'IET 15339'	121.5	73.3	27.8	3.6	22.8	100.2	74.8	15.1	3.0	34.8
CD (P=0.05)	4.8	4.6	0.5	0.1	0.4	0.9	6.6	0.3	0.1	0.4

Table 2. Grain yield and net returns as influenced by cultivars and crop establishment methods in rice–wheat system (pooled data of 1999 to 2001)

Treatments	Grain yield (tonnes/ha)			Net returns (Rs/ha)		
	Rice	Wheat	Ttoal	BREY	Rice	Wheat
Crop establishment						
Unpuddled	4.90	5.20	10.10	9.52	13,263	24,000
Transplanted	4.93	5.06	9.99	9.47	12,281	23,110
CD (P= 0.05)	NS	NS	-	-	NS	NS
Cultivar						
'Krishna Hamsa'	5.84	4.97	10.81	9.92	16,505	22,315
'IET 15391'	4.26	5.44	9.70	9.59	10,945	25,653
'IET 15392'	3.28	5.20	8.48	8.40	4,757	24,343
'Trigeena'	5.46	5.09	10.55	9.57	12,793	23,229
'Pusa Basmati 1'	4.21	5.37	9.58	9.47	10,587	25,205
'IET 13549'	4.28	5.22	9.50	9.38	11,312	23,999
'Saket 4'	5.52	4.90	10.42	9.60	14,653	21,817
'IET 15339'	6.49	4.84	11.33	10.40	20,623	21,882
CD (P=0.05)	0.22	0.27	-	-	1,281	1,996

BREY, Basmati rice-equivalent yield

1999–2000: Coarse rice @ Rs 490/q; fine rice @ Rs 520/q; basmati rice @ Rs 600/q; straw @ Rs 30/q; cost of cultivation, non-basmati group Rs 15,732/ha; basmati group Rs 16,241/ha, wheat @ Rs 580/q; straw @ Rs 90/q; cost of cultivation Rs 13,143/ha

2000–2001: Coarse rice @ Rs 510/q; fine rice @ Rs 540/q; basmati rice @ Rs 620/q; straw @ Rs 30/q; cost of cultivation, non-basmati group Rs 16,490/ha; basmati group Rs 16,970/ha, wheat @ Rs 610/q; straw @ Rs 95/q; cost of cultivation Rs 13,144/ha

15339', 'IET 15392', 'IET 13549' and 'Pusa Basmati 1', while in case of wheat significantly higher 1,000-grain weight was recorded in the variety grown after 'IET 15392' and 'IET 15391' (Table 1). Similar trend was also observed in yield-contributing characters of rice like panicle weight (g), effective tillers/m and 1,000-grain weight (g) by Dhiman *et al.* (1999). Among non-basmati varieties, 'IET 15339' gave significantly higher net returns than other varieties tested. In basmati group, 'IET 13549', 'IET 15391' and 'Pusa Basmati 1' gave more or less similar net returns. Comparatively higher yielder varieties of rice resulted in low net returns of wheat during both the years.

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