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Effect of preceding crops on yield of succeeding transplanted *aman* rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted at Joydebpur, Gazipur, during early *kharif* seasons of 1987–90 to study the effect of preceding crops, viz. rice (*Oryza sativa* (L.), maize (*Zea mays* L.) and blackgram (*Phaseolus mungo* L.), and crop combinations (inter-or mixed crop) on nitrogen requirement of the succeeding transplated *aman* rice. The grain yield of transplanted aman rice was significantly higher when the crop was grown after sole blackgram. The preceding legume imporved the yield-contributing characters such as panicle length, number of panicles/m^2, number of grains/panicle and 1,000-grain weight. The yield increase from the preceding legume was noted in rice crops receiving fertilizer up to 120 kg N/ha.

Mixed cropping of maize (*Zea mays* L.) with legume is superior to single cropping in maintaining soil fertility and increasing crop yield even under adverse climate condition (Bains, 1968; Pathak *et al.*, 1970). Legumes in rotation improve soil fertility particularly soil N, and thereby increase the productivity of subsequent non-legume crop (Mongia *et al.*, 1988). Quantitative data are, however, lacking on the extent of benefit that legumes can give to the following cereal crops. An investigation was carried out to determine the effect of preceding early *kharif* crops and crop combinations on the yield and economics of succeeding transplanted *aman* rice (*Oryza sativa* L.).

MATERIALS AND METHODS

A field experiment was conducted at the Central Research Station, the BARI Joydebpur, Gazipur, during *kharif* season, 1987–90, covering March to December, at Joydebpur (240^{O} N and 92^{O} 25 E, 8 m above the sea-level). The soil was clay loam with pH 6.3 belonging to Chhiata series of Grey Terrace soil, having moderately slow permeability. The soil was low in organic matter (1.10%), nitrogen (14.0 mg/kg), phosphorus (15 mg/kg), potash (66 mg/kg) and sulphur (16 mg/kg). The *kharif* season experiment was set up in randomized block design with 4 replications. The treatments tested were: broadcast sole *aus* rice; row-seeded sole *aus* rice; row-seeded sole blackgram (*Phaseolus mungo* L.), 25 cm apart (sole); unform maize *row* in sole stand (75 cm x 25 cm); maize paired row (37. 5 cm row distance between 2 individual rows of a pair, 150 cm distance between 2 such pairs (100%) + blackgram rows (44%), 25 cm apart; 4 rows of *aus* rice (67%), 25 cm apart alternated with *Sesbania* broadcast (33%); row-seeded *aus* rice, 25 cm apart (100%) + *Sesbania* broadcast between rows

(50% seeding ratio); and row-seeded *aus* rice, 25 cm apart (67%) alternated with blackgram rows (33%), 25 cm apart. 'Barnali', 'BR 21 and Barimash' were used for maize, *aus* rice and blackgram respectively. The seeds were sown on 15,18 and 12 April in 1987, 1988 and 1990 respectively and on 3 May 1989 respectevely. A basal dose of 20 kg N/ha was applied to blackgram and rice and 40 kg N/ha to maize. N @ 20 kg/ha was top-dressed 15–20 days after seeding (DAS) and rest 20 kg N/ha at 35–45 days to *aus* rice, whereas 40 kg N/ha at 25 days and 40 kg N/ha at 42 days to maize rows only. Full dose of P, K, S and Zn were applied at final land preparation according to recommendation. Soil samples at 30 cm depth were collected for analysis before sowing seeds of *kharif* 1 crops. *Sesbania* plants at a height of 60 cm (45 days) and biomass of blackgram was incorporated into the soil after plucking (once only) pods, 70 days after seeding. Maize and rice were harvested 90 and 105 days after seeding. Grain, straw and yield attributes were recorded from 20 plants. Seeds of *aman* rice (variety 'BR 11') were sown in the seed bed and 25-day-old seedlings were transplanted. Two seedlings/hill with a spacing of 25 cm x 15 cm was maintained. Each main plot was subdivided into 4 subsplot and N levels (0, 40, 80 and 120 kg/ha) were assigned to transplanted *aman* rice. Nitrogen levels were superimposed over the cropping treatments accommodating in split-plot design. Fertilizers (60 kg P_2O_5 and 40 kg K_2O kg/ha) were given as per recommended dose. First, second and third top-dressings (urea) were given 15, 30 and 45 days after transplanting of rice. Since there was no significant difference in case of individual year at 5% probability levels, the data recorded were pooled.

RESULTS AND DISCUSSION

The effect of preceding crops and crop combinations on length of panicle, panicles/m^2, number of fertile grains/panicle and 1,000-grain weight of transplanated *aman* rice were found significant.

Yield attributes

Preceding crops significantly affected the paniclelength. Significantly maximum panicle length was obtained before blackgram in sole situation. The lowest length of panicle was recorded when preceded by sole blackgram. Increasing level of N increased the pancile length (Table 1).

Panicles/m^2 of transplanted *aman* rice after sole blackgram was significantly higher than other combinations. The lowest number of panicles/m^2 was obtained when preceded by cereals. The result thus showed that legume grown before transplanted *aman* increased the panicles/m^2 compared with previous cereal crop. Significantly highest number of panicles/m^2 was recorded from 120 kg N/ha.

The preceding crops did bring about significant changes in the number of grains/panicle. After the grain legumes the fertile grains were significantly higher than rice or maize in sole situation. Overall legume–cereal combination produced higher number of fertile grains of transplanted *aman* rice than the cereal–cereal combinations. A trend of increase was observed in fertile grains/panicle due to increase in the level of nitrogen treatment.

Transplanted *aman* rice showed increased 1,000-grain weight when followed by blackgram. Blackgram or *Seabania* in rice rotation produced indentical grain weight of transplanted *aman* rice, whereas lowest grain weight was recorded when the preceding crop was broadcast *aus* rice.

Table 1. Effect of preceding crops and nitrogen levels on the yield attributes of transplanted *aman* rice (Pooled)

Preceding early *kharif* crops and crop combinations	Panicle length (cm)	Panicles/ m^2	Fertile grains/ panicle	1,000-grain weight (g)
Broadcast sole *aus* rice	21.3	280	82	21.97
Row-seeded sole *aus* rice	21.6	289	85	22.17
Row-seeded sole blackgram	22.0	317	95	22.52
Uniform maize row in sole stand	21.5	288	84	22.03
Maize paired row (100%) + blackgram rows (44%)	21.9	310	93	22.42
Row-seeded *aus* rice (67%) + *Sesbania* broadcast in strip (33%)	21.7	302	90	22.32
Row-seeded *aus* rice (100%) + *Sesbania* broadcast (50%)	21.8	305	91	22.31
Row-seeded *aus* rice (67%) + blackgram rows (33%)	21.8	307	91	22.33
CD (P = 0.05)	0.04	1.41	0.81	0.05
N (kg/ha)				
0	20.92	225	76	21.60
40	21.55	290	85	22.00
80	22.06	335	93	22.65
120	22.40	352	100	22.79
CD (P = 0.05)	0.03	0.80	0.45	0.03

There was a tread of increase in 1,000-grain weight with the increase of N level.

Grain yield

The grain yield of transplanted aman rice was significanly affected by preceding crops. The significant residual effect of preceding legume on the grain yield of succeeding cereal crop may be due to improvement in soil fertility brought about by the legumes included in crop rotation (Sharma *et al.*, 1986). After the grain legumes (greengram, cowpea or blackgram) the rice yield was greater than after maize. The increase in panicle length, panicles/m^2, number of fertile grains/panicle and 1,000-grain weight in transplanted *aman* rice raised after blackgram was responsible for higher yield of transplanted alman rice. Misra and Misra (1975) and Lal *et al.* (1978) also reported similar results when wheat was grown after blackgram, greengram and cowpea.

Grain yield was significantly affected by nitrogen levels. Rice yield increased with the increasing levels of N application. The lowest yield was obtained from rice grown without added N.

The interaction between preceding crops and N fertilization was found statistically significant. Grain yield was higher when rice was sequentially followed by sole blackgram and blackgram + maize and least when transplanted *aman* rice was followed by broadcast *aus* rice. At the higher rate of N fertilization however, rice yield was maximum when the crop was followed by blackgram in sole and intercrop situation. At the lowest rate of N rice yield was significantly

Table 2. Grain and straw yields (tonnes/ha) of transplanted *aman* rice as influenced by preceding crops and N fertilization (pooled)

Treatment	Grain yield (tonnes/ha) at					Straw yield (tonnes/ha) at				
	N_0	N_{40}	N_{80}	N_{120}	Mean	N_0	N_{40}	N_{80}	N_{120}	Mean
Broadcast sole *aus* rice	2.31	3.18	3.79	3.86	3.27	2.31	3.02	3.76	3.95	3.25
Row-seeded sole *aus* rice	2.47	3.33	3.83	3.74	3.40	2.54	3.20	3.87	4.08	3.38
Row-seeded sole blackgram	2.73	3.62	4.20	4.32	3.71	2.70	3.71	4.28	4.42	3.77
Uniform maize row in sole stand	2.45	3.31	3.81	3.92	3.36	2.43	3.25	3.81	3.96	3.33
Maize paired row (100%) + blackgram rows (44%)	2.61	3.46	4.16	3.65	2.63	3.67	4.21	4.36	3.71	
Row-seeded *aus* rice (67%) + *Sesbania* broadcast in strip (33%)	2.63	3.45	3.97	4.04	3.51	2.59	3.54	4.04	4.19	3.51
Row-seeded *aus* rice (100%) + *Sesbania* broadcast (50%)	2.66	3.45	4.01	4.13	3.55	2.63	3.52	4.06	4.23	3.55
Row-seeded *aus* rice (67%) + blackgram rows (33%)	2.64	3.46	4.02	4.12	3.56	2.64	3.48	4.06	419	3.56
Mean (N level)	2.57	3.39	3.97	4.08		2.57	3.39	3.97	4.08	
CD (P = 0.05) for grain yield						*CD (P = 0.05) for straw yield*				
Preceding crops	0.01					Preceding crops	0.02			
N levels	0.01					N levels	0.01			
Any 2 treatment means	0.04					Any 2 treatment means	0.06			

lowest when it was preceded by cereal. At 80 kg N/ha added to transplantated *aman* rice, the yield of rice grown after blackgram or *Sesbania* in rotation was significantly higher than the transplantated *aman* rice yield recorded after cereals with 120 kg N/ ha. Hamid *et al.* (1984) reported that at the highest rate of N fertilization, rice yield was greatest when the crop was preceded by greengram and soybean and smallest after sorghum and fallow.

Pooled highest straw yield was recorded from higher doses of N either preceded by blackgram in sole and intercrop situation. The results revealed that all the legumes grown before rice increased the yield of straw compared with previous cereal crops at all N levels, although the magnitude of increase differed.

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