

Comparative performance of upland rice (*Oryza sativa*)-based intercropping systems under rainfed conditions of Vindhyan region

A. K. SINGH, R. A. SINGH AND R. P. SINGH

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University,
Varanasi, Uttar Pradesh 221 005

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ABSTRACT

A field experiment was conducted during 1988–1989 on sandy clay-loam soils of Vindhyan plateau under rainfed conditions, to maximize the productivity of upland rice (*Oryza sativa* L.)-based intercropping systems. The normal-sown rice (*Oryza sativa* L.) intercropped with sesame (*Sesamum indicum* L.) was more compatible and advantageous than other combinations. The highest yield recovery of rice (94.8%) and sesame (83.3%) was recorded from this system. Soybean [*Glycine max* (L.) Merr.] and blackgram or urdbean (*Phaseolus mungo* L.) were equally competitive with normal or paired-row-sown rice, but reduced the yield of rice by 7.8 and 11% in normal sown and 10.9 and 10.5% in paired-row-sown rice respectively. All the growth parameters and yield attributes of rice were favourably more under sole cropping, followed by normal rice intercropped with sesame. This combination recorded the highest rice-equivalent yield (48.09 q/ha) and yield advantage (78%), followed by paired rice + sesame intercropping system.

In the monsoon season rainfed, direct-sown upland rice (*Oryza sativa* L.) is a major crop of medium deep Ultisols of Vindhyan region, but the yield levels are very low as the crop suffers due to moisture stress because of the low water-holding capacity of the soil and erratic rainfall. Due to ill-distribution of rainfall in the region, farmers of the area follow mixed cropping as a measure of crop security. The farmers grow upland rice mixed with various oilseeds and pulses by broadcasting them. There is a great potential to increase the productivity of rice-based system through scientific method of intercropping. The present study was therefore taken to study

the compatibility of different crops and planting patterns with main crop rice.

MATERIALS AND METHODS

A field experiment was conducted for 2 years (1988 and 1989) under dryland conditions on sandy clay-loam soil (Ultisol) at the research farm Barkachha, Mirzapur of Banaras Hindu University. The intercropping of 'Akashi' upland rice was done with 'Durga' soybean [*Glycine max* (L.) Merr.], 'T 12' (*Sesamum indicum* L.) sesame and 'T 9' blackgram or urdbean (*Phaseolus mungo* L.) during monsoon season, with their respective pure stands. The experiment was laid out in randomized

Present address: ¹Division of Agronomy, Indian institute of Sugarcane Research, Lucknow, Uttar Pradesh 226 002

Table 1. Growth attributes of rice at maturity as affected by different treatments

Treatment	Plant height (cm)			Dry-matter accumulation (g/50 cm row)		
	1988	1989	Mean	1988	1989	Mean
Rice (normal) sole	68.5	68.3	66.9	74.0	74.2	74.1
Rice (paired) sole	68.0	68.5	66.8	68.5	68.7	68.6
Rice (normal) + soybean	66.0	66.3	66.2	66.0	66.5	66.3
Rice (paired) + soybean	65.5	65.4	65.5	66.5	66.8	66.7
Rice (normal) + sesame	68.0	68.3	68.2	67.6	67.8	67.7
Rice (paired) + sesame	67.9	67.6	67.8	65.5	65.7	65.6
Rice (normal) + urdbean	66.4	66.6	66.5	67.2	67.5	67.4
Rice (paired) + urdbean	66.5	66.8	66.7	67.5	67.8	67.7
LSD (P = 0.05)	2.12	1.64		0.87	1.03	

block design with 4 replications. In normal-sown rice, row spacing of 30 cm was kept, whereas in paired rows the rice crop was sown at a row distance of 20 cm and between 2 pairs of rows 40 cm space was left. The plant population of rice in both methods of sowing was 100% of the normal. In intercrop treatments, 1 row of intercrop was sown between 2 normal rows or interspace of pairs of rows of rice keeping the plant population of intercrop at 75%. During both the years, the sowing was done just after the commencement of the regular monsoon. Recommended fertilizer doses of 80 kg N/ha, 40 kg P_2O_5 /ha and 20 kg K_2O /ha for rice; 20 kg N, 80 kg P_2O_5 and 40 kg K_2O /ha for soybean; 18 kg N, 46 kg P_2O_5 and 20 kg K_2O /ha for urdbean and 40 kg N, 20 kg P_2O_5 and 20 kg K_2O /ha for sesame were applied as furrow placement at the time of sowing. The soil of the experimental field was medium in nitrogen (140 kg N/ha) and potassium (230 kg K_2O /ha) and low in phosphorus (10.5 kg P_2O_5 /ha). The rainfall during the cropping seasons (June to October) was 978.0 and 999.8 mm during 1988 and 1989 respectively.

RESULTS AND DISCUSSION

Growth attributes

The growth of rice in terms of plant height and dry-matter accumulation was recorded at different stages; however, the data have been presented for maturity stage only (Table 1). The plant height and dry-matter accumulation of rice was the highest in sole crop of rice. The dry-matter accumulation by rice plants was significantly reduced when intercropped with different crops. Among the intercrops, sesame had lesser competition than others.

Yield attributes

The yield attributes of rice, viz. effective tillers/m row length, length of panicles, grains/panicle and seed index, were recorded at maturity stage (Table 2). The seed index of rice was not affected significantly by different treatments. Like growth parameters, all these yield attributes of rice had higher values under sole crop of rice and reduced to significant level under intercropped treatments. Rice and sesame system proved better than others by recording higher yield attributes, followed

Table 2. Yield attributes of rice as affected by different treatments

Treatment	No. of effective tillers/m row			Panicle length (cm)			Grains/panicle			Seed index (g/1,000 grains)		
	1988	1989	Mean	1988	1989	Mean	1988	1989	Mean	1988	1989	Mean
Rice (normal) sole	115.5	113.8	114.7	14.1	14.1	14.1	53.4	53.5	53.5	17.4	17.6	17.5
Rice (paired) sole	114.1	112.9	113.5	14.0	14.1	14.1	53.2	53.5	53.4	17.3	17.3	17.3
Rice (normal) + soybean	85.5	85.3	85.4	12.0	12.3	12.2	48.4	48.1	48.3	17.5	17.5	17.5
Rice (paired) + soybean	80.4	83.5	82.0	11.0	12.2	12.1	44.5	44.8	44.7	17.4	17.4	17.4
Rice (normal) + sesame	111.0	110.7	110.9	13.6	13.5	13.6	52.0	52.5	52.3	17.6	17.5	17.6
Rice (paired) + sesame	110.5	108.8	109.7	13.5	13.4	13.5	51.5	51.5	51.5	16.9	17.2	17.1
Rice (normal) + urdbean	106.5	107.8	107.2	13.5	13.4	13.5	49.2	48.8	49.0	17.3	17.3	17.3
Rice (paired) + urdbean	98.5	103.4	101.0	13.4	13.3	13.4	49.6	49.5	49.6	17.7	17.4	17.6
LSD ($P = 0.05$)	3.55	2.97		0.21	0.60		0.97	0.76		NS	NS	

by rice + urdbean and rice + soybean in a decreasing order. In general, the yield attributes of rice in normal-sown crop were slightly higher as compared to paired-planting in sole as well as in intercropped systems.

Yield and land-equivalent ratio

Significantly highest grain yield of rice was recorded under normal-sown sole crop, followed by paired sole crop of rice. In intercropped treatments the highest productivity of rice was obtained in rice (normal) + sesame, which was 94.8% of the sole crop. Rice-equivalent yield and land-equivalent ratio calculated on the basis of market prices available after 1 month of harvest of the crop were 29.75–48.00 q/ha and 1.44–1.78 respectively in intercropping systems. These were higher than sole crop of rice. This indicates the higher biomass production resulting in more efficient utilization of land and available resources under rainfed conditions. Similar findings were noted by Sharma *et al.* (1986).

Rice yield was not good in sole cropping and it further decreased in intercropping system. The yields of intercrops also decreased in intercrop system than their sole optima, but the combined yields of all the intercropping systems on the basis of equivalent were increased by 2 folds or more compared with sole rice. The highest rice-equivalent yield (48.09 q/ha) was recorded in rice (normal) + sesame intercropping system. This system also accounted for maximum yield advantage (78%) over its sole crop. The next best combination was rice (paired) + sesame. In general, normal-sown rice with intercrop gave higher total productivity than paired-sown rice. Thus, intercropping of direct-sown upland rice with sesame or urdbean or soybean was

Table 3. Grain yield, yield recovery, rice-equivalent yield and land-equivalent ratio (LER) as influenced by treatments

Treatment	Crop yield (q/ha)			Yield recovery (%)	Rice-equivalent yield (q/ha)			LER		
	1988	1989	Mean		1988	1989	Pooled	1988	1989	Mean
Rice (normal) sole	18.76	18.90	18.83	100	18.76	18.90	18.83	1.00	1.00	1.00
Rice (paired) sole	18.32	18.45	18.39	100	18.32	18.45	18.39	1.00	1.00	1.00
Soybean sole	6.00	6.20	6.10	100	23.68	23.56	23.62	1.00	1.00	1.00
Sesame sole	8.20	8.00	8.10	100	34.53	38.00	36.27	1.00	1.00	1.00
Urdbean sole	6.50	6.40	6.45	100	20.53	20.00	20.27	1.00	1.00	1.00
Rice (normal) + soybean	17.21 (3.50)	17.50 (3.60)	17.36 (3.55)	92.2 (58.2)	31.03	31.18	31.11	1.50	1.51	1.51
Rice (paired) + soybean	16.65 (3.40)	16.50 (3.40)	16.58 (3.40)	88.1 (55.7)	30.07	29.42	29.75	1.45	1.42	1.44
Rice (normal) + sesame	17.76 (6.80)	17.95 (6.70)	17.86 (6.75)	94.8 (83.3)	46.39	49.78	48.09	1.76	1.79	1.78
Rice (paired) + sesame	16.99 (6.50)	17.00 (5.90)	17.00 (6.20)	90.3 (76.5)	44.36	45.03	44.70	1.70	1.64	1.67
Rice (normal) + urdbean	16.77 (4.50)	16.75 (4.30)	16.76 (4.40)	89.0 (68.2)	30.98	30.19	30.59	1.59	1.56	1.58
Rice (paired) + urdbean	16.77 (5.00)	16.55 (4.00)	16.66 (4.50)	88.5 (69.8)	32.56	29.05	30.81	1.66	1.50	1.58
LSD (P = 0.05)	0.92	0.65			2.24	2.99	1.33			

Figures in parentheses relate to intercrop

found more productive and advantageous on a system basis in Ultisols of Vindhyan region. Ghosh *et al.* (1986) and Prasad *et al.* (1989) also reported the similar results.

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