Indian Journal of Agronomy 44 (3) : 452—455 (September 1999)

Efficiency of rice (*Oryza sativa*)-based crop sequences under coastal ecosystem

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Received : June 1997

ABSTRACT

A field experiment conducted during 1994-95 and 1995-96 at Bhubaneswar revealed that preceding *in situ* green manuring of cowpea was beneficial for significant and highest grain yield of rice (3.26 t/ha). The yield attributes such as panicle length, fertile grains/panicle and harvest index were closely associated with the highest grain yield of rice. Rice-tomato ('BT 10') recorded highest net return (Rs 60, 618.95/ha) and benefit : cost ratio (4.42). Rice-groundnut recorded highest land use efficiency (63.86%) and energy output : input ratio (4.54). The production efficiency was however, superior (105.61 kg/ha/day) in rice-cabbage sequence.

Key words : Rice-based cropping system, Tomato, Cabbage, Cowpea, Sesame

Sequences of cropping is an unique asset to exploit sustainability in food production. Rice-based cropping system has assumed paramount importance to meet the dietary habits of 42% population of India. Inclusion of vegetables can generate employment, provide nutrition, security and additional income. The per capita availability of vegetable in Orissa is very low (19.5 kg/head/year) as compared to the I.C.M.R. prescription (36.5 kg/head/year). The productivity level of rice (14.65 q/ha), potato (11.25 t/ha) and mustard (4.93 q/ha) in Orissa is very less compared with that of national average of 17.41 q/ha, 16.22 t/ha and 9.03 q/ha respectively. The situation in groundnut is however, favourable. It was therefore thought necessary to investigate in detail to develop appropriate crops in sequence after rice crop under the coastal ecosystem.

MATERIALS AND METHODS

Field experiments were conducted during summer, *kharif* and *rabi* seasons of 1994-95 and 1995-96 at the Central Research Station, Orissa University of Agriculture and Technology, Bhubaneshwar at the same site and lay-out. The soil was sandy loam with pH 5.6 and organic carbon content of 0.40%. The soil fertility

status indicated 0.055% total N and 21 and 145 kg/ha available P_2O_5 and K_2O respectively. The experiment was conducted in randomized block design with 4 replications. Six treatments (Table 2) on rice based crop sequences, S_1 : rice-groundnut; S_2 : rice-tomato var. 'BT 2'; S_3 : rice-mustard; S_4 : rice cabbage, S_5 : rice-potato, and S_6 : rice-tomato var. BT 10 were taken during *kharif* and *rabi* seasons respectively, preceded by summer crops (S_1 : cowpea; S_2 : tomato-okra, S_3 : maize; S_4 : cabbage-okra; S_5 : sesame and S_6 : cowpea-green manure) as in Table 1. The crops were grown as per the recommended package of practices. Observation on rice 'Sarathi and succeeding crops were recorded as per standard statistical procedures. The meteorological observations indicated well-distributed rainfall during *kharif* season in both the years with highest value of 489.3 and 195.1 mm in the month of August in 1st and 2nd year respectively. The winter crops were also benefited with temperature ranging from 18.3 to 30.9 °C and 18.7 to 31.8°C in the respective years. Rice grain equivalent, land use efficiency and production efficiency were calculated as per the formula given below.

$$\text{Rice grain equivalent (RGE)} = \frac{\text{Yield of the produce (t/ha)} \times \text{price of the produce}}{\text{Price of rice (Rs/ha)}}$$

$$\text{Land use efficiency (\%)} = \frac{\text{Total duration of crop sequence}}{365} \times 100$$

$$\text{Production efficiency (kg/ha/day)} = \frac{\text{Total grain production/ha in sequence}}{\text{Total duration of crops in a sequence}}$$

The energy values were calculated as per the procedures outlined by Mittal *et al.* (1985)

RESULTS AND DISCUSSIONS

Residual effects of preceding crops on rice

The preceding crops (Table 1) had significant influence on yield and yield attributes of *kharif* rice. *In situ* green manuring of cowpea could help to produce highest grain yield on the succeeding *kharif* rice (3.26 t/ha). This could be due to in-building of soil physical and chemical constituents. Similar results were recorded by Hegde (1993). The higher grain yield was associated with significantly higher panicle length (22.35 cm), fertile grains/panicle (99.96) and harvest index (47.45%). The preceding crop of maize could never build the soil fertility and resulted in poor rice yield (2.92 t/ha). The results confirm the findings of Gangwar *et al.* (1995).

Performance of rabi crops

Tomato var. 'BT 2' (S_2) and 'BT 10' (S_6) could ride over other *rabi* crops in terms of yield. 'BT 10' recorded highest yield (31.33 t/ha) because of higher number and size of fruits. Similar results were obtained by Jha *et al.* (1996). The performance of cabbage, potato and groundnut was better but the situation was deplorable in mustard.

Efficiency of crop sequences

The net return (Rs 61,618/ha) and benefit : cost ratio (4.43) were highest in rice-tomato var. 'BT 10' (S_6) followed by rice-

Table 1. Effect of preceeding crops on yield of rice

Treatment	Grain yield (t/ha)			Panicle length (cm)			Fertile grains/panicle			Harvest index (%)		
	1994-95	1995-96	Mean	1994-95	1995-96	Mean	1994-95	1995-96	Mean	1994-95	1995-96	Mean
S_1 (Cowpea)	3.22	3.20	3.21	21.19	21.60	21.39	91.30	88.25	89.77	45.31	46.17	45.74
S_2 (Tomato-okra)	2.97	3.04	3.05	19.80	18.96	19.38	81.20	82.80	82.00	45.40	45.03	45.22
S_3 (Maize)	2.94	2.91	2.92	17.97	17.48	17.72	79.90	75.52	77.71	42.09	44.83	43.46
S_4 (Cabbage-okra)	3.04	3.01	3.02	19.49	18.92	19.20	83.20	81.62	82.41	43.24	44.94	44.09
S_5 (Sesame)	3.14	3.11	3.12	20.17	19.96	20.06	87.80	83.75	85.78	41.14	45.60	43.37
S_6 (Green manuring of cowpea)	3.29	3.23	3.26	22.46	22.25	22.35	99.50	94.42	99.96	48.52	46.37	47.45
CD (P = 0.05)	0.09	0.03		1.35	1.04		NS	11.61		1.50	0.25	

Table 2. Relative efficiency of different cropping systems and their economics

Treatment	Yield of rabi crops (t/ha)	Rice grain equivalent (t/ha)			Land use efficiency (%)			Production efficiency (kg/ha/day)			Net return (Rs/ha) (mean of 2 years)	Benefit : cost ratio (mean of 2 years)
		1994-95	1995-96	Mean	1994-95	1995-96	Mean	1994-95	1995-96	Mean		
S_1 (Rice-groundnut)	1.76	8.63	7.94	8.28	68.20	59.45	63.86	34.66	36.58	35.62	57,181.77	1.81
S_2 (Rice-tomato var. 'BT 2')	30.16	20.11	22.72	21.41	63.00	61.64	62.30	87.43	100.96	94.19	57,181.77	4.24
S_3 (Rice-mustard)	1.02	6.11	6.06	6.02	59.70	53.42	56.56	28.05	30.87	29.46	8,931.85	1.65
S_4 (Rice-cabbage)	18.50	22.86	19.11	20.98	55.00	53.69	54.34	113.72	97.50	105.61	56,032.32	4.27
S_5 (Rice-potato)	18.88	14.22	20.89	17.55	56.40	55.61	56.01	69.03	2.95	85.99	40,553.42	2.93
S_6 (Rice-tomato var. 'BT 10')	31.33	21.41	23.67	22.54	63.00	62.46	62.73	93.10	3.84	98.47	60,618.95	4.43
CD (P = 0.05)		1.10	0.75					5.18	3.45			

tomato var. 'BT 2' (S_2). The rice grain equivalent was not satisfactory in rice-mustard (6.06 t/ha) and rice-groundnut (8.28 t/ha), whereas rice-tomato var. 'BT 10' recorded the highest value (22.54 t/ha). Rice-groundnut had the privilege to record highest LUE (63.86%). The production efficiency in rice-mustard was very poor (29.46 kg/ha/day), whereas it was highest in rice-cabbage sequence (105.61 kg/ha/day). However, rice-tomato (S_6) recorded moderate P.E. of 98.47 kg/ha/day. The energy requirement for varying crop sequences indicated that rice-potato (S_5) required highest energy input (39.03×10^3 MJ/ha) and output (106.88×10^3 MJ/ha). The energy output : input ratio was however the highest in rice-groundnut (4.54) followed by rice-mustard (3.99). Similar results were observed by Padhi (1993).

REFERENCES

Gangwar, K.S., Sharma, S.K. and Tomar, R.K. 1995. Evaluation of different cropping systems under irrigated upland conditions. *Indian Journal of Agronomy* **40** (9) : 491-492.

Hegde, D.M. 1993. Benefits of green manuring in cereal based sequence. *Indian Farming* **2** : 26-27.

Jha, K.P., Singh, Y.V., Sasmal, S. and Jha, Sunita. 1996. Suitable rice based cropping systems for alluvial soils of coastal Orissa. *Indian Farming* **2** : 4-9.

Mittal, V.K., Mittal, J.P. and Dhawan, K.C. 1985. Research digest on energy requirement in Agriculture section. Co-ordinating cell, AICRP, PAU, Ludhiana.

Padhi, A.K. 1993. Productivity and economics of rice based cropping sequences. *Indian Journal of Agronomy* **38** (3) : 351-356.