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Growth, yield and economics of rice (*Oryza sativa*)–finger millet (*Eleusine coracana*) crop sequence as influenced by coirpith and farmyard manure with and without inorganic fertilizers

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ABSTRACT

The response to coirpith and farmyard manure (FYM) with and without recommended inorganic fertilizers (RIF) in respect of growth and yield of rice (*Oryza sativa* L.)–finger millet [*Eleusine coracana* (L.) Gaertn] crop sequence was studied during 1998–2000. Growth and yield parameters were generally higher in FYM @ 12.5 tonnes/ha + RIF application and was comparable with the composted coirpith (CCP) @ 12.5 tonnes/ha + RIF application. The lowest growth and yield attributes were recorded with raw coirpith application alone. Significantly higher mean grain yield of 6,632 and 6,471 kg/ha in rice was recorded with application of FYM + RIF and CCP + RIF, respectively, and were comparable with each other. This was 50% and 46.4% increase over the control. Similarly, for finger millet the yield increase was 60.7 and 55.8% with FYM + RIF (2,816 kg/ha) and CCP + RIF (2,739 kg/ha). The net returns and benefit : cost ratio were more in rice–finger millet cropping sequence applied with FYM + RIF (Rs 29,960/ha) and CCP + RIF (Rs 29,356/ha), while it was lowest in raw coirpith application realising Rs 14,751/ha only.

Key words : Rice–finger millet crop sequence, Coirpith, FYM, Inorganic fertilizer, Growth, Yield, Economics

In the North-western agroclimatic zone of Tamil Nadu, rice–finger millet crop sequence is predominantly adopted under irrigation. The yields of these crops are far below the state average due to coarse-textured, less-nutrient retentive and poor organic reserve soil. Coirpith (coir waste or coconut fibre waste), a by-product from coir industries, is made available to an extent of 0.2 to 0.3 million tonnes annually in Tamil Nadu.Coir waste could be a viable substitute in replacing scarce farmyard manure in terms of its nutrient value and amending nature by providing better soil physical and chemical properties (Parasuraman and Mani, 2001; Singaram and Pothiraj, 1991; Satyanarayana *et al.,* 1984).

So far no studies have been taken up to explore the possibilities of using coir waste either as raw or composted in combination with recommended inorganic fertilizers to rice–finger millet crop sequence of the zone. Hence a study on the effect of coir waste on growth, yield and economics was undertaken as it would give better scope for coir-waste usage and can be a boon to the farming community to use the coir waste as potential manure.

MATERIALS AND METHODS

The field experiment was conducted at Regional Research Station, Paiyur, during 1998–2000 in rice–finger millet crop sequence under irrigated conditions. The soil of the experimental site was sandy loam (Typic Ustorthent) with pH 7.6 and electrical conductivity 0.42 dS/m. The available N, P and K status being low, medium and high were 242, 12.6 and 258 kg/ha respectively. The experiment was laid out in randomized block design with 3 replications. The treatments included were : T_1, control; T_2, recommended inorganic fertilizers (RIF) alone; T_3, raw coirpith (RCP) @ 12.5 tonnes/ha alone; T_4, composted coirpith (CCP)@12.5 tonnes/ha alone; T_5, farmyard manure (FYM) @ 12.5 tonnes/ha alone; T_6, RCP+RIF; T_7, CCP + RIF; and T_8, FYM + RIF. The treatments were imposed to rice–finger millet crop sequence. The recommended fertilizer dose for rice is 150:50:50 kg N : P : K/ha and for finger millet 60 : 30 : 30 kg N : P : K/ha. The coirpith and FYM were incorporated before transplanting as per the treatment schedule (RCP– 0.26% N, 0.05% P and 1.24% K; CCP – 1.08% N, 0.07%

P and 1.4% K; FYM – 0.32% N, 0.13% P and 0.24% K). First crop of rice ('Paiyur 1') was raised during November–December depending on the release of canal water from Krishnagiri Reservoir Project of Thenpennai River. The second crop of finger millet ('DPI 2011') was planted in the same field after the harvest of the first season rice with similar set of treatments without altering the layout plan continuously for 2 years. The data on plant height, productive tillers, panicle length, test weight of the grain, grain and straw yields were recorded at the time of harvest. Economics of the rice–finger millet cropping system as a whole pertaining to different treatments imposed was also worked out.

RESULTS AND DISCUSSION

Growth and yield attributes

Rice responded well to fertilizer application with and without organic manure substitution. Maximum plant height was recorded with an integrated package of FYM + RIF, followed by CCP+RIF. Except RCP alone, all other treatments recorded more plant height than the control (Table 1). The reduced plant height under RCP may be due to the fact that during the process of decomposition of coirpith, there would be temporary locking of nutrients, especially nitrogen by the microbes for their survival and multiplication.

Significant higher values of yield attributes, viz. productive tillers/hill, panicle length, grains/panicle and 1,000-grain weight, were recorded by integration of inorganic fertilizers with organic manure of varied sources. It showed that under the integrated nutrition, the crop enjoyed a better nutritional environment and was reflected in the yield attributes as well. The chaffy grains/panicle were more in RCP, while it was lesser under FYM + RIF. In finger millet also, the effect of treatments on growth and yield attributes followed similar trend (Table 2) and more beneficial nature of combined use of FYM and CCP with RIF was more pronounced than other treatments.

Yield

Significantly higher mean grain yield in rice was obtained with FYM + RIF and CCP + RIF, with a yield increase of 50.0 and 46.4% over control and 13.1 and

Table 1. Growth and yield attributes of rice as influenced by coirpith and FYM with and without inorganic fertilizers (mean data of 2 years)

Treatment	Plant height at harvest (cm)	Productive tillers/hill	Panicle length (cm)	Grains/ panicle	Chaffy grains/ panicle	1,000-grain weight (g)
T_1, Control	98.0	7.2	22.7	198.4	25.7	16
T_2, RIF alone	112.6	8.0	23.2	231.0	16.2	17
T_3, RCP alone	94.9	7.0	22.2	192.0	30.7	15
T_4, CCP alone	100.9	7.4	23.2	216.2	23.5	16
T_5, FYM alone	106.3	7.5	23.2	218.9	20.7	17
T_6, RCP + RIF	111.8	8.1	23.9	244.0	19.5	17
T_7, CCP + RIF	119.4	8.9	24.0	255.4	16.7	17
T_8, FYM + RIF	121.3	9.2	24.5	270.2	13.5	18
CD (P=0.05)	9.6	0.65	0.65	22.9	4.0	0.5

RIF, Recommended inorganic fertilizers; RCP, raw coirpith; CCP, composted coirpith; FYM, farmyard manure

Table 2. Growth and yield attributes of finger millet as influenced by coirpith and FYM with and without inorganic fertilizers (mean data of 2 years)

Treatment	Plant height at harvest (cm)	Tillers/ panicle	Panicle length (cm)	Fingers/ panicle	Length of panicle (cm)	1,000-grain weight (g)
T_1, Control	68.6	2.5	7.5	4.4	6.6	2.59
T_2, RIF alone	72.5	3.2	8.2	4.9	7.1	2.69
T_3, RCP alone	66.2	2.3	7.1	3.9	6.4	2.55
T_4, CCP alone	69.4	2.7	7.7	4.8	6.7	2.71
T_5, FYM alone	71.0	3.1	7.9	4.8	7.1	2.73
T_6, RCP + RIF	73.5	3.3	8.2	4.9	7.2	2.65
T_7, CCP + RIF	75.9	3.4	8.5	5.7	7.4	2.78
T_8, FYM + RIF	77.9	3.9	8.8	6.5	7.7	2.79
CD (P=0.05)	5.1	0.3	0.4	0.95	0.45	0.14

RIF, Recommended inorganic fertilizers; RCP, raw coirpith; CCP, composted coirpith; FYM, farmyard manure

10.3%, respectively, over RIF alone (Table 3). Least grain yield of 4,202 kg/ha was recorded by RCP alone. All other treatments significantly recorded higher yield than RCP and the control. The mean straw yield of 9.5 and 8.8 tonnes/ha was recorded by FYM + RIF and CCP + RIF, with an increase of 55.7 and 44.3% over the control. The RIF alone rated best than RCP, CCP and FYM alone. However, among the organic manures, FYM recorded higher straw yield followed by CCP.

In finger millet, while not much variation observed between the 2 years, the pooled grain yield differed markedly (Table 3). Maximum grain yield of 2,816 kg/ha was recorded in FYM + RIF, being at par with that obtained from CCP + RIF. All the treatments remained inferior to the above treatments with a yield of 1,486 to 2,245 kg/ha. Comparing with 1998–99, the straw yield was relatively more in 1999–2000. The FYM + RIF outyielded all others with a maximum yield of 3.5 tonnes/ha.

Organic manure alone or RIF alone recorded less yield to the combined application of organic manure with RIF. This may be due to the balanced nutrition of the crop from organic source that favours the crop with slow and steady nutrient availability throughout the crop-growth period, from the inorganic source that meets out the immediate requirements in an adequate level. This would have helped the crop for better growth, enhanced yield-attributing parameters and finally the yield. The organic manures except RCP though proved better than the control, they could not compete with integrated nutrient involved treatments because that these manures though supply all the nutrients, it may not be in sufficient levels and hence lesser yield. The RIF alone did not stand before organic manures+RIF due to the fact that though enough quantity of nutrient is supplied, it was only for a short period but not throughout the crop cycle. Favourable effect of integrated use of FYM with inorganics (Singh *et al.*, 2001) and green-manures with inorganics (Sumathy *et al.*, 1999)

Table 3. Grain and straw yields of rice and finger millet as influenced by coirpith and FYM with and without inorganic fertilizers

Treatment	Rice						Finger millet					
	Grain yield (kg/ha)			Straw yield (tonnes/ha)			Grain yield			Straw yield		
	1998–99	1999–2000	Pooled	1998–99	1999–2000	Pooled	1998–99	1999–2000	Pooled	1998–99	1999–2000	Pooled
T_1, Control	4,522	4,319	4,421	6.3	5.9	6.1	1,997	1,792	1,758	2.0	3.1	2.5
T_2, RIF alone	5,804	5,938	5,865	8.4	7.5	8.2	2,396	2,219	2,285	2.3	3.6	2.9
T_3, RCP alone	4,324	4,080	4,202	5.9	5.7	5.8	1,969	1,623	1,486	1.8	2.8	2.3
T_4, CCP alone	5,420	4,551	4,895	6.6	6.2	6.4	2,059	2,038	1,726	2.0	3.2	2.6
T_5, FYM alone	5,503	5,219	5,361	6.6	7.3	7.0	2,198	2,152	1,974	2.1	3.3	2.7
T_6, RCP + RIF	5,851	6,175	6,013	7.3	7.9	7.6	2,411	2,300	2,245	2.3	3.6	2.9
T_7, CCP + RIF	6,223	6,719	6,471	8.9	9.5	8.8	2,940	2,664	2,739	2.5	4.0	3.0
T_8, FYM + RIF	6,489	6,775	6,632	9.2	9.8	9.8	3,083	2,729	2,816	2.6	4.5	3.5
CD (P=0.05)	998	1042	491	0.7	0.8	1.0	165	218	182	0.3	0.5	0.3

RIF, Recommended inorganic fertilizers; RCP, raw coirpith; CCP, composted coirpith; FYM, farmyard manure

Table 4. Economics of rice–finger millet cropping sequences as influenced by coirpith and FYM with and without inorganic fertilizers

Treatment	Net income (Rs/ha)			Benefit : cost		
	1998–99	1999–2000	Mean	1998–99	1999–2000	Mean
T_1, Control	19,322	17,252	18,287	1.9	1.8	1.9
T_2, RIF alone	25,517	24,990	25,254	2.0	1.9	2.0
T_3, RCP alone	16,254	13,248	14,751	1.7	1.6	1.7
T_4, CCP alone	21,024	17,673	19,349	1.9	1.7	1.8
T_5, FYM alone	21218	20,622	20,920	1.8	1.8	1.8
T_6, RCP + RIF	23,463	25,481	24,472	1.9	1.9	1.9
T_7, CCP + RIF	28,866	30,845	29,856	2.1	2.1	2.1
T_8, FYM + RIF	29,339	29,980	29,960	2.0	2.0	2.0

RIF, Recommended inorganic fertilizers; RCP, raw coirpith; CCP, composted coirpith; FYM, farmyard manure

was reported in rice. Similarly, integrated use of FYM or composted coirpith @ 12.5 tonnes/ha with recommended inorganic fertilizers recorded the highest grain yield in sorghum–soybean crop sequence (Appavu *et al.*, 2000) and in groundnut (Raj kannan *et al.*, 2001).

Economics

Maximum net returns and benefit : cost ratio were obtained from FYM + RIF and CCP + RIF (Table 4). Application of RIF alone rated next best and all other treatments gave lesser income and benefit : cost ratio. Incorporation of coirpith or FYM @12.5 tonnes/ha along with recommended inorganic fertilizers increased the seed yield, net income and benefit : cost ratio of sesame (Parasuraman and Rajagopal, 1998). Hence application of RIF coupled with FYM or CCP is efficient in increasing the yield and for better returns in rice–finger millet cropping sequence.

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