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Response of hybrid rice (*Oryza sativa* L.) to green leaf manure, FYM and chemical fertilizers

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ABSTRACT

A two year field experiment was undertaken during wet season of 1998 and 1999 to study the effect of chemical fertilizers and green leaf manuring or FYM in combination with chemical fertilizers on growth, yield attributes and yield of hybrid rice, uptake of nutrients and content of nutrients in soil after cropping. Different treatments consisting of combined application of green manuring or FYM with chemical fertilizers significantly influenced the yield attributes and yield compared with suboptimal recommended dose of fertilizers and control. Application of organic manures or green leaf manures in conjunction with chemical fertilizers significantly influence the N, P and K uptake in grain and straw of rice compared to control. Available N, P and K contents were also significantly affected by combined application of organic manures, green manures with chemical fertilizers compared to control.

Key words : Green leaf manure, Hybrid rice, Chemical fertilizer, Organic manure

INTRODUCTION

The rising cost of fertilizers and need to conserve plant nutrients by recycling them focuses attention on organic materials as sources of fertilizer elements. The organic manures presently provide on an average only 23 kg nutrients per ha in India. This can be increased considerably by proper utilization of available organic material. The continuous unbalanced use of fertilizers in cropping system often leads to disproportionate nutrient availability and adverse effect on physico-chemical properties of soil which finally results in to decline crop yields. The integrated use of organic manures, green manures and chemical fertilizers can help to maintain optimum crop yields and required soil nutrient pool on a sustained basis. Thus, there is a vast scope for increasing nutrient supply through use of green manures, organic manures and use of improved varieties. However, there is no scope for reducing the consumption of chemical fertilizers since the level of crop productivity is not only to be maintained but it is to be increased in the coming years which is presently not possible without the use of chemical fertilizers. The fertilizer use should be promoted till a full proof low input technology for higher productivity is available. Therefore, study has been formulated to find out response of hybrid rice to green leaf manuring, FYM and integrated nutrient supply system.

MATERIALS AND METHODS

The experiments were conducted at Agronomy Farm, Konkan Krishi Vidyapeeth, Dapoli for two consecutive seasons, 1998-99 and 1999-2000. The soil of the experimental plot was clay loam in texture, medium in available nitrogen (295.22 Kg/ha), low in available phosphorus (12.96 Kg/ha) and potassium (105.03 Kg/ha).

Table 1: Details of treatments and symbols used

Symbol	Treatments	
	Kharif (rice)	*Rabi* (groundnut)
T_1	No organic manures, No chemical fertilizers	No organic manures, No chemical fertilizers
T_2	50% recommended NPK through fertilizers	75% recommended NPK through fertilizers
T_3	50% recommended NPK through fertilizers	100% recommended NPK through fertilizers
T_4	75% recommended NPK through fertilizers	75% recommended NPK through fertilizers
T_5	100% recommended NPK through fertilizers	100% recommended NPK through fertilizers
T_6	100% recommended NPK through fertilizers	75% recommended NPK through fertilizers
T_7	75% recommended NPK through fertilizers	100% recommended NPK through fertilizers
T_8	50% recommended NPK through fertilizers + 50% N through FYM	75% recommended NPK through fertilizers
T_9	75% recommended NPK through fertilizers + 25% N through FYM	100% recommended NPK through fertilizers
T_{10}	50% recommended NPK through fertilizers + 50% N through Glyricidia	75% recommended NPK through fertilizers
T_{11}	75% recommended NPK through fertilizers + 25% N through Glyricidia	100% recommended NPK through fertilizers

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The experiment was laid out in Randomized Block Design with three replications. The treatment details are given in Table 1. During both the years, rice seedlings were transplanted in the first week of July in *kharif*. Fertilizers were applied as per treatments. N was applied in three splits to rice crop along with basal application of P and K. Recommended package of practices for crop was followed. Plant protection measures were undertaken as and when required.

RESULTS AND DISCUSSION

Analysied variance carried out for growth parameter and yield contributing attributes are presented in Table 2, 3, 4, 5 and 6.

Effect of green leaf manure, FYM and chemical fertilizers on growth characters:

Increased production of hybrid rice due to combined application of organic manures and chemical fertilizers can be explained in the light of growth contributory characters (Table 2). Height of plant, number of leaves and number of tillers per hill at various growth stages clearly brought out the superiority of treatment involving 50% recommended NPK through fertilizers + 50% N either through glyricidia or FYM. The dry matter accumulation is considered to be the reliable index of crop growth and was significantly influenced by application of 50% recommended NPK through fertilizers + 50% N either through glyricidia or FYM during both the years. The results are in conformity with those reported by Reddy *et al*. (1972), Bal (1990) and Shinde (1995).

Effect of green leaf manure, FYM and chemical fertilizers on yield attributing characters:

Treatment T_{10} (50% RDF + 50% N through glyricidia) and 100% RDF (T_5 and T_6) recorded significantly more number of panicles per hill compared to the remaining treatments, but the differences between former three treatments were of the similar magnitude. T_8 (50% RDF + 50% N through FYM), T_{11} (75% RDF + 25% N through glyricidia) and T_9 (75% RDF + 25% N through FYM) also showed their supremacy over rest of the treatments, but the differences between former three treatments were of the similar order.

In case of yield attributing characters like length of panicle, number of filled grains per panicle, number of unfilled grains per panicle, weight of grains per panicle and 1000 grain weight, it was observed from the data presented in Table 3 that T_{10} (50% RDF + 50% N through glyricidia), T_8 (50% RDF + 50% N through FYM), T_{11} (75% RDF + 25% N through glyricidia), T_9 (75% RDF + 25% N through FYM) and 100% RDF (T_5 and T_6) produced its superiority with respect to yield attributes longer panicles over rest of the treatments, while former six treatments behaved similarly with each other, during both the years.

Better performance of combined use of organic manures with chemical fertilizers might be due to synergistic effect of inorganic fertilizers and organic manures, as well as the slow release of nutrients throughout the crop growth, thus helping to form more photosynthates and translocating the same from source to sink. (Peeran and Ramulu, 1995). Matiwade and

Table 2 : Effect of different treatments on growth attributes of rice

Symbol	Treatments	Plant height at harvest (cm)		No. of tillers/hill at harvest		No. of leaves/hill at harvest		Dry matter at harvest (g)	
		1998	1999	1998	1999	1998	1999	1998	1999
T_1	Control	81.31	81.55	7.06	7.06	28.53	27.66	32.94	32.67
T_2	50% RDF	100.66	101.78	8.40	8.53	37.93	38.53	52.74	55.80
T_3	50% RDF	100.85	103.00	8.60	8.73	38.46	39.93	53.12	56.32
T_4	75 % RDF	104.74	106.76	9.60	9.73	48.26	46.80	60.43	63.30
T_5	100 % RDF	110.66	111.43	11.27	11.26	55.40	56.60	69.82	70.50
T_6	100 % RDF	110.08	111.38	11.06	11.47	55.26	56.27	69.67	69.90
T_7	75 % RDF	104.88	106.88	9.93	9.87	47.33	47.60	61.22	63.56
T_8	50 % RDF+50 % N through FYM	109.97	113.22	13.60	13.66	59.93	61.33	72.17	74.90
T_9	75 % RDF+25 % N through FYM	109.62	112.50	12.80	13.07	58.27	60.26	70.28	73.46
T_{10}	50 % RDF+50 % N through Gly.	112.58	115.24	13.66	13.87	60.27	62.07	73.77	76.22
T_{11}	75 % RDF+25 % N through Gly.	111.03	113.73	12.93	13.26	58.33	60.53	71.18	74.64
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	1.10	1.02	0.31	0.37	0.80	1.16	1.38	1.73
	C.D. (P=0.05)	3.24	3.00	0.93	1.08	2.38	3.42	4.10	5.11

Table 3 : Effect of different treatments on yield attributes of rice

Symbol	Treatments	1998 No. of panicles/ hill	1998 Length of panicle (cm)	1998 No. of filled grains/ panicle	1998 No. of unfilled grains/ panicle	1998 Weight of grains/ panicle (cm)	1998 1000 grain weight (g)	1999 No. of panicles/ hill	1999 Length of panicle (cm)	1999 No. of filled grains/ panicle	1999 No. of unfilled grains/ panicle	1999 Weight of grains/ panicle (cm)	1999 1000 grain weight (g)
T_1	Control	6.93	20.00	90.57	13.97	2.60	28.78	7.00	22.00	90.60	12.10	2.62	28.89
T_2	50% RDF	8.60	22.18	100.23	11.83	2.93	29.24	8.53	24.20	101.87	10.87	2.98	29.30
T_3	50% RDF	8.66	22.85	101.86	11.66	2.99	29.30	8.80	24.83	101.16	10.80	3.00	29.32
T_4	75 % RDF	9.00	25.18	107.43	9.86	3.14	29.34	9.50	26.72	108.40	8.93	3.19	29.38
T_5	100 % RDF	10.77	27.88	112.27	8.30	3.29	29.49	10.77	28.72	114.20	7.20	3.38	29.55
T_6	100 % RDF	10.67	27.87	110.93	8.43	3.28	29.46	10.67	28.60	113.87	7.43	3.36	29.50
T_7	75 % RDF	9.10	25.85	107.13	9.77	3.14	29.40	9.60	26.90	108.96	8.83	3.24	29.41
	50% RDF + 50% N through FYM	10.33	29.09	113.40	7.80	3.36	29.78	10.56	29.32	115.40	6.60	3.46	29.80
	75% RDF + 25% N through FYM	10.13	28.00	113.66	7.90	3.32	29.70	10.30	29.02	114.57	6.90	3.38	29.68
	50% RDF + 50% N through Gly.	10.80	29.46	113.76	6.70	3.36	29.88	10.80	29.50	116.83	5.77	3.46	29.86
T_{11}	75%RDF + 25% N through Gly.	10.26	28.36	112.80	6.93	3.35	29.69	10.40	29.10	114.83	5.93	3.43	29.72
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	0.096	0.57	1.09	0.44	0.045	0.28	0.17	0.53	1.38	0.39	0.03	0.27
	C.D. 5 %	0.28	1.69	3.22	1.30	0.13	0.82	0.52	1.55	4.07	1.15	0.10	0.79

Sheelavanter (1994) observed that grain yield is essentially the manifestation of yield contributing characters of crops.

Effect of green leaf manure, FYM and chemical fertilizers yield (q/ha):

Application of 50% RDF + 50% N either through Glyricidia (T_{10}) or FYM (T_8), 75% RDF + 25% N through glyricidia (T_{11}) or FYM (T_9), 100% RDF (T_5 and T_6) proved significantly superior with respect to grain yield of rice over rest of the treatments during both the years, but the differences between former six treatments were of the similar order (Table 4). T_{10}, recorded 105.41, and 104.85 % higher grain yield over T_6, during 1998 and 1999, respectively.

Regarding straw yield, T_{10}, T_{11} T_8, T_9, T_5 and T_6 were significantly superior over rest of the treatments during both the years. The differences in respect of straw yield between T_{10}, T_8 T_{11} and T_9 were found to be not significant, during both the years. While in 1999, T_{10} proved significantly superior over T_5 and T_6. Many workers have demonstrated identical results with different combinations of organic and inorganic sources of nutrients (Bal, 1990, Patil *et al.*, 1991; Shinde, 1995).

Effect of green leaf manure, FYM and chemical fertilizers on N, P and K content (%) in grain and straw:

Data regarding per cent nitrogen content in rice grain and straw as affected by different treatments are presented in Table 5. It could be seen that, treatment T_{10} (50% RDF + 50% N through glyricidia), T_8 (50% RDF + 50% N through FYM), T_{11}, T_6, T_9 and T_5 recorded significantly higher nitrogen content in rice grain and straw compared to the remaining treatments, but the differences between these six treatments were of the similar magnitude during both the years.

Data regarding per cent phosphorus content revealed that treatment T_{10} (50% RDF + 50% N through glyricidia) registered significantly higher phosphorus content in rice grain and straw than the remaining treatments, except T_5 and T_6.

It was evident from the data that, T_5, T_8, T_9, T_{11}, T_{10} and T_6 registered significantly higher potassium content in grain over rest of the treatments but the differences between former six treatments, as well as between T_7 and T_4, T_3 and T_2 were not upto the level of significance, during both the years. During both the years T_{10} proved significantly superior over

Table 4 : Mean grain yield (q/ha), straw yield (q/ha) and pooled data of hybrid rice as affected by different treatments

Symbol	Treatments	1998		1999		Pooled mean	
		Grain yield (q/ha)	Straw yield (q/ha)	Grain yield (q/ha)	Straw yield (q/ha)	Grain yield (q/ha)	Straw yield (q/ha)
T_1	Control	37.32	37.23	37.22	37.10	37.27	37.17
T_2	50 % RDF	52.88	55.34	54.89	56.91	53.89	56.13
T_3	50 % RDF	55.09	57.31	55.43	57.11	55.26	57.21
T_4	75 % RDF	61.23	63.62	63.37	65.49	62.30	64.56
T_5	100 % RDF	67.57	69.85	69.47	71.43	68.52	70.64
T_6	100 % RDF	67.07	69.39	69.21	71.16	68.14	70.28
T_7	75 % RDF	61.41	63.74	64.71	66.77	63.06	65.26
T_8	50 % RDF + 50 % N through FYM	69.31	71.07	71.42	73.66	70.37	72.37
T_9	75 % RDF + 25 % N through FYM	68.80	70.05	69.91	72.21	69.36	71.13
T_{10}	50 % RDF + 50 % N through Gly.	70.70	72.47	72.57	74.76	71.64	73.62
T_{11}	75 % RDF + 25 % N through Gly.	69.01	71.76	71.13	73.33	70.07	72.55
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	1.55	1.58	1.22	1.17	0.91	0.91
	C.D. (=0.05)	4.57	4.66	3.59	3.45	2.51	2.52
	Mean	61.85	63.80	63.58	65.45	62.72	64.63

Table 5 : Effect of different treatments on N, P and K content (%) of rice

Symbol	Treatments	1998						1999					
		N content (%)		P content (%)		K content (%)		N content (%)		P content (%)		K content (%)	
		Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1	Control	0.95	0.28	0.20	0.057	0.116	1.26	0.93	0.29	0.20	0.058	0.117	1.26
T_2	50% RDF	1.02	0.34	0.24	0.078	0.135	1.50	1.09	0.35	0.24	0.078	0.136	1.51
T_3	50% RDF	1.03	0.34	0.25	0.082	0.139	1.51	1.13	0.37	0.25	0.082	0.138	1.52
T_4	75 % RDF	1.19	0.41	0.30	0.108	0.162	1.57	1.24	0.44	0.29	0.110	0.162	1.59
T_5	100 % RDF	1.30	0.51	0.34	0.122	0.180	1.66	1.32	0.52	0.36	0.124	0.182	1.67
T_6	100 % RDF	1.31	0.51	0.34	0.121	0.173	1.64	1.32	0.52	0.35	0.122	0.174	1.65
T_7	75 % RDF	1.22	0.45	0.29	0.110	0.164	1.58	1.24	0.46	0.29	0.111	0.165	1.59
T_8	50 % RDF + 50 % N through FYM	1.34	0.54	0.33	0.118	0.176	1.63	1.36	0.56	0.34	0.120	0.178	1.64
T_9	75 % RDF + 25% N through FYM	1.30	0.51	0.31	0.116	0.175	1.61	1.32	0.52	0.32	0.117	0.176	1.63
T_{10}	50 % RDF + 50 % N through Gly.	1.35	0.55	0.37	0.124	0.173	1.67	1.37	0.57	0.38	0.126	0.174	1.68
T_{11}	75 %RDF + 25 % N through Gly.	1.32	0.52	0.33	0.123	0.174	1.62	1.34	0.55	0.34	0.126	0.177	1.64
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	0.021	0.015	0.01	0.003	0.003	0.009	0.019	0.016	0.01	0.0033	0.003	0.015
	C.D. 5 %	0.060	0.045	0.03	0.010	0.008	0.025	0.056	0.047	0.03	0.0099	0.008	0.041

all the remaining treatments, except T_5 and T_6, where the differences were not significant in respect of potassium content in rice straw.

Effect of green leaf manure, FYM and chemical fertilizers on N, P and K uptake (kg/ha) in grain and straw:

Data regarding per cent nitrogen content in rice grain and straw as affected by different treatments are presented in Table 6. In 1998, T_{10} (50% RDF + 50% N through glyricidia) registered significantly higher N uptake by rice grain and straw as compared to rest of the treatments, While in 1999, more or less similar trend was observed, except that T_{11} recorded significantly higher N uptake by rice grain compared to rest of the treatments.

Treatment T_{10} (50% RDF + 50% N through

Table 6 : Effect of different treatments on N, P and K uptake of rice

Symbol	Treatments	1998						1999					
		N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)		N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
		Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1	Control	35.36	10.44	7.48	2.11	4.33	46.97	34.63	10.94	7.31	2.17	4.38	46.92
T_2	50% RDF	54.14	18.98	12.52	4.31	7.15	83.06	59.63	19.91	13.19	4.43	7.44	86.12
T_3	50% RDF	56.73	19.53	13.99	4.71	7.65	85.86	62.59	21.22	13.74	4.68	7.64	86.88
T_4	75 % RDF	72.85	26.16	18.35	6.91	9.92	99.78	78.59	28.87	18.56	7.24	10.40	104.02
T_5	100 % RDF	87.78	35.56	23.05	8.50	12.16	116.01	90.73	37.70	24.90	8.85	12.49	119.69
T_6	100 % RDF	87.89	35.35	22.83	8.46	11.60	113.77	91.69	37.61	24.31	8.75	11.97	118.52
T_7	75 % RDF	75.00	28.86	18.02	6.99	10.13	100.55	80.18	30.64	19.06	7.53	10.71	106.22
T_8	50 % RDF + 50 % N through FYM	92.84	38.36	22.85	8.36	12.20	115.81	94.89	40.51	24.49	8.67	12.45	118.60
T_9	75 % RDF + 25% N through FYM	89.22	35.77	21.36	8.15	12.04	112.56	93.76	38.42	22.75	8.56	12.50	120.17
T_{10}	50 % RDF + 50 % N through Gly.	95.47	39.90	26.20	8.99	12.23	121.07	99.64	43.23	27.79	9.46	12.64	125.86
T_{11}	75 %RDF + 25 % N through Gly.	91.08	37.34	22.80	8.83	12.00	116.24	95.98	40.43	24.60	9.27	12.62	121.27
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	2.57	1.22	1.25	0.292	0.265	3.183	1.75	0.92	1.104	0.247	0.248	3.23
	C.D. 5 (P=0.05)	7.64	3.63	3.71	0.868	0.786	9.450	5.18	2.72	3.575	0.732	0.735	9.57

Table 7 : Effect of different treatments on available N, P and K in soil after harvest of rice

Symbol	Treatments	1998			1999		
		Avail. N (kg/ha)	Avail. P_2O_5 (kg/ha)	Avail. K_2O (kg/ha)	Avail. N (kg/ha)	Avail. P_2O_5 (kg/ha)	Avail. K_2O (kg/ha)
T_1	Control	278.17	10.78	85.16	250.43	8.73	53.89
T_2	50% RDF	291.55	12.76	89.45	294.35	14.76	72.17
T_3	50% RDF	291.61	12.84	90.38	294.10	16.26	74.15
T_4	75 % RDF	298.41	15.26	93.15	303.22	19.01	77.10
T_5	100 % RDF	305.28	17.29	100.00	315.19	23.43	90.18
T_6	100 % RDF	305.33	17.34	98.90	315.73	23.02	89.00
T_7	75 % RDF	298.44	15.22	92.90	303.65	19.22	77.85
T_8	50 % RDF + 50 % N through FYM	328.57	17.92	136.26	367.21	25.98	158.13
T_9	75 % RDF + 25 % N through FYM	325.68	17.72	122.50	352.44	24.52	134.98
T_{10}	50 % RDF + 50 % N through Gly.	333.52	14.62	135.83	375.35	20.38	155.39
T_{11}	75 % RDF + 25 % N through Gly.	322.98	14.87	121.98	351.09	20.54	131.19
	'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	S.E. ±	2.26	0.65	0.84	2.90	1.02	0.97
	C.D. 5 %	6.70	1.93	2.49	8.60	3.00	2.89
	Mean	307.23	15.15	106.05	320.25	19.62	101.28
	Initial value	295.22	12.96	105.03	305.41	16.23	99.38

glyricidia) registered significantly higher P uptake in grain over all the treatments, except T_5, T_8, T_6 and T_{11}, where the differences were of the similar order during both the years. During 1998, T_{10}, T_{11}, T_5, T_6, T_8 and T_9 recorded significantly higher P uptake by straw over T_7, T_4, T_3, T_2 and T_1, but the differences between former six treatments were not significant. In 1999, T_{10} (50% RDF + 50% N through glyricidia) proved significantly superior than all the remaining treatments, except T_{11}, T_5 and T_6, where the differences were not upto the mark. Similar results were observed by Sahrawat (1982) and Ramteke *et al.* (1998).

Effect of green leaf manure, FYM and chemical fertilizers available on N, P and K after crop harvest:

Data pertaining to mean changes in available N, P_2O_5 and K_2O in soil as affected by different treatments after harvest of rice are summarized in Table 7. In 1998 - 99, application of 50% RDF + 50% N through glyricidia (T_{10}) registered significantly higher available N over all the remaining treatments, except 50% RDF + 50% N through FYM (T_8), which behaved similarly with each other.

In 1998, T_8, T_9, T_6 and T_5 recorded significantly higher available P_2O_5 than the remaining treatments, but the differences between former four treatments were not upto the level of significant. Whereas in 1999, T_8 (50% RDF + 50% N through FYM) and T_9 (75% RDF + 25% N through FYM) showed their superiority over all the remaining treatments, except T_5 and T_6 which were similar with each other.

During 1998-99, T_8 and T_{10} registered significantly higher value of available K-status in soil over all the remaining treatments, but the difference between these two treatments was of the similar order. Mandal *et al.* (1985) recorded the similar results.

Conclusion:

The nutrients should be tailors through green manuring particularly glyricidia, FYM and inorganic fertilizers to rice in order to maintain long term soil fertility and soil health.

Thus green manuring with glyricidia and FYM could substitute 50 % N need of rice without any detrimental effect on productivity. Hence, integrated use of FYM or glyricidia to the extent of 50 % N with 50 % RDF is an judicious blend to stabilized yield at maximum level without deteriorating soil health in South Konkan zone of Maharashtra.

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