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INFLUENCE OF ORGANIC AND INORGANIC N FERTILIZATION ON GROWTH YIELD AND ECONOMICS OF TRANSPLANTED RICE

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ABSTRACT

A field study was carried out during *kharif* and *rabi* seasons of 2001-02 and 2002-03. An appreciable improvement in growth components (plant height, and number of tillers) and grain yield were evidenced in *kharif* and *rabi* rice with organic manure *Sesbania aculeate*, FYM, poultry manure and pressmud along with inorganic N (urea) applied 50% each. The integration of 50% N as organic through *sesbania aculeate* with 50% as inorganic (urea) brought about conspicuous yield improvement with 24 and 25 per cent in *kharif* and *rabi* rice respectively over 100% inorganic N alone. This treatment also recorded the highest net return and benefit.

INTRODUCTION

Rice, one of the most important staple foods produced and consumed all over the world and utilized by more than two billion people in Asia and the contribution of India is 22 per cent of the total world rice production. In our country to meet the food demand of the ever increasing human population, it is imperative to maximize the productivity of rice, as land and water are limited for extending the area under rice (Siddiq, 2000). According to Sharma and Mitra (1989), the response of rice to N is generally very high and its supply is essential for realization of the full potential of the rice cultivar. Application of optimum dose of N to rice is gaining importance since N is such a star nutrient which is indispensable in crop production. The low recovery (30-40%) of applied N in lowland rice (*Oryza sativa* L.) and higher price necessitate the use of alternative 'N' sources to inorganic N fertilizer to sustain rice productivity.

MATERIAL AND METHODS

Field experiments were conducted in rice during *kharif* and *rabi* seasons of 2001-02 and 2002-03 at Agricultural College and Research Institute. Coimbatore (Latitude 11° N, Longitude 77° E and altitude 426.7m). The soil of the experimental field was deep clay loam, moderately drained with neutral reaction, classified taxonomically as Typic Haplustalf with a pH ranging 6.6 to 8.1, low in available nitrogen (274 kg ha^{-1}), medium in available phosphorus (17.8 kg ha^{-1}) and high in available potassium (585 kg ha^{-1}). The trial was laid out in randomized black design with three replications as follows :

- T_1 - 100% N as pressmud alone
- T_2 - 75% N as pressmud + 25% N as inorganic
- T_3 - 50% N as pressmud + 50% N as inorganic
- T_4 - 100% N as Sesbania aculeate alone
- T_5 - 75% N as Sesbania aculeate + 25% N as inorganic
- T_6 - 50% N as Sesbania aculeate + 50% N inorganic
- T_7 - 100% N as composted poultry manure alone
- T_8 - 75% N as composted poultry manure + 25% N as inorganic
- T_9 - 50% N as composted poultry manure + 50% N as inorganic
- T_{10} - 100% N as FYM = 25% N as inorganic
- T_{11} - 75% N as FYM + 25% N as inorganic
- T_{12} - 50% N as FYM + 50% N as inorganic
- T_{13} - 100% of the recommended dose of N as inorganic
- T_{14} - Control

N.B. : All the treatments except T_{14} received recommended dose of P_2O_5 and K_2O.

Recommended dose of N, P_2O_5, K_2O for *kharif* and *rabi* rice are 120;38:38 kg ha^{-1} and 150:50:50 kg ha^{-1} respectively. The 'N' was applied as per the treatments schedule. The *kharif* and *rabi* season variety CO 47 and ADT 38, respectively fan raising the nursery. The seeds were soaked in water for 24 hours and incubated. The sprouted seeds were broadcast and raised in nursery without adding any fertilizer. Transplanting was done on 20th day in the field with a spacing of 15 x 10 cm in *kharif* and on 25th day with a spacing of 20 x 10 cm in *rabi* @ two seedling hill-1, harvested *kharif* and *rabi* 105 and 130 days.

RESULTS AND DISCUSSION

Effect on growth characters : The plant height was measured at active tillering, panicle initiation, flowering and harvest stages in both *kharif* 2001-02 and 2002-03 and the plant height was greatly influenced by nutrient management practices especially N application (Kandasamy and Ramasamy (1998). Rice plant height increased as the crop growth advanced from active tillering and it was maximum at harvest stage. The plant height increased lineraly from 28.50 to 53.70 cm, 47.73 to 81.36 cm, 65.20 to 103.50 cm and 67.30 to 108.30 cm at active tillering, panicle initiation, flowering and harvest stages respectively during *kharif* 2001-02 and the values during *kharif* 2003-03 were 35.33 to 55.30, 55.63 to 88.03 cm, 73.56 to 115.00 cm and 74.34 to 117.15 cm respectively for the different stages of crop growth. Irrespective of the stages, plant height was the lowest in control. Application of 100% N as organic alone in general resulted in increased plant height at different stages of crop growth in both the years as compared to control. However, the values registered were comparable with the values obtained for the combined application of organics and inorganics to supply N in the ratio 0.75:0.25 (75% organic with 25% inorganic) and 1.0 (100% organic). Significantly higher plant height was associated with combined application of organic and inorganic N in the ratio of 0.50:0.50, the plants being tallest in the plots receiving 50% N through inorganic + 50% N through *Sesbania aculeata*. This is agreement with in the findings of Srinivasulu Reddy (1988) and Hameed khan (1990). Similarly, the plant height ranged from 23.81 to 47.53 cm, 32.21 to 74.68 cm, 56.26 to 96.99 and 66.74 to 107.61 cm during *rabi* 2001-02 and 25.91 to 59.81 cm, 34.76 cm 58.42 to 98.81cm and 70.69 to 109.50 cm during *rabi* 2002-03 for the active tillering, panicle initiation, flowering and harvest stages respectively. As in the *kharif* season, the plant height was also found to increase with the conjoint application of organics and inorganics N as compared to inorganic N alone (T_{13}). The application of 50% N was inorganic with 50% N through Sesbania aculeata (T_6) was found to be the best in enhancing the plant height in both the seasons at various stages (Table 1).

Effect on number of tillers per hill : The number of tillers produced per hill was more with 50% N through *Sesbania aculeata* + 50% N as inorganic (T_6) at active tillering, panicle initiation, flowering and harvest stages (12.46, 14.46,13.46, 12.36 and 15, 51, 16.07, 15.58 and 15.53) and it was at par with that of 50% N through FYM + 50% N as inorganic (T_{12}), 50% N through poultry manure + 50% N through poultry manure + 50% N as inorganic (T_9) and 50% N through pressmud + 50% N as inorganic fertilizer (T_3) but superior to 100% N as inorganic (T_{13}). During kharif 2001-02 and 2002-03. The number of tillers hill-1 was the least in control.

The maximum number of tillers produced $hill^{-1}$ was associated with 50% N through *Sesbania aculeata* + 50% N as inorganic (11.78, 13.63, 13.23, 12.50 and 13.30, 15.26, 14.98 and 14.69) and this was followed by 50% N through FYM + 50% N as inorganic (T_{12}), 50% N through composed poultry manure + 50% N as inorganic (T_9) and 50% N through pressmud + 50% N as inorganic (T_3) in all the four stages. The application of 100% inorganic N was superior

Table 1. Effect of organics and inorganic N on plant height (cm) at different growth stages

Treatments	Kharif 2001				Kharif 2002				Rabi 2001-02				Rabi 2002-03			
	Active tillering	Panicle initiation	Flowering	Harvest	Active tillering	Panicle initiation	Flowering	Harvest	Active tillering	Panicle initiation	Flowering	Harvest	Active tillering	Panicle initiation	Flowering	Harvest
T_1	42.90	67.56	84.95	85.21	43.86	74.64	87.64	93.56	36.54	54.25	75.98	80.98	37.51	56.48	72.21	84.54
T_2	43.20	68.52	85.29	86.54	44.10	75.93	88.54	94.33	36.63	54.39	76.50	81.09	37.63	56.90	78.43	85.69
T_3	48.5	76.76	92.50	95.40	52.50	81.98	103.83	107.50	44.78	67.42	85.79	89.60	46.27	68.25	88.65	97.08
T_4	46.12	75.08	89.30	91.23	49.50	82.70	101.23	103.41	41.23	64.73	83.50	87.53	44.48	64.90	84.63	93.52
T_5	46.63	75.12	90.60	92.40	50.80	81.10	102.0	104.37	45.42	64.88	83.63	87.61	44.67	65.30	85.10	94.02
T_6	53.70	81.36	103.50	108.30	55.30	88.03	115.0	117.15	47.53	74.68	96.99	107.61	59.81	76.41	98.81	109.50
T_7	44.52	70.98	86.79	87.92	44.80	77.59	91.71	96.87	38.34	56.88	78.99	82.99	39.61	57.12	79.11	87.86
T_8	44.90	71.62	87.50	88.24	45.30	77.86	92.54	97.53	38.53	56.92	79.26	83.21	39.81	57.30	80.41	88.93
T_9	49.8	78.80	96.80	99.50	53.41	85.33	107.83	112.75	45.64	69.91	89.91	95.44	48.37	70.31	90.89	100.22
T_{10}	45.32	73.19	88.87	89.57	47.20	79.41	94.91	99.43	39.09	60.63	80.15	84.59	40.98	61.43	82.17	91.63
T_{11}	45.90	73.44	89.26	90.38	48.60	79.63	95.86	100.80	39.26	60.72	80.49	85.33	41.13	61.87	83.30	92.98
T_{12}	52.86	80.10	99.60	102.30	54.70	86.33	111.90	114.41	46.78	71.24	92.70	101.52	53.51	73.80	95.64	103.41
T_{13}	45.93	73.90	88.33	89.97	49.40	81.10	100.94	102.56	40.98	64.53	82.97	86.54	43.97	64.50	83.42	92.93
T_{14}	28.50	46.73	65.20	67.30	35.33	55.63	73.56	74.34	23.81	32.21	56.26	66.74	25.91	34.76	58.42	70.69
SEd	0.84	1.14	1.64	0.92	2.17	1.88	1.06	1.24	1.58	1.88	7.12	0.99	2.60	2.20	2.71	1.45
CD (=0.05)	1.74	2.35	3.38	1.90	4.47	3.87	2.19	2.56	3.27	3.87	14.65	2.03	5.36	4.53	5.58	2.99

Table 2. Effect of organics and inorganic N on number of tiller per hill^{-1} at different growth stages

Treatments	Kharif 2001				Kharif 2002				Rabi 2001-02				Rabi 2002-03			
	Active tillering	Panicle initiation	Flowering	Harvest	Active tillering	Panicle initiation	Flowering	Harvest	Active tillering	Panicle initiation	Flowering	Harvest	Active tillering	Panicle initiation	Flowering	Harvest
T_1	8.38	10.32	8.92	8.57	12.13	10.57	10.60	10.48	9.86	11.84	10.64	10.51	11.27	13.52	13.57	13.38
T_2	8.50	10.46	9.09	10.10	12.41	13.50	10.66	10.63	9.92	11.97	10.73	10.62	11.32	13.77	13.64	13.43
T_3	10.03	12.46	11.06	10.67	14.55	14.98	12.58	12.73	10.67	12.90	11.53	11.50	12.68	14.89	14.33	14.11
T_4	9.40	11.69	10.32	9.98	13.90	13.98	10.58	11.29	10.44	12.57	11.09	10.98	12.45	14.60	14.02	13.96
T_5	9.53	11.86	10.66	11.42	14.20	14.47	11.91	12.30	10.52	12.68	11.34	11.32	12.51	14.76	14.11	14.0
T_6	12.46	14.46	13.46	12.36	15.61	16.07	15.58	15.53	11.78	13.63	13.23	12.50	13.30	15.26	14.98	14.69
T_7	10.63	10.71	9.26	8.68	13.25	13.98	10.11	10.79	10.02	12.18	10.73	10.64	11.55	13.98	13.79	13.63
T_8	10.73	10.86	9.56	10.96	13.53	13.57	10.91	11.35	10.11	12.24	10.98	10.96	11.63	14.11	13.86	13.68
T_9	10.73	12.86	11.46	11.96	14.29	15.30	13.66	13.06	10.98	13.11	11.98	11.90	12.75	15.0	14.51	14.21
T_{10}	8.23	11.19	19.78	8.88	13.58	13.75	10.25	11.08	10.20	12.46	11.03	10.96	11.78	14.09	13.84	13.70
T_{11}	9.13	11.33	10.06	11.20	13.87	13.94	11.66	11.76	10.32	12.52	11.23	11.12	11.98	14.33	13.93	13.75
T_{12}	11.53	14.26	12.0	12.19	15.30	15.49	14.91	14.73	11.30	13.41	12.11	12.09	13.0	15.16	14.83	14.50
T_{13}	9.29	11.54	10.19	9.87	13.60	12.88	10.47	11.04	10.32	12.39	10.98	10.87	12.38	14.53	13.98	13.91
T_{14}	5.63	6.26	6.33	6.21	8.48	9.47	8.61	8.25	7.68	9.97	9.88	9.63	7.86	10.11	10.06	10.01
SEd	0.210	0.287	0.373	0.883	0.571	0.318	0.718	0.856	0.244	0.193	0.417	9.63	0.399	0.552	0.529	0.219
CD (=0.05)	0.433	0.589	0.766	1.815	1.174	0.655	1.477	1.761	0.503	0.397	0.859	1.151	0.821	1.136	1.087	0.450

Table 3. Effect of organics and inorganic N on yield (kg ha^{-1}) and economic (Rs. ha^{-1})

Treatments	Kharif				Rabi				Economic			
	2001		2002		2001-02		2002-03		2001-02		2002-03	
	Grain yield	Straw yield	Grain yield	Straw yield	Grain yield	Straw yield	Grain yield	Straw yield	Net Return	B.C. ratio	Net Return	B.C. ratio
T_1	4498	6775	5127	6875	5010	6510	5015	6727	17158	1.39	31479	1.72
T_2	4510	6850	5224	7196	5050	6730	5075	6815	19812	1.48	134874	1.85
T_3	5842	8110	6117	8196	6440	7490	6610	7680	43659	2.15	49449	2.31
T_4	5050	7690	5713	7950	5215	7120	5625	7350	41492	2.19	48302	2.39
T_5	5288	7760	5902	8156	5360	7360	5720	7475	44020	2.29	50243	2.47
T_6	7330	9130	7780	9430	7570	8160	7750	8310	58261	2.94	62921	2.87
T_7	4690	7170	5288	7495	5060	6850	5175	6950	39534	2.20	44269	2.35
T_8	4725	7218	5434	7505	5090	6950	5300	7040	40085	2.22	45927	2.40
T_9	6300	8470	6648	8810	6650	7680	6780	7790	51982	2.60	57714	2.77
T_{10}	5025	7420	5611	7725	5160	6980	5465	7110	30555	1.69	36455	1.82
T_{11}	5076	7405	5690	7815	5120	7120	5505	7250	34187	1.82	40285	1.97
T_{12}	6870	8850	7280	9127	6825	7920	6990	7950	50459	2.32	54889	2.43
T_{13}	5375	7630	5553	7760	5525	7050	5598	7125	42009	2.23	48468	2.42
T_{14}	3675	6030	3775	6098	3650	5740	3665	5785	11086	1.35	22417	1.71
SEd	129.28	159.70	153.0	143.56	145.70	287.18	125.54	204.73	-	-	-	-
CD (=0.05)	265.04	327.40	313.65	294.69	298.69	412.72	257.36	419.70	-	-	-	-

to control in increasing the production of tillers per hill. During *rabi* 2001-2002 and 2002-03. The number of tillers produced in control was the minimum (7.68, 9.97, 9.88, 9.63 and 7.86, 10.1, 11.06 and 10.01) at respective the stages of crop growth. Matiwade and Sheelavantar (1994) observed that yielding ability of rice with green manuring of *Sesbania rostrata* alone and when coupled with the recommended dose of N, to increase the number of panicle per hill, panicle length, grain per panicle and thousand rain weight compared with the recommended dose of N alone (Table 2).

Effect of grain and straw yield : The grain yield ranged from 3675 to 7330 kg ha^{-1} and from 3775 to 7780 kg ha^{-1} during *kharif* 2001-02 and 2002-03 respectively showing a better performance during *kharif* 2002. The highest grain yield of 7330 and 7780 kg ha^{-1} was associated with the application of 50% N through *Sesbania aculeata* + 50% N as inorganic (T_6) and it was next followed by T_{12} *viz.*, 50% N through FYM + 50% N as inorganic (6870 and 7280 kg ha^{-1}) but superior to the application of 50% N through poultry manure + 50% N as inorganic (T_3) (5842 and 6117 kg ha^{-1}). The lowest grain yield (3675 and 3775 kg ha^{-1}) was obtained with the treatment which did not receive either organic or inorganic (T_{14}) N additions. Vaiyapuri *et al.* (1998) reported that the combined application of green manure Sesbania sepciosa @ 12.75 t ha^{-1} with inorganic N recorded significantly higher grain and straw yield.

Grain, yield of rice increased from 3650 to 7575 kg ha^{-1} and from 3665 to 7750 kg ha^{-1} respectively for the different treatment tried. The application of 50% N through *Sesbania aculeata* + 50% N as inorganic (T_6) registered the highest grain yield and was superior to 100% N as inorganic alone (T_3) in improving the grain yield during both the *rabi* seasons. During *rabi* 2001-02 and 2002-03. The higher grain yield observed in the present study due to the combined application of inorganic N and organic could be attributed to the slow and steady rate of N release into soil solution to match the required absorption pattern of rice plant. Probably, the adequate N supply might have promoted its translocation of assimilate form source to sink resulting in more spikelet formation, improved vegetative growth as indicated by taller plants, more number of tillers and higher LAI. This was in agreement with the earlier findings of Hirematha and Patel (1998).

Monetary returns : Application 50% N as through *Sesbania aculeate* ha + 50% N through inorganic fertilizer gave higher net return and benefit cost ration of Rs. 58261 and 62921 ha^{-1} and 2.94 and 2.87 during *kharif* 2001-02 and 2003-03 respectively (Table 3). Similar trend was also observed in straw yield as in the case of grain yield or rice.

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