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Effect of different organic sources and inorganic fertilizers on soil fertility, yield and economics in transplanted rice

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Abstract
Field Experiments were conducted at the Tamil Nadu Agricultural University, Coimbatore in Kharif and Rabi seasons of 2011-12 and 2012-13 to find out the influence of different organic sources and inorganic N fertilizers on rice productivity and profitability. The integration of 50% N as organics through *Sesbania aculeate* with 50% N as inorganic (Urea) increased the yield by 24 percent in kharif and 25percent in *rabi* rice combination. The available N, P, K and organic carbon contents were increased in the above treatment as compared to 100% N as through inorganic alone. Application of 50% N through *Seshania aculeata* + 50% N as inorganic fertilizer gave higher net return and benefit cost ratio of Rs. 58261 and 62921 ha^{-1} and 2.94 and 2.87 during 2011-12 and 2012-13 respectively in the kharif and rabi seasons.

Keywords: Transplanting rice, press mud, *Sesbania aculeata,* poultry manure and FYM, inorganic N

Introduction
In sustainable rice production, organic manuring plays an important role. Recent times, combination of organic with inorganic N is more productive than their individual application. Recently increased high yielding rice cultivars respond to high N fertilization. Use of organic manures has become scarce due to several reasons particularly due to scarcity in availability. In the relevance of integrated nutrient management involving organic manures and inorganic fertilizers in optimum combination has been realized to sustain the productivity of rice at economically viable levels. In this context a study was conducted to find out the effects of organic manures and inorganic fertilizers applied favourably had higher grain and straw yield and economics with increased soil fertility status in rice.

Materials and Methods
Field experiments were conducted at the wetland farm of Tamil Nadu Agricultural University, Coimbatore in kharif and rabi seasons of 2011-12and 2012-13.
The soil was clay loam with pH of 8.1, low in available N (274.0 Kg ha^{-1}), medium in available P (17.8 Kg ha^{-1}) and high in available K (585.0 Kg ha^{-1}). Different organic sources viz., green manures, FYM, press mud and composted poultry manures were compared with 100% recommended N and one absolute control as detailed under.

Treatment details
T1 - 100% N as press mud alone
T2 - 75% N as press mud + 25% N as inorganic
T3 - 50% N as press mud+50% N as inorganic
T4 - 100% N as *sesbania aculeate* alone
T5 - 75% N as *sesbania aculeata*+ 25% N as inorganic
T6 - 50% N as *sesbania aculeata*+ 50% N as inorganic
T7 - 100% N as composted poultry manure alone
T8 - 75% N as composted poultry manure + 25% N as inorganic
T9 - 50% N as composted poultry manure + 50% N as inorganic
T10 - 100% N as FYM alone
T11 - 75% N as FYM + 25% N as inorganic

T12 - 50% N as FYM + 50% N as inorganic
T13 - 100% of the recommended dose of N as inorganic
T14 - Absolute control (No organic and inorganic)

N.B: all the recommended package of practices were followed in the treatments except T4 The organic manures besides were incorporated in the soil one week before transplanting of rice, N and K were applied in four equal splits at basal, active tillering, panicle initiation and flowering stages. The entire dose of P was applied as basal before transplanting. Observations on grain and straw yield of rice were recorded and post harvest soil samples were collected and analysed for organic carbon content and available N, P and K status by standard methods (Jackson, 1973) [5]. Economics was also worked out for various treatments studied.

The results revealed that during kharif 2011-12 and 2012-13 significantly had higher grain yield in the treatment received the application of 50% N through *Sesbania aculeata*+ 50% N as inorganic (7330 and 7780 Kg ha^{-l}) and it was next followed by T_{12} viz., 50% N through FYM + 50% N as inorganic (6870 and 7280 Kg ha^{-l}) but superior other treatment combinational in the respective seasons. The application of 50% N through *Sesbania aculeata*+ 50% N as inorganic (T6) registered the highest grain yield. As he lowest grain yield was obtained with the treatment which did not receive either organic or inorganic (T_{14}) N addition both the years in the respective seasons. Similar trend was also observed in straw yield as in the case of grain yield of rice. Similar results were also opines by Mishra and Sharma (1997) [8] and Kumaresan and Rangasamy (1997) [6] Lokanathan (2008) [7] reported higher yield to the tune of 20% in CORH3 rice hybrid and 17.2% in ADT 43 rice variety with application of both organic and inorganic fertilizers together. (Table 1).

Table 1: Effect of organic and inorganic fertilizer on yield (Kg ha^{-l}) and Economics (Rs. ha^{-l})

Treatment	Kharif						Rabi			Economic		
	2011		2012		2011-12		2012-13		2011- 12	2012-13		
	Grain yield	Straw yield	Grain yield	Straw yield	Grain yield	Straw yield	Grain yield	Straw yield	net	B.C	net	B.C
T1	4498	6775	5172	6875	5010	6510	5015	6727	17518	1.39	31479	1.72
T2	4510	6850	5224	7196	5050	6730	5075	6815	19812	1.48	34874	1.85
T3	5842	8110	6117	8196	6440	7490	6610	7680	43659	2.15	49449	2.31
T4	5050	7690	5713	7950	5215	7120	5625	7350	14192	2.19	48302	2.39
T5	5288	7760	5902	8156	5360	7360	5720	7475	44020	2.29	50243	2.47
T6	7330	9130	7780	9430	7570	8160	7750	8310	25261	2.94	62921	2.87
T7	4690	7170	5288	7495	5060	6850	5175	6950	39534	2.2	44269	2.35
T8	4725	7218	5434	7505.	5090	6950	5300	7040	40085	2.22	45927	2.4
T9	6300	8470	6648	8810	6650	7680	6780	7790	51982	2.6	57714	2.77
TlO	5025	7490	5611	7725	5120	6980	5465	'1110	30555	1.69	.36455	U2
'1'11	5076	7405	5690	7815	5160	7120	5505	7250	34187	1.82	40285	1.97
T12	6870	8850	7280	9127	6825	7920	6990	7980	50459	2.32	54889	2.43
T13	5375	7630	5553	7760	5525	7050	5598	7125	42009	2.23	48468	2.42
T14	3675	6030	3775.	6098	3650	5740	3665	5785	11086	1.35	22417	1.71
SE.d	129.28	159.7	153	143.56	145.7	287.18	125.54	204.73	-	-	-	-
CD P=0.05	265.04	327.4	313.65	294.30	298.69	412.72	257.36	419.7	-	-	-	-

Effect on soil fertility

Available N, P and K status in soil

During kharif 2011-12, and 2012-13, the soil available N status in the post harvest soils was significantly higher. with the application of 50% N through *Sesbaniaaculeata*+50% N as inorganic (332.62 and 332;60 Kg ha^{-l}) and least was observed in the absolute control (TI4) which recorded 225.96 and 236.52 Kgha^{-l}.in the respective seasons similar trend was also observed in the rabi seasons also.

The increase in available N status due to application of green manure may be attributed to higher retention of N as NH4 ion in the soil as reported by Duhan and Mahendra Singh (2000) [3].

Available P status in the post harvest of the soil was more during kharif 2011-12 and 2012-13 by the application of 50% N through *Sesbania aculeata*+ 50% N as inorganic fertilizer (Urea) (25.85 and 24.95 Kg ha^{-l}). The treatment T14 (Absolute control) recorded the least availability of soil phosphorus in both the seasons similar trend was also observed in the *rabi* seasons of both the years.

In Rabi 2011-12 and 2012-13, the application of 50% N through *Sesbaniaaculeata*+50% N as inorganic (24.36 and 24.56 Kg ha-l) T6 recorded the maximum soil available phosphorus and it was on par with that observed by the application of 50% N through FYM +50% N as inorganic (23.66 and 24.26 Kg ha-l) T12, 50% N through poultry manure + 50% N as inorganic (23.18 and 23.98 Kg ha-l). The lowest soil available phosphorus was noticed in absolute control (Without organic and inorganic fertilizer) (13.66 and 14.26 Kg ha^{-1}) T14. The organic manures application found to improve the available P status in the soil. This was in agreement with the earlier findings of Saravanapandian and Annadurai (2001) [9].

The soil available K status was ranging from 520.64 to 602.64 Kg ha^{-1}and from 532.30 to 610.35 Kg ha^{-1} in post harvest soil sample during Kharif 2011 and 2012 respectively showing the influence of organic and inorganic N addition in improving the status of soil fertility The application of 50% N through *Sesbania aculeata*+50% N as inorganic (602.64 and 610.35 Kg ha^{-1}) T6 registered the highest amount of soil available Potassium.

In *rabi* season also similar effects were reported at in the case of kharif seasons. A similar result in transplanted rice was also reported by Chaphale and Basole (1999). The organic and inorganic fertilizer balance applied nutrients i.e increase available nitrogen (Kg. ha^{-1}), Phosphorus (Kg. ha^{-1}) and Potassium (Kg. ha^{-1}). This might be due to increased enzymatic activity and lower fixation of nutrients like P and K by addition of organic manures, crop residues during the crop growth period (Ghoshet. Al 2008) (Table 2).

Table 2: Effect of organic and inorganic fertilizer on soil available nutrient status (Kg ha^{-1})

Treatments	*Kharif* 2011			*.Kharif2012*			*Rabi* 2011-12			*Rabi* 2012-13		
	N	P	K	N	P	K	N	P	K	N	P	K
Tl	261.18	17.09	538.16	272.27	17.24	550.30	251.72	17.32'	539.41	258.34	18.98	549.33
T2	262.24	17.21	538.41	. 273.93	17.51	552.64	253.44	17.53	540.26	259.74	19.03	551.40
T3	293.45	20.26	579.88	306.02	22.86	586.85	289.36	22.87	585.10	288.44	23.70	598.66
T4	270.19	17.98	553.26	279.25	18.45	562.80	269.49	18.36	563.12	268.24	19.90	580.62
Ts	271.56	18.13	555.49	281.51	.18.54	564.24	265.60	18.56	564.84	269.64	19.94	583.77
T6	332.62	24.85	602.64	332.60	24.90	610.35	332.84	24.36	608.59	332.60'	24.56	625.34
T7	264.76	17.49	529.16	275.20	17.73	550.33	257.14	17.50	541.03	261.64	19.26	559.21
Ts	265.88	17.52	540.26	276.46	17.82	552.60	258.55	17.84	542.19	263.04	19.33.	561.40
T9	295.19	20.84	580.55	310.54	22.97	590.51	290.24	23.18	.586.40	290.57	23.98	605.74
TIO	267.09	17.78	545.50	277.73	17.98	556.17	260.18	17.98	551.28	264.94	19.54	570.17
T11	268.44	17.83	546.98	278.99	18.13	558.72	261.77	18.15	553.43	266.34	19.64	572.60
Tn	314.62	23.88	581.49	312.08	23.48	592.30	312.04	23.66	597.30	311.36	24.26	615.14
T13	275.08	19.90.	561.09	285.92	18.66	568.07	268.50	18.8	562.98	267.54	19.86	578.42
T14	225.96	13.30	520.64	236.52	13.50	532.30	224.09	13.66	516.49	232.40	14.26	530.42
SEd	8.50	1.79	8.40	9.37	1.80	8.57	9.65	3.10	8.90	9.65	3.27	9.10
CD	17.43	3.68	17.23	19.21	3.71	17.58	19.8	3.37	18.26	19.79	3.72	18.67
(p = 0.05)												

Table 3: Effect of organic and inorganic fertilizer on soil available organic carbon (%) at postharvest Stage

Treatments		Soil ore: Anic Carbon (%)		
	Kharif2011	*Kharif2012*	*Rabi* 2011-12	*Rabi* 2012-13
Tl	0.77	0.81	0.78	0.82
T2	0.78	0.82	0.78	0.83
T3	0.84	0.86	0.82	0.86
T4	0.80	0.82	0.79	0.83
T5	0.80	0.83	0.79	0.83
T6	0.92	0.94	0.90	0.92
T7	0.78	0.82	0.78	0.83
Ts	0.78	0.82	0.78	0.83
T9	0.85	0.88	0.84	*0.8G*
T10	0.78	0.82	0.79	0.83
Tu	0.78	0.82	0.79	0.83
T12	0.88	0.92	0.86	0.88
T13	0.82	0.84	0.76	0.84
T14	0.70	0.71	0.69	0.69
SEd	0.005	0.002	0.003	0.003
CD (P+0.05)	0.015	0.0104	0.006	0.006

Organic carbon content

The results revealed that during Kharif 2011-12 and 2012-13 organic carbon contend showed positive and significant influence by application of organic manure. Organic carbon content was significantly higher in the treatments that received organic manures. It was higher in the application of 50% N through *Sesbania aculeata*+ 50% N as inorganic (0.92 and 0.94%) T6 and was superior to that observed with 50% through FYM + 50% N as inorganic (0.82 and 0.92%) T12 and T14 (Absolute control).

Similar results were obtained in the *rabi* seasons also during both the years of study. The least organic carbon content was noticed in the absolute control where no organic and inorganic were applied. This was in line with the earlier findings of Chaphale *et al.* (2000) [2].

Economics

Application of 50% N through *Seshania aculeata*+50% N as inorganic fertilizer gave higher net return and benefit cost ratio of Rs.58261 and 62921 ha^{-1} and 2.94 and 2.87 during 2011-12 and 2012-13 respectively in the kharif and rabi seasons. (Table 1)

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