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LONG TERM EFFECT OF CONTINUOUS FERTILIZATION BY ORGANIC AND INORGANIC SOURCES ON RICE PRODUCTIVITY

K. Anilakumar, I. Johnkutty and Kamalam Joseph
Regional Agricultural Research Station, Pattambi 679 306, India

Abstract: Pooled analysis of grain yield data for25 years (1961 to 1985) generated from a permanent manurial experiment with tall indica rice varieties revealed that during the first crop season (kharif), the treatment receiving combined application of cattle manure and NPK was significantly superior to others. The above treatment was on par with combined application of cattle manure, green leaves and NPK during the second crop season (rabi). The increases in yield by the former treatment over NPK alone were 7.6 and 5.6 per cent respectively during kharif and rabi seasons.

INTRODUCTION

Organic matter improves the growth of rice crop directly by providing considerable macro and micro-nutrients and indirectly by way of improving the physico-chemical and microbiological properties of soil. Research has clearly validated the manifold beneficial effects of the combined application of organic and inorganic manures on soils, rice and environment (Sahu and Nayak, 1971; Sinde and Ghosh, 1971). By way of combined application, the organic matter brings forth better matrix for the absorption and retention of nutrients. The present study was taken up to find out the effect of continuous application of cattle manure, green leaves and ammonium sulphate individually and in combination with and without phosphorus and potassium on tall indica rice.

MATERIALS AND METHODS

The permanent manurial experiment was started during the first crop season (kharif) of 1961 in the low land laterite soils of the Regional Agricultural Research Station, Pattambi with the following treatments.

T_1 : Cattle manure (CM) 8970 kg/ha (8000 lb/acre) to supply 44.8 kg N/ha (40 lb N/acre)
T_2 : Green leaves (GL) 8970 kg/ha to supply 44.8 kg N/ha
T_3 : GM + GL each 4485 kg/ha
T_4 : Ammonium sulphate (AS) to supply 44.8 kg N/ha
T_5 : CM 4485 kg/ha + AS 22.4 kg N/ha with P_2O_5 and K_2O each 22.4 kg/ha
T_6 : GL 4485 kg/ha + AS 22.4 kg N/ha with P_2O_5 and K_2O each 22.4 kg/ha
T_7 : CM and GL each 2243 kg/ha + AS 22.4 kg N/ha with P_2O_5 and K_2O each 22.4 kg/ha
T_8 : AS 44.8 kg N/ha with P_2O_5 and K_2O each 22.4 kg/ha

The dose of N was kept constant (44.8 kg N/ha) for all the treatments, taking the N content in cattle manure and green leaves as 0.5 per cent. The experiment was laid out in RBD with four replications. Organic manures were applied 7 to 10 days before planting and incorporated by digging. Ammonium sulphate was applied one month before flowering as complete top dressing. Phosphorus and potassium were applied

as single superphosphate and muriate of potash respectively, fully as basal. The test varieties were PTB 2 (Ponnaryan) and PTB 20 (Chuvanna Chitteni) for the first (kharif) and second (rabi) seasons respectively. The grain yields recorded from 1961 to 1985 were analysed statistically for individual seasons as well as by pooling 25 years data in kharif and 23 years data in rabi.

RESULTS AND DISCUSSION

From the grain yield data presented in Tables 1 and 2, it can be seen that statistical significance was obtained in almost all the years except 1961, 1964, 1970, 1972, 1980 and 1983 during kharif and 1961, 1971, 1973 and 1983 during rabi. Out of 25 kharif seasons, organic alone (T_1, T_2, T_3) and organic and inorganic (T_5, T_6, T_7) recorded highest grain yield during 9 and 14 seasons respectively while inorganic alone (T_4, Tg) was superior during two seasons. During rabi, out of 23 seasons, the respective values were 5, 13 and 5. The experiment was vitiated during the rabi seasons of 1981 and 1982 due to drought. Pooled analysis of the data revealed that during kharif, combined application of cattle manure and NPK (T_5) was significantly superior to other treatments with an yield increase of 7.6 per cent over NPK alone (T_8). For rabi season, the treatments receiving combined application of cattle manure, green leaves and NPK (T_7) and cattle manure and NPK (T_5) were on par and significantly superior to all other treatments. N alone (T_4) and green leaves alone (T2) were significantly lower than all other treatments during both the seasons. The increased rice yield due to the combined application of organic and inorganic manures was earlier reported by Sahu and Nayak (1971), Sinde and Ghosh (1971), CRRI (1975) and Pillai and Vamadevan (1978). The increased yield could be attributed to the favourable effects of organic matter on the soil physical conditions and microbial activity, which in turn increased the availability of nutrients. Further, mineralization of organic matter increased the exchange sites for cations in the soil and thereby reduce the losses of nutrients. The slower rate of release of nutrients from organic sources might have helped the rice plant to meet the nutrient requirement at all stages and thus resulted in higher yield through combined application of organic and inorganic manures. The lowest yield in treatment receiving green leaves alone (T_2) might be due to the adverse effects of CO2 and other reduced products (Katyal, 1977).

The combined effect of $T_1 + T_2 + T_3$ (organic alone) over T_4, T_5, T_6, T_7 and T_8 and that of $T_5 + T_6 + T_7$ (organic and inorganic) over T_4 and T_8 (inorganic alone) were compared by contrast analysis and found that the differences in grain yield was not significant (Table 3).

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Table 1. Grain yield (t/ha) as affected by continuous application of organic and inorganic manures, kharif 1961 to 1985

Year	CM alone	GL alone	CM + GL	N alone	CM + NPK	GL + NPK	CM + GL + NPK	NPK alone	CD (0.05)
1961	3.26	3.55	3.55	3.44	3.51	3.56	3.43	3.43	NS
1962	3.03	3.02	3.29	3.16	3.57	3.85	3.36	3.44	0.29
1963	2.56	2.88	2.65	2.93	3.15	3.20	3.26	3.21	0.16
1964	2.94	3.17	3.14	3.90	3.48	3.61	3.61	3.44	NS
1965	3.66	3.59	3.86	3.56	3.95	4.17	3.84	3.67	0.32
1966	3.04	2.84	2.92	2.64	3.31	3.22	3.29	3.40	0.31
1967	2.29	2.40	2.33	2.14	2.54	2.44	2.26	2.23	0.18
1968	2.89	2.91	2.98	2.79	3.19	3.39	3.19	3.29	0.31
1969	2.96	2.73	3.05	2.84	3.17	3.37	3.45	3.20	0.34
1970	2.67	2.79	2.75	2.61	2.61	2.72	2.48	2.73	NS
1971	3.26	2.69	3.10	3.04	2.85	3.12	2.89	3.06	0. 32
1972	2.27	2.29	2.52	2.35	2.81	2.37	2.38	2.61	NS
1973	3.02	2.46	2.84	2.31	2.87	2.37	2.88	2.44	0.52
1974	2.99	2.19	2.91	2.34	2.81	2.35	2.61	2.62	0.43
1975	3.44	2.65	3.17	2.77	3.19	3.15	3.22	3.12	0.18
1976	2.68	2.11	2.64	1.64	2.69	2.40	2.64	2.27	0.61
1977	2.91	2.48	2.94	2.37	3.02	2.49	2.81	2.84	0.32
1978	2.79	2.42	2.54	2.20	2.85	2.26	2.60	2.41	0.27
1979	2.30	1.95	2.23	1.94	2.08	1.80	2.02	1.91	0.31
1980	2.37	1.99	2.21	2.10	2.10	1.96	2.22	1.71	NS
1981	2.63	1.95	2.26	2.15	2.46	2.70	2.56	2.31	0.45
1982	3.44	3.21	3.14	2.45	3.22	2.67	3.13	2.80	0.22
1983	2.16	2.13	1.93	2.16	2.17	2.07	2.12	2.21	NS
1984	2.77	1.93	2.62	1.92	2.80	1.98	2.51	1.89	0.18
1985	3.35	2.68	3.36	2.42	3.13	2.66	3.12	2.35	0.24
Pooled mean (25 years)	2.87	2.60	2.84	2.52	2.95	2.79	2.86	2.74	0.058

NS = Not significant; CM = Cattle manure; GL = Green leaves

Table 2. Grain yield (t/ha) as affected by continuous application of organic and inorganic manures, rabi 1961 to 1985

Year	CM alone	GL alone	CM + GL	N alone	CM + NPK	GL + NPK	CM + GL + NPK	NPK alone	CD (0.05)
1961	2.33	3.08	2.75	2.80	2.89	3.28	3.22	3.46	NS
1962	3.06	3.69	3.47	3.67	3.79	4.00	3.99	4.11	0.16
1963	2.50	2.90	2.83	3.01	3.07	3.09	3.09	3.15	0.29
1964	4.38	4.60	4.29	4.56	5.06	4.88	4.88	4.65	0.32
1965	1.83	1.83	2.05	1.58	2.23	2.14	2.50	1.86	*024*
1966	3.40	3.22	3.46	3.77	3.96	3.81	4.05	4.36	0.56
1967	3.03	2.91	3.21	2.90	3.48	3.67	3.59	3.92	0.40
1968	2.30	2.48	2.46	2.33	2.62	2.73	2.79	2.76	0.24
1969	2.77	3.03	3.02	2.52	2.98	3.14	2.99	3.07	**0.22**
1970	2.95	2.22	2.61	1.29	3.04	2.75	2.98	**2.75**	0.34
1971	2.77	2.57	2.95	2.60	2.95	.2.84	3.00	**2.73**	NS
1972	2.69	2.76	2.79	2.23	2.71	2.91	2.90	**2.61**	0.23
1973	3.20	2.61	3.28	2.42	3.15	2.87	3.08	2.79	NS
1974	3.11	2.14	2.85	2.17	3.03	2.41	2.85	**2.49**	0.27
1975	3.49	3.18	3.54	3.03	3.63	3.61	3.80	3.39	0.26
1976	3.72	2.56	3.86	2.88	3.87	3.42	3.65	3.29	0.39
1977	3.23	2.60	3.22	2.58	3.31	2.65	3.30	**2.81**	0.52
1978	3.25	3.17	3.23	2.84	3.46	3.00	3.34	**2.96**	0.21
1979	2.40	1.83	**2.21**	1.65	2.53	1.92	2.45	2.06	0.33
1980	3.71	3.32	3.56	3.16	3.50	3.30	3.43	3.43	0.19
1983	3.07	3.21	3.00	3.03	3.21	3.22	3.31	3.02	NS
1984	3.31	2.17	**2.97**	1.14	3.12	2.05	2.91	2.42	0.43
1985	4.02	3.20	3.76	**2.68**	3.98	3.21	3.75	3.25	0.26
Pooled mean (23 years)	3.07	2.84	3.10	2.65	3.29	3.08	3.30	3.10	0.080

NS = Not significant; CM = Cattle manure; GL = Green leaves

The experiment was vitiated during 1981 and 1982

Table 3. Contrast analysis of grain yield as affected by continuous application of organic and inorganic manures

Kharif

Treatment mean (25 years) kg /18.48m^2	T1	T2	T3	T4	T5	T6	T7	T8
	5.296	4.803	5.240	4.655	5.455	5.163	5.291	5.069

				Sum of square	F	Significance
1.	$T_1 + T_2 + T_3 - 3\,T_4$	=	+1.374	0.00629	0.0428	NS
2.	$T_1 + T_2 + T_3 - 3\,T_5$	=	-1.026	0.00351	0.0239	NS
3.	$T_1 + T_2 + T_3 - 3\,T_6$	=	-0.150	0.000075	0.00051	NS
4.	$T_1 + T_2 + T_3 - 3\,T_7$	=	-0.534	0.00095	0.00646	NS
5.	$T_1 + T_2 + T_3 - 3\,T_8$	=	+0.132	0.000058	0.00039	NS
6.	$T_5 + T_6 + T_7 - 3\,T_8$	=	+0.702	0.00164	0.0112	NS
7.	$T_5 + T_6 + T_7 - 3\,T_4$	=	-1.944	0.0126	0.0856	NS

Interaction mean sum of square 0.1471 r25

Rabi

Treatment mean (23 years) kg /18.48m^2	T1	T2	T3	T4	T5	T6	T7	T8
	5.670	5.242	5.734	4.887	6.072	5.696	6.0%	5.730

				Sum of square	F	Significance
1.	$T_1 + T_2 + T_3 - 3\,T_4$	=	+1.985	0.0146	0.0555	NS
2.	$T_1 + T_2 + T_3 - 3\,T_5$	=	-1.570	0.0089	0.0340	NS
3.	$T_1 + T_2 + T_3 - 3\,T_6$	=	-0.442	0.0007	0.0027	NS
4.	$T_1 + T_2 + T_3 - 3\,T_7$	=	-1.642	0.0097	0.0372	NS
5.	$T_1 + T_2 + T_3 - 3\,T_8$	=	-0.544	0.00106	0.0041	NS
6.	$T_5 + T_6 + T_7 - 3\,T_8$	=	+0.674	0.00165	0.0063	NS
7.	$T_5 + T_6 + T_7 - 3\,T_4$	=	-3.221	0.0376	0.1423	NS

Interaction mean sum of square 0.2623 r.23

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