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Effect of organic sources of nitrogen on productivity, quality of rice (*Oryza sativa*) and soil fertility in single crop wetlands

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ABSTRACT

A field experiment was conducted during 1996–97 and 1997–98 to study the influence of organic manures, viz. *dhaincha [Sesbannia cannabina* (Retz.) Pers.], sunnhemp (*Crotalaria juncea* L.) and FYM, on productivity, quality and soil fertility. All the sources of organic manures improved the yield, quality and soil fertility. Among the various organic sources, *in-situ* incorporation of *dhaincha* @ 12 tonnes/ha remarkably increased the grain (18%) and straw (16%) yields of rice (*Oryza sativa* L.) over no organic manure, owing to increase in growth and yield-attributing characters of rice. An incorporation of *dhaincha* increased the optimum cooking time, total amylose content, crude protein content and reduced the gruel loss (%) of grain. Organic manures significantly improved the soil-fertility status and it was pronounced by the *dhaincha* incorporation by increasing organic carbon content, available soil N, P and K at post-harvest stage.

Key words : Rice, Organic manures, Productivity, Quality, Fertility

Now-a-days double crop wetland areas are being converted into single crop wetland due to the availability of limited water supply in almost all command areas of Tamil Nadu. In single crop wetland, the pre-season period of June–August is kept fallow. During this period about 200 mm of average rainfall is received. There is a possibility of raising green-manure crop during this pre-season fallow period. Green-manure *in-situ* incorporation can effectively substitute the inorganic nitrogen by 20–50% (Alok Kumar and Yadav, 1995). Among the organic manures, FYM and green-manure are commonly used (Meelu and Morris, 1987). The present investi- gation was aimed to study the effect of organic manures on productivity, quality of rice and soil fertility under the lowland condition in Periyar-Vaigai command areas of Tamil Nadu.

MATERIALS AND METHODS

A field experiment was conducted

during the rainy season (*kharif*) (June–September) season of 1996–97 and 1997–98 at Madurai, on sandy clay-loam soil. The soil had organic carbon 0.52%, pH 7.6, electrical conductivity 0 41 m mhos/cm and available N, P_2O_5 and K_2O 202, 13,4 and 289.1 kg/ha respectively.

The experiment consisted of 4 treatments, viz. control, FYM, *dhaincha* and sunnhemp, arranged in randomized block design having 5 replications. *Dhaincha* and sunnhemp were raised as pre-season crop using summer showers for *in-situ* incorporation. Quadrate area of 0.25 m^2 was selected in the sampling area of each plot and the plants were removed at the time of incorporation (45 DAS). The green-manure crops were weighed and expressed in tonnes/ha. *Dhaincha* @ 12 tonnes/ha and sunnhemp @ 11 tonnes/ha were incorporated *in situ.* Farmyard manure (FYM) @ 12.5 tonnes/ha was spread and incorporated at the start of first puddling. The green matter was allowed to decompose for 3 days and then the plots were thoroughly puddled and levelled properly for transplanting of rice var. 'Co. 43' rice. The recommended dose of fertilizer (150, 50 and 50 kg/ha) of N, P, and K and azospirillum inoculation (seed, 600 g/ha, seedling, 1,000 g/ha, soil, 2,000 g/ha) were commonly used in all the treatments. The data were recorded on yield, quality and fertility characters in 1996–97 and 1997–98.The data were pooled and presented. The time of sowing and harvest are given in Table 1.

RESULTS AND DISCUSSION

Yield

The effect of *in-situ* incorporation of *dhaincha* was superior in registering higher

Table 1. Time of sowing and harvest of green-manure and rice

Details	1996–97	1997–98
Date of sowing of green-manure crops	26 July 1996	27 July 1997
Date of incorporation of green-manure crops	9 September 1996	12 November 1997
Date of sowing of rice	14 August 1996	17 October 1997
Date of transplanting of rice	13 September 1996	16 November 1997
Date of harvest of rice	30 December 1996	28 Febuary 1998
Net plot size (m × m)	12.2 × 7.1	12.2 × 7.1

Table 2. Influence of organic sources of nitrogen on productivity of rice

Treatment	Days to 50% flowering	Panicles/ m^2	Panicle length (cm)	Total grains/ panicle	Filled grains/ panicle	Sterility (%)	Test grain weight (g)
Control	119	315.2	16.07	112.05	86.58	25.55	18.57
FYM	112	350.9	17.53	118.97	93.17	21.64	20.37
Dhaincha	101	420.2	20.54	135.74	106.63	16.10	22.15
Sunnhemp	107	386.7	18.93	128.31	100.62	18.16	21.21
CD (P = 0.05)	2.8	16.5	1.29	5.87	2.70	1.43	0.79

Table 3. Influence of organic sources of nitrogen on yield and quality of rice

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	Optimum cooking time (min.)	Gruel loss (%)	Total amylose content (%)	Crude protein content (%)
Control	5,373	7,248	14.59	3.93	25.2	7.8
FYM	5,934	7,717	16.19	3.62	26.4	8.3
Dhaincha	6,374	7,717	16.19	3.62	26.4	8.3
Sunnhemp	6,142	8,098	16.69	3.33	27.2	8.3
CD (P = 0.05)	156	221	0.7	0.15	0.8	0.31

Table 4. Influence of organic sources of nitrogen on post-harvest soil-available N, P, K (kg/ha) and organic carbon content (%)

Treatment	Organic carbon content	Soil-available nutrients		
		Nitrogen	Phosphorus	Potassium
Control	0.492	167.72	13.95	226.5
FYM	0.576	181.77	15.95	234.5
Dhaincha	0.730	209.61	18.60	249.0
Sunnhemp	0.660	195.86	17.45	241.5
CD (P = 0.05)	0.041	10.43	0.75	4.40

grain and straw yields than other sources (Table 3). The grain yield production was 18.6% and 14.3% higher in *dhaincha* and sunnhemp incorporation respectively over the no-manure application. The marked increase in grain yield could be owing to improvement in yield attributes (Table 2) (Thiagarajan, 1991) and enrichment of soil fertility through green-matter addition into the soil (Gopalasamy and Vidhyasekaran, 1987).

Quality

Among the organics, the incorporation of *dhaincha* @ 12 tonnes/ha recorded higher cooking time due to the increased hardiness of grain (Omar Hattb, 1995), total amylose content due to ensured supply of nutrients, crude protein content due to correct quantity of N supplied at critical times through right sources and lowest loss of gruel due to proper N nutrition and favourable soil condition (Table 3). Though *in-situ* incorporation of *dhaincha* increased the cooking time, it was on a par with sunnhemp incorporation and FYM application. The highest gruel loss was observed with no-organic manure.

Soil fertility

Higher availability of N, P, K and organic carbon was noticed with the application of *dhaincha,* followed by sunnhemp and FYM (Table 4). Under anaerobic conditions, decomposition of turned down crop residue was fairly slowed

and resulted in maintence of soil-available N. Further, it can be added that incorporated green-manure in lowland rice might have scavenged soil mineralization, prevented the nitrogen losses through denitrification or leaching when the soil was flooded and also helped effective recycling of soil N for succeeding rice (Sivabal, 1989). Even after harvest of rice, the basally applied green-manure would have contributed the mineralized N, which would add to the soil N (Bouldin, 1987) and thus helped in maintaining the soil-available N uptake of the nutrients depletion by rice.

Increase in available P with green-manure might be attributed to P-solubilizing capacity of green-manure (Khind and Madkin, 1986). Organic acids and carbondioxide liberated during the decomposition of green-matter might have formed complex substances with metal ions and increased the concentration of P in the soil.

The green-manure registered significantly higher K availability in soil due to their easy decomposition of mineral constituents and their effect in dislodging the exchangeable K into the soil solution (Mahapatra and Jee, 1993).

Thus *in-situ* incorporation of *dhaincha* and sunnhemp increased the productivity, improved the quality of rice and soil fertility in Madurai, Tamil Nadu.

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