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Effect of green manuring and NPK combinations on soil health and yield of rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted during *kharif* 1991-92 to 1995-96 at Sindewahi, to study the effect of incorporation of leafy foliage of glyricidia [*Gliricidia sepium* (J.) Walp.] with different levels of NPK on physico-chemical properties of soil and yield of rice (*Oryza sativa* L.). Incorporation of glyricidia leafy foliage at same site for 5 years recorded increase in organic carbon, total N, available NPK, water holding capacity and decrease in bulk density of soil over control. This treatment also recorded the significantly higher grain (52.08 q/ha) and straw (83.28 q/ha) yield over control. Amongst the fertilizer levels, application of 100 : 50 and 50 kg NPK/ ha recorded higher grain and straw yields over all other treatments. Maximum B : C ratio was obtained with glyricidia (5.10) followed by 100 : 50 : 50 kg NPK/ha (1.40).

Key words : Green manuring, Gliricidia, Rice, Soil health, NPK

In eastern Maharashtra, a large area is under rainfed agriculture. The soils are generally coarse in texture and productivity is low due to deterioration of soil properties and loss of nutrients through runoff. Rice crop on these soils is more economical during *kharif* season due to heavy rainfall (July-September). Use of manures with chemical fertilizers brought marked favourable changes on soil physico-chemical properties. Green manuring during *kharif* season proved beneficial for improving physico-chemical properties of soil (Bellakki and Badanur 1997). Under irrigated condition, its effect on soil physico-chemical properties under rainfed conditions is not known. The present study was therefore undertaken to study the effect of leafy foliage of glyricidia on properties of sandy clay loam soil and rice yield under rainfed conditions.

MATERIALS AND METHODS

A long term field experiment was conducted during *kharif* 1991-92 to 1995-96 on same site at Regional Rice Research Station, Sindewahi, dist. Chandrapur (Maharashtra). The experimental soil was sandy clay loam in texture, having pH 6.8,

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Table 1. Effect of green manuring and NPK on soil properties

Treatment	pH	EC (dS/m)	Bulk density (mg/m^3)	MWHC (%)	Pore space (%)	Organic carbon (%)	Total nitrogen (%)	Available nutrient (kg/ha)		
								N	P	K
Green manuring										
M_0 No green manuring	6.8	0.25	1.73	36.0	35.1	0.65	0.050	240	16.8	305
M_1 5 t/ha gliricidia foliage	6.8	0.23	1.55	38.8	41.0	0.81	0.071	266	18.5	320
CD (P = 0.05)	NS	NS	0.15	2.43	5.75	0.14	0.017	23.1	N.S.	N.S.
N : P : K level (kg/ha)										
T_1 100 : 50 : 50	6.7	0.23	1.69	35.4	36.3	0.71	0.071	252	18.1	301
T_2 100 : 50 : 00	6.7	0.24	1.65	34.9	37.8	0.71	0.069	240	18.3	305
T_3 100 : 00 : 50	6.6	0.25	1.70	34.9	35.8	0.70	0.074	241	16.2	307
T_4 00 : 50 : 50	6.7	0.21	1.71	35.5	36.5	0.75	0.072	239	18.2	295
T_5 100 : 00 : 00	6.8	0.21	1.69	36.4	36.3	0.73	0.073	234	16.1	301
T_6 00 : 50 : 00	6.7	0.25	1.65	35.7	37.8	0.75	0.071	250	18.5	299
T_7 00 : 00 : 50	6.6	0.27	1.69	35.8	36.3	0.74	0.069	240	16.6	295
T_8 00 : 00 : 00	6.7	0.28	1.70	36.00	35.8	0.75	0.070	241	16.0	295
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

EC 0.21 dS/m, organic carbon 0.52%, total N 0.05%, $CaCO_3$ 1.2% and available N 240 kg/ha. The bulk density of soil was 1.74 mg/m^3, pore space 35.8% and maximum water holding capacity was 35.2%.

Sixteen treatment combinations including 2 levels of green manuring and 8 of NPK fertilizers were studied in factorial randomized block design replicated thrice (Table 1). Rice variety 'Sye 75' was sown in the fourth week of June, and seedlings of rice were transplanted in the fourth and first week of July and August respectively. The harvesting of crop was done in the second and third week of November. Total rainfall received during rainy season of 1991, 1992, 1993, 1994 and 1995 was 813, 1,037, 1128, 932 and 1,096 mm, respectively.

The green leaves of gliricidia were added and incorporated in the soil by puddling before transplanting of rice seedlings. The recommended dose of P, K and half dose of N were applied at the time of transplanting and remaining half dose of N was applied in 2 equal splits, at tillering and panicle initiation stage. The initial and post- harvest surface soil sample (0-15 cm) were collected and analysed for physical and chemical properties of soil as per standard methods.

RESULTS AND DISCUSSION

Effect on soil properties

The physical and chemical properties of soil were significantly influenced due to addition of glyricidia leafy foliage (Table 1). The bulk density of soil decreased from 1.74 to 1.55 mg/m^3 with increased in pore space and water holding capacity to the extent of 11.0% and 10.2% respectively over the control. This decrease in bulk density and

Table 2. Effect of green manuring and NPK on mean yield of straw, grain and B : C ratio

Treatment	Pooled yield (q/ha)		Additional yield over control (q/ha)	Value of additional yield (Rs/ha)	Cost of fertilizer (Rs/ha)	Net profit (Rs/ha)	B : C ratio
	Straw	Grain					
Green manuring							
M_0 No green manuring	69.44	45.62					
M_1 5 t/ha gliricidia foliage	83.28	52.08	6.46	3,553	500	3,053	5.40
CD (P = 0.05)	4.60	5.60					
N : P : K level (kg/ha)							
T_1 10 : 50 : 50	86.00	54.22	9.40	5,170	1,520	3,650	1.40
T_2 100 : 50 : 00	80.95	50.49	5.67	3,119	1,095	2,024	0.84
T_3 100 : 00 : 50	80.30	50.10	5.28	2,904	1,145	1,759	0.53
T_4 00 : 50 : 50	80.00	48.81	3.99	2,195	800	1,395	0.74
T_5 100 : 00 : 00	76.28	49.06	4.24	2,332	720	1,612	1.23
T_6 00 : 50 : 00	71.14	46.64	1.82	1,001	375	626	0.67
T_7 00 : 00 : 50	71.98	46.64	1.82	1,001	425	576	0.35
T_8 00 : 00 : 00	67.99	44.82					
CD (P = 0.05)	04.6	02.07					

increase in porosity along with water holding capacity associated with increase in organic carbon content from 0.65 to 0.81%. The chemical properties like organic carbon, total N and available N were significantly improved. Whereas increase in available P and K were not marked. The results are in conformity with those of Prasad and Singh (1977). Effect on pH and E.C. of soil due to green manuring with gliricidia was non-significant.

The results of continuous application of nutrients NPK through fertilizers either alone or in combination recorded increase in bulk density of soil from 1.69 to 1.71 mg/m^3. This might be due to deterioration of soil structure by higher use of chemical fertilizer. Similar results were reported by Bhardwaj (1992). An application of NPK through fertilizers recorded a slight improvement in available NPK.

Effect on yield and B : C ratio

The pooled results of successive 5 years (Table 2) revealed significant differences in the yield of rice due to incorporation of gliricidia and levels of fertilizers. The significantly higher yield of grain (52.08 q/ha) and straw (83.28 q/ha) were recorded by incorporation of gliricidia foliage @ 5 t/ha over the control. The increase in yield was 14.16% and 19.93% over the control in respect of grain and straw. Anilkumar and Mathew (1994) reported 12.3% higher yield due to application of gliricidia foliage @ 5 t/ha over the control.

Among the fertilizer levels, application of recommended level of NPK (100 : 50 : 50 kg/ha) recorded significantly higher grain (54.22 q/ha) and straw (86.0 q/ha) yields followed by either an application of recommended level of N and P (50.49 q/ha grain and 80.95 q/ha straw) or N and K (50.10 q/ha grain and 80.39 q/ha straw). Because the experimental soil was medium in available phosphorus. The maximum net profit was recorded with application of 100:50:50 NPK kg/ha followed by application of gliricidia @ 5 t/ha. The B : C ratio was the highest for application of glyricidia (5.10) followed by application of 100 : 50 : 50 NPK kg/ha (1.40). This was due to high cost of NPK supplied through fertilizer. The interaction effect between green manuring and fertilizer was non-significant. Similar results were reported by Gattani *et al.* (1976).

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