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Response of rice (*Oryza sativa*) to sources of organic manures and levels of zinc sulphate in deep black soils

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) seasons of 1998 and 1999 to study the response of rice (*Oryza sativa* L.) to sources of organic manures and levels of $ZnSO_4$ in deep black soils. Application of poultry manure @ 2 tonnes/ha recorded significantly higher seed yield during both the years, followed by farmyard manure (7 tonnes/ha) and pressmud (2 tonnes/ha). Application of 25 kg $ZnSO_4$/ha resulted in significantly higher seed yield and panicles/hill. Interaction effects indicated that, an application of poultry manure or farmyard manure with 25 kg $ZnSO_4$/ha was optimum.

Key words : Rice, Organic manures, $ZnSO_4$, Black soil, Yield

Zinc deficiency is one of the most commonly seen micronutrient deficiencies in rice. Continuous use of high-analysis fertilizers combined with monocropping of rice and neglect use of organic manures manifest the occurrence of wide-spread zinc deficiency. Khanda *et al.* (1997) reported that zinc deficiency in rice soils exists since long time, hence blanket soil application of 5–20 kg/ha of $ZnSO_4$ has been recommended for most of the field crops. But response to zinc under different sources of organic manures is lacking. Hence the present investigation was undertaken to study the response of rice to the sources of organic manures and levels of $ZnSO_4$ in deep black soils.

MATERIALS AND METHODS

A field experiment was conducted at the Agricultural Research Station, Siruguppa, during the rainy (*kharif*) seasons of 1998 and 1999 under irrigated condition. The soil type was deep black, with pH 8.2. The available N, P_2O_5 and K_2O in soil were 260, 42 and 650 kg/ha respectively. The experiment was laid out in split-plot design and replicated thrice. There were 15 treatment combinations, consisting of 5 sources of organic manures (no organic manure; farmyard manure (0.5: 0.2 : 0.5% N:P:K), rice husk (0.5:0.3:0.4% N:P:K), poultry manure (3.0:2.6:1.4% N:P:K), pressmud (1.8:3.2:2.1% N:P:K) and 3 levels of

$ZnSO_4$ (0, 25 and 50 kg/ha). The crop received a uniform dose of 150, 75 and 75 N, P and K kg/ha. A basal dose of 50% N, full P and K were applied at transplanting. Remaining 50% N was top-dressed twice at 30-day interval in equal splits. The $ZnSO_4$ was applied separately at the time of transplanting by mixing with adequate quantity of sand. Rice 'SIRI 429' and 'Sonamasuri' varieties of rice were planted during 1998 and 1999, respectively, by giving a spacing of 20 cm × 10 cm.

RESULTS AND DISCUSSION

Effect of organic manures

There was a significant effect of organic manures on the yield and yield attributes of rice (Tables 1, 2). Among organic manures, incorporation of poultry manure (2 tonnes/ha) resulted in significantly higher seed yield, followed by farmyard manure (7 tonnes/ha) during individual year and pooled analysis. The pooled analysis showed that application of poultry manure and farmyard manure increased the seed yield by 18.4% and 11.3%, respectively, over the control (Table 1). Similarly, yield increase in rice with the application of poultry manure and farmyard manure was reported by Prasad (1999). Increase in grain yield in the present study may be attributed to yield attributed like panicles/hill, seeds/panicle and 1,000-seed weight. The superiority of farmyard manure and poultry manure is due to the release of aliphatic and aromatic hydroxy acids, humates and lignins (Ram Singh *et al.*, 1985). Farmyard manure acts as nutrient reservoir and upon decomposition produces organic acids, thereby adsorbed ions are released slowly for the entire growth leading to higher yields (Nimje and Jagdish Seth, 1988).

Effect of zinc

Application of $ZnSO_4$ significantly influenced the yield and yield attributes during individual year and pooled analysis. The seed yield of rice increased significantly to the application of $ZnSO_4$ up with 25 kg/ha, irrespective of sources of organic manures in both the years. Further increase in $ZnSO_4$ to 50 kg/ha did not improve the

Table 1. Effect of organic manures and $ZnSO_4$ levels on seed yield of rice

Treatment	Seed yield (kg/ha)		
	1998	1999	Pooled
M_0, No organic manure	3,841	4,407	4,124
M_1, Farmyard manure (7 tonnes/ha)	4,321	4,863	4,591
M_2, Rick husk (5 tonnes/ha)	4,170	4,450	4,303
M_3, Poultry manure (2 tonnes/ha)	4,743	5,023	4,883
M_4, Pressmud (2 tonnes/ha)	4,284	4,807	4,545
CD (P=0.05)	505	434	306
Z_0, 0 kg/ha	3,912	4,391	4,151
Z_{25}, 25 kg/ha	4,464	4,818	4,641
Z_{50}, 50 kg/ha	4,439	4,921	4,680
CD (P=0.05)	277	248	188

Table 2. Yield attributes of rice as influenced by organic manures and $ZnSO_4$ levels

Treatment	1998			1999		
	Panicles/ hill	Seeds/ panicle	1,000-seed weight (g)	Panicles/ hill	Seeds/ panicle	1,000-seed weight (g)
Organic sources						
M_0, No organic manure	7.7	74.2	19.68	8.5	107.1	14.04
M_1, Farmyard manure	9.0	84.0	20.42	9.3	112.5	14.96
M_2, Rice husk	8.4	77.4	19.82	8.5	115.8	14.42
M_3, Poultry manure	12.0	93.5	20.90	9.7	117.5	14.68
M_4, Pressmud	10.3	78.5	18.83	9.2	110.8	14.49
CD (P=0.05)	1.3	12.0	NS	0.8	NS	0.54
Zinc sulphate						
Z_0, 0kg/ha	9.0	75.9	20.01	8.2	106.6	14.33
Z_{25}, 25 kg/ha	9.7	80.0	20.18	9.2	116.1	14.49
Z_{50}, 50 kg/ha	9.8	88.9	20.21	9.7	115.5	14.73
CD (P=0.05)	0.7	7.1	NS	0.5	5.0	NS

Table 3. Interaction effect of organic manures and $ZnSO_4$ on seed yield of rice

Treatment	$ZnSO_4$ (kg/ha)					
	1999			Pooled		
	0	25	50	0	25	50
M_0, No organic manure	3,977	4,590	4,655	3,738	4,306	4,329
M_1, Farmyard manure	4,385	4,883	4,322	4,118	4,872	4,783
M_2, Rice husk	4,606	4,655	4,089	4,395	4,501	4,030
M_3, Poultry manure	4,356	5,290	5,436	4,346	5,060	5,244
M_4, Pressmud	4,639	4,675	5107	4,115	4,465	5,014
CD (P=0.05)		600			525	

*For comparing interaction between organic manures and $ZnSO_4$ at all levels

seed yield of rice. The pooled analysis indicated that the response to the applied $ZnSO_4$ was up to 11.8% at 25 kg/ha over the control, but further increase to 50 kg/ha showed an addition of only 0.8% increase in yield over 25 kg/ha. This may be attributed to yield attributes like panicles/hill and seeds/panicle which followed similar trend. Rao and Shukla (1997) also recorded response to $ZnSO_4$ up to 30 kg/ha. Kundu and Puste (1997) also reported similar favourable influence of $ZnSO_4$ application on the gain yield. The increase in yield due to zinc application may be attributed to its role on various enzymatic reaction and it acts as catalyst in various growth processes and in hormone production and protein synthesis.

Interaction effect

The interaction between organic manures and $ZnSO_4$ was significant during 1999 and pooled analysis (Table 3). The pooled data revealed that, application of poultry manure or FYM with 25 kg $ZnSO_4$/ha recorded significantly higher seed yield, followed by pressmud with 50 kg $ZnSO_4$/ha. An increase in yield in these treatments was 33.0, 22.8 and 28.4%, respectively, over control (M_0Z_0). The data also indicated that application of 25 kg $ZnSO_4$ /ha alone with organic manures resulted in significantly increase in grain yield by 15.4% over the control and further increase to 50 kg/ha did not increase the seed yield significantly. The trend was similar during 1999. Incorporation of rice straw husk did not show any beneficial effect with respect to zinc. The results clearly indicated that application of poultry manure or farmyard manure with $ZnSO_4$ (25 kg/ha) resulted in significant yield increase in rice.

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