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Effect of zinc-enriched organic wastes on dry-matter production, yield and economics in rice (*Oryza sativa*) in Entisol of North-Western Tamil Nadu

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) seasons of 1997 and 1998 on a red loamy sand soil, to evaluate the effect of zinc-enriched with organic wastes on dry-matter production at different growth stages, yield and economics in rice (*Oryza sativa* L.). Zinc-enriched pressmud was found to be the best, followed by zinc enriched with goat manure with net return of Rs 29,455 and Rs 24,033 respectively compared with least of Rs 19,250 in the control.

Key words : Zinc, Organic wastes, Rice, Yield, Dry matter, Economics

Majority of rice-growing soils in the North, Western Tamil Nadu are coarse-textured red loamy sand and about 70–80% area is deficient in available zinc (< 1ppm). In rice cultivation, zinc is the most essential micronutrient, as it plays a vital role in translocation of nitrogen and in protein synthesis. The evaluation of zinc-enriched organic wastes has not been done extensively. The present investigation was therefore undertaken to evaluate the efficacy of zinc-enriched organic wastes in a zinc-deficient soil of North-Western Tamil Nadu.

MATERIALS AND METHODS

A field experiment was conducted during 1997 and 1998 at the Regional Research Station, Paiyur, with medium-duration rice 'Paiyur 1, with 145 days duration. The soil of the experimental field was red loamy sand with pH 7.4, EC 0.75 dS/m organic carbon 0.35% and DTPA-Zn 0.85 ppm. The trial was laid out in randomized block design with 3 replications. The zinc-enriched organic wastes were prepared by incubating finely powdered waste and zinc as $ZnSO_4 . 7H_2O$ in 5:1 ratio under aerobic condition for about 30 days. Calculated quantities of zinc-enriched organic wastes to supply 25 kg $ZnSO_4$/ha were applied basal as per treatment schedule (Table 1). All the plots including the control were applied with a common dose of 150, 50 and 50 kg N, P_2O_5 and K_2O/ha respectively. Plant samples were collected at tillering (30 days after transplanting), panicle initiation (60 days

Table 1. Details of treatments used in the experiment

Treatment particulars
Control (no zinc sulphate)
$ZnSO_4$ (25 kg/ha inorganic)
Zn-CCP (25 kg/ha $ZnSO_4$ enriched with 125 kg composted coirpith)
Zn-FYM (25 kg/ha $ZnSO_4$ enriched with 125 kg farmyard manure)
Zn-MFP (25 kg/ha $ZnSO_4$ enriched with 125 kg mango fruit peel waste material from mango pulp industries)
Zn-PrM (25 kg/ha $ZnSO_4$ enriched with 125 kg pressmud)
Zn-NLP (25 kg/ha $ZnSO_4$enriched with 125 kg neem leaf powder)
Zn-PM (25 kg/ha $ZnSO_4$ enriched with 125 kg poultry manure)
Zn-GM (25 kg/ha $ZnSO_4$ enriched with 125 kg goat manure)

after transplanting) and at harvest. Whole plant sample was collected without losing any root. The root portion at tillering and panicle-initiation stages and the stubble (root with 5 cm straw) at harvest were carefully washed under running water and dried. The shoot portion, collected at tillering and panicle initiation, was partitioned into stem and leaf, dried and dry-matter yield was recorded. At harvest, the grain and straw yields were recorded besides calculating zinc-use efficiency, harvest index and economics.

RESULTS AND DISCUSSION

Tillering stage

The more beneficial nature of zinc application in altering the dry-matter production even at tillering stage could be visualized, indicating the response of rice to zinc (Table 2). While not much variation could be observed between the 2 years, the mean root dry matter was 5.71–13.22 q/ha. However, the stem dry matter differed between the years. The mean over the years indicated that the stem dry matter was the least in the control and the highest in the Zn-pressmud (PrM)-treated plot. The leaf dry matter significantly varied only during 1998 and the Zn-PrM recorded the highest compared with the control. The magnitude of variation in leaf dry matter was not very spectacular when compared with the root and stem dry-matter yields. In the dry-matter production of root, stem and leaves, the Zn-PrM treatment proved to be the best.

Panicle-initiation stage

With advancement of crop growth from tillering to panicle initiation, the dry-matter yield also increased progressively irrespective of the nature of treatment as well as crop partitioning (Table 3). However, the magnitude of variations among the treatments was detrimental check at panicle-initiation stage. The treatment involving Zn-PM and Zn-NLP (neem leaf powder) recorded significantly higher root dry matter during 1997 but in 1998, Zn-CCP (composted coir pith), Zn-PrM, Zn-NLP and Zn-PM (poultry manure) rated better and were at par as against the least in the control.

The stem dry matter increased significantly with zinc application. The Zn-PrM treatment showed the highest-followed by Zn-CCP.

The mean leaf dry matter was the highest in Zn-PrM. The treatments involving $ZnSO_4$ (inorganic) and Zn-NLP rated next best.

Harvest stage

Various treatments resulted significantly higher in the grain yield (Table 4). The mean over the years indicated that 25 kg/ha $ZnSO_4$ as Zn-PrM excelled all other treatments by registering 46.1% yield increase over the control and 26.9% over $ZnSO_4$ without organic enrichment. The Zn-GM (goat manure) rated next best with 24.6% yield increase over the control. The zinc-treated plots showed yield increase of 4.5–46.1% over the control. Such an yield

Table 2. Effect of zinc-enriched organic wastes on dry-matter production at tillering stage (q/ha) in rice

Treatment	Root			Stem			Leaf		
	1997	1998	Mean	1997	1998	Mean	1997	1998	Mean
Control	7.00	4.42	5.71	16.81	10.32	13.57	13.01	8.64	10.83
$ZnSO_4$	8.00	8.10	8.05	26.48	23.82	25.15	16.34	13.88	15.11
Zn-CCP	8.94	9.40	9.17	20.81	18.70	19.76	15.01	13.65	14.33
Zn-FYM	10.14	10.20	10.17	22.28	20.10	21.19	14.61	12.42	13.52
Zn-MFP	8.60	7.60	8.20	24.88	22.45	23.67	15.47	13.15	14.31
Zn-PrM	14.09	12.35	13.22	32.68	29.45	31.07	20.41	17.41	18.91
Zn-NLP	13.21	12.10	12.66	25.68	23.00	24.23	16.21	12.61	14.41
Zn-PM	9.47	8.52	9.00	24.35	18.25	21.30	15.54	11.45	13.50
Zn-GM	7.20	6.50	6.85	21.54	16.30	18.92	14.01	11.40	12.71
CD (P=0.05)	2.47	2.06		5.06	4.05		NS	2.89	

Details of treatments are given in Table 1

Table 3. Effect of zinc-enriched organic wastes on dry-matter production at panicle-initiation stage (q/ha) in rice

Treatment	Root			Stem			Leaf		
	1997	1998	Mean	1997	1998	Mean	1997	1998	Mean
Control	14.54	9.69	12.12	29.75	17.57	23.66	18.61	11.86	15.24
$ZnSO_4$	19.94	16.85	18.40	34.48	2930	31.89	23.01	18.40	20.71
Zn-CCP	19.08	20.81	19.95	46.89	39.80	43.35	17.88	14.30	16.09
Zn-FYM	17.37	14.35	15.85	39.62	33.68	36.65	18.28	19.62	18.95
Zn-MFP	20.08	17.31	18.70	35.88	30.50	33.19	18.94	15.15	17.05
Zn-PrM	21.08	19.46	20.27	47.36	40.26	43.81	26.21	20.97	23.59
Zn-NLP	21.74	19.24	20.49	43.96	37.37	40.67	21.68	19.68	20.68
Zn-PM	24.88	18.48	21.68	43.09	36.63	39.86	19.48	14.91	17.20
Zn-GM	18.34	14.35	16.35	40.82	34.70	37.76	19.81	13.25	16.53
CD (P=0.05)	3.63	3.06		1.98	4.35		1.51	3.02	

Details of treatments are given in Table 1

Table 4. Effect of zinc-enriched organic wastes on yield and economics in rice

Treatment	Grain yield (q/ha)			Straw yield (q/ha)			Stubble yield (q/ha)			Harvest index (%)	Net return (Rs/ha)	Benefit : cost ratio
	1997	1998	Mean	1997	1998	Mean	1997	1998	Mean			
Control	47.47	52.21	49.84	85.73	87.12	86.43	20.41	19.06	19.74	36.57	19,250	3.57
$ZnSO_4$	54.67	60.13	57.40	80.13	81.40	80.77	23.59	28.68	26.14	41.54	21,769	3.69
Zn-CCP	49.60	54.56	52.08	80.53	83.05	81.79	21.36	26.46	23.91	38.90	19,426	3.40
Zn-FYM	53.63	59.00	56.32	83.99	84.10	84.05	23.06	28.23	25.65	40.12	21,447	3.65
Zn-MFP	52.93	59.59	56.41	82.33	78.94	80.64	22.72	27.48	25.10	41.16	21,317	3.63
Zn-PrM	65.81	79.87	72.84	90.56	100.52	95.54	34.88	38.03	36.46	43.25	29,455	4.64
Zn-NLP	52.72	57.99	55.36	85.24	94.20	89.72	27.94	27.38	27.66	38.16	21,298	3.62
Zn-PM	50.93	66.02	58.48	78.93	89.37	84.15	26.99	31.18	29.09	41.00	22,424	3.77
Zn-GM	57.12	67.12	62.12	83.97	83.17	83.57	30.27	32.21	31.24	42.64	24,033	3.97
CD (P=0.05)	8.68	10.15	4.84	NS	NS	NS	6.98	6.71	3.19			

Details of treatment are given in Table 1

*Prevailing market price (Rs/q) : Rice grain, 450; rice straw, 50

increase may be attributed to deficiency of available Zn (< 1ppm) in soil of the experimental fields and hence irrespective of the sources, application of zinc had a profound influence in enhancing the yield. This is in conformity with the findings of Dhillon *et al.* (1993) Saravanan and Ramanathan (1998), and Rao and Shukla (1999).

The straw yield was not altered by the treatments in either of the years (Table 4). However, the treatments Zn-PrM and Zn-NLP recorded straw yields better than the control. It may be noted that all the treatments including the control were applied with an uniform dose of NPK and even then increased straw yield in these treatments might be due to balanced nutrition as was quoted by Rao and Shukla (1999).

Stubble yield in rice culture assumes greater significance owing to their incorporation into the soil. The data collected on stubble yield gave evidence for the beneficial effect of addition of zinc sulphate either alone or as organics enriched form. Zinc application increased the mean stubble yield (Table 4). The Zn-PrM in tune with grain and straw yields also helped in leaving behind higher amounts of stubbles. All other zinc-treated plots also proved their supremacy over the control. The fact that these stubbles upon decomposition in the soil would provide a more conducive environment to the succeeding crop. Besides, these stubbles cause improvement in soil physical properties, complexation and chelation (Veeraraghavan *et al.,* 1983; Bhat *et al.,* 1991).

All the zinc-treated plots recorded harvest index greater than the control, confirming the findings of Rao and Shukla (1999).

Economics

All the Zn treatments showed higher net returns and benefit : cost ratio than the control (Table 4). The Zn-PrM treatment resulted in the highest returns, followed by Zn–GM. Benefit : cost ratio also followed almost the similar trend.

Thus application of 25 kg $ZnSO_4$/ha after enrichment with pressmud was found to be the best for obtaining increased yield and more profit in rice grown in the red loamy sand soils.

REFERENCES

Bhat, A.K., Beri, V. and Sidhu, B.S. 1991. Effect of long term crop residues on soil productivity. *Journal of Indian Society of Soil Science* **39** (2) : 280–382.

Dhillon, N.S., Hundal, H.S. and Dev, G. 1993. Studies on P nutrition of rice–wheat cropping sequence in a samana sandy loam *Journal of Indian Society of Soil Science* **41** : 784–786.

Rao, C.P. and Shukla, D.N. 1999. Yield and nutrient uptake of rice (*Oryza sativa*) as influenced by sources and levels of phosphorus and zinc under transplanted conditions. *Indian Journal of Agronomy* **44** (1) : 94–98.

Saravanan, A. and Ramanathan, K.M. 1988. Effect of zinc application on its availability and yield of rice. *Oryza* **25** : 271–273.

Veeraraghavan, B., Rajamannar, A. and Sree Ramulu, U.S. 1983. Economic recycling of crop residues. (In) *Proceedings of National Seminar on Utilization of Organic Wastes,* held at Agricultural College and Research Institute, Madurai, pp. 123–129.