Madras Agric. J., 83(5): 280-283 May 1996
https://doi.org/10.29321/MAJ.10.A01022

EFFECT OF ZINC ENRICHED ORGANIC MANURES ON RICE YIELD

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ABSTRACT

A pot experiment was conducted to study the influence of well decomposed organic manures, zinc enriched (ZnE) organic manures, different levels of Zn on ADT-36 rice yield and organic carbon and available Zn content in post-harvest soils. Two types of soils were used for the pot experiment. The experiment was conducted adopting completely factorial randomised design. The results revealed that grain and straw yield of rice was associated with the application of ZnE organic manures @ 1 $t.ha^{-1}$ than the recommended level of organic manure @ 12.5 $t.ha^{-1}$. The enrichment of organic manures @ 1.25 mg Zn kg^{-1} increased the grain and straw yield to the tune of 26 per cent over on Zn application which showed the possibility of reducing fertilizer Zn rates. Among the ZnE organic manures, FYM + GLM enriched with 1.25 mg Zn Kg^{-1} increased grain yield markedly over organic manures @ 12.5 $t.ha^{-1}$.

KEY WORDS : ZnE Organic Manures, Zinc Levels, Rice Yield

In India, about 8 million ha of agricultural lands are deficient in Zn (Katyal, 1975). In Tamil Nadu, 50 per cent of the soils are deficient in Zn. Zinc sulphate fertilizer is most commonly used because of its greater solubility and availability than other sources. The $ZnSo_4$ is highly expensive. In recent years, the concept of Integrated Nutrient Management is gaining wide acceptance as it is an apporpriate measure for enhancing soil fertility and crop productivity. The enrichment of organic manures with mineral nutrients not only enhance the rate of decomposition but also improves the nutrient status (Singh, 1987). Keeping these points in view, an experiment was carried out to study the influence of ZnE organic manures on rice yield and organic carbon and available-Zn in post harvest soil.

MATERIALS AND METHODS

Details of pot experiment

Crop : Rice Var. ADT-36

Soils : S_1 - Typic ustorthents. Nasiyanur
S_2 - Vertic acquic ustropepts. Kaliannanpudur.

Treatments : Twenty five\

a. Control-NPK-100 : 50 : 50 $Kg.ha^{-1}$
b. Zinc enriched FYM @ 1 $Mg.ha^{-1}$
c. Zinc enriched CCP @ 1 $Mg.ha^{-1}$
d. Zinc enriched FYM+GLM @ (1/2 + 1/2) $Mg.ha^{-1}$

Manurial levels

L_0 - Control
L_1 - 1 $Mg.ha^{-1}$
L_2 - 12.5 $Mg.ha^{-1}$

Zinc levels : O, 1.25, 2.50, 3.75, 5.00 $mg.kg^{-1}$
Replications : Two
Design : Factorial completely randomised design

A pot experiment was conducted using two types of soils (S1-Typic ustorthents, Nasiyanur Village, Bhavani Taluk of Periyar District and S_2-Vertic aquic ustropepts, Kaliannanpudur village, Coimbatore Taluk and district, with rice ADT-36 as test crop. A set of 25 treatment combinations (five levels of Zn *viz.*,0, 1.25, 2.50, 3.75 and 5.0 ppm Zn as $ZnSo_4$ and five ZnE organic manures *viz.*, Zn alone, ZnE FYM, ZnE FYM+GLM (green leaf manure), ZnE CCP (composted coir pith) and ZnE CCP + GLM were followed in the above pot experiment. Organic manure @ 12.5 $t.ha^{-1}$ was used as control for the each ZnE organic manures.

Zinc Enrichment of organic manures

Different sources of organic manures *viz.*, well decomposed FYM, raw coirpith and green leaf manure *Glyricidia* sp) were used for the Zn enrichment of farm yard manure (FYM), raw coir pith and the chopped pieces of *Glyricidia* plant were air dried prior to Zn enrichment. Five Kg of FYM was incubated, with a calculated quantity of Zn as $ZnSO_4$ $7H_2O$, for 60 days by adding

Table 1. Effect of zinc and zinc enriched organic manures on organic carbon and DTPA-Zn in post-harvest soil

Zn enriched organic manures	Zn levels (ppm)	Organic carbon (%)			DTPA-Zn (ppm)		
		S_1	S_2	Mean	S_1	S_2	Mean
Zn	0.00	1.22	0.91	1.06	0.63	0.87	0.75
	1.25	1.23	1.92	1.13	0.93	1.36	1.15
	2.50	1.12	0.90	1.01	1.38	1.60	1.49
	3.75	1.25	0.95	1.10	1.56	2.30	1.93
	5.00	1.12	0.86	0.99	2.09	2.34	2.21
	Mean	1.19	0.93	1.06	1.32	1.69	1.51
FYM-Zn	0.00	1.28	0.95	1.12	1.90	2.10	2.00
	1.25	1.25	0.80	1.03	3.28	4.06	3.67
	2.50	1.11	0.98	1.04	3.28	4.03	3.66
	3.75	0.90	0.85	0.88	3.73	3.50	3.62
	5.00	1.10	0.69	0.89	3.84	3.72	3.78
	Mean	1.13	0.85	0.99	3.19	3.48	3.34
FYM-GLM-Zn	0.00	1.67	1.19	1.43	1.52	1.73	1.66
	1.25	1.37	0.79	1.08	3.29	4.06	3.67
	2.50	1.14	1.00	1.07	3.64	3.98	3.81
	3.75	1.15	0.76	0.95	3.67	4.19	3.92
	5.00	0.80	0.77	0.78	3.66	4.29	3.97
	Mean	1.23	0.90	1.06	3.16	3.65	3.41
CCP-Zn	1.00	1.24	1.17	1.21	1.56	1.35	1.46
	1.25	0.80	0.92	0.86	3.21	2.85	3.03
	2.50	1.20	1.21	1.20	3.68	2.87	3.27
	3.75	0.86	0.87	0.85	3.36	3.80	3.58
	5.00	0.77	1.01	0.88	4.01	3.93	3.97
	Mean	0.97	1.03	1.00	3.15	2.96	3.06
CCP-GLM-Zn	0.00	1.67	1.12	1.40	1.76	1.74	1.75
	1.25	1.32	1.01	1.16	3.07	3.31	3.19
	2.50	1.35	1.28	1.32	4.25	3.70	3.97
	3.75	1.30	1.01	1.15	4.20	3.96	4.08
	5.00	1.09	0.95	1.02	4.38	4.05	4.21
	Mean	1.35	1.07	1.21	3.53	3.35	3.44
	Mean	1.17	0.96		2.87	3.03	
			CD			CD	
		Zn	0.05			1.10	
		OM	0.05			0.10	
		S	0.03			0.06	
		Zn x OM	0.10			0.21	
		Zn x S	0.07			0.13	
		OM x S	0.07			0.13	

throughout the period of incubation. A known quantity of coirpith was taken and allowed to decompose, after the addition of calculated quantity of Zn as $ZnSO_4$, for 60 days. The mixture of coirpith and Glyricidia, FYM and Glyricidia in the ratio of 1:1 were taken and composted as detailed above.

Soil Analysis

The soil smples collected were analysed for the physico-chemical characteristics. The sandy clay loam Nasiyanur soil and the clay loam Kaliannanpudur soil was tested to be neutral in soil reaction (pH 6.90 and 7.82 for Nasiyanur and Kaliannanpudur soils respectively). The available

NPK for Nasiyanur and Kaliannanpudur soils were 196 and 154, 13 and 31 and 98 and 196 Kg.ha^{-1} respectively. The organic carbon and DTPA extractable-Zn content of the soils were 0.45 and 0.56 per cent and 0.50 and 0.73 mg.kg^{-1} for Nasiyanur and Kaliannanpudur soils respectively. Soil samples were also collected at post-harvest stage. Soil samples were processed and analysed for organic carbon and DTPA extractable-Zn. The yield of grain and straw was recorded after harvest.

RESULTS AND DISCUSSION

Organic carbon

The data on organic carbon are presented in Table 1. Application of organic manures

Table 2. Effect of Zinc and Zinc enriched organic manures on grain and straw yield of rice

Zn enriched organic manures	Zn levels (ppm)	Grain yield (g.pot^{-1})			Straw yield (g.pot^{-1})		
		S_1	S_2	Mean	S_1	S_2	Mean
Zn	0.00	25.8	24.8	25.3	40.0	45.0	42.5
	1.25	27.8	28.8	28.3	50.0	55.0	52.5
	2.50	29.0	33.5	22.9	55.0	60.0	57.5
	3.75	32.0	29.5	33.1	56.0	57.5	56.8
	5.00	32.0	32.3	32.1	50.0	50.0	50.0
	Mean	27.3	29.4	28.3	50.2	53.5	57.9
FYM-Zn	0.00	19.0	26.8	22.9	37.5	45.0	41.3
	1.25	29.3	31.0	30.1	46.5	55.0	50.0
	2.50	36.0	37.8	35.4	65.0	65.0	65.0
	3.75	38.0	34.6	35.6	37.5	60.0	58.8
	5.00	31.0	37.5	34.3	62.5	60.0	61.3
	Mean	29.3	34.0	31.6	54.0	56.5	55.3
FYM-GLM-Zn	0.00	25.0	28.6	20.8	40.0	57.5	48.8
	1.25	32.5	37.3	34.9	57.5	55.0	56.3
	2.50	37.5	39.0	38.4	65.0	57.5	61.3
	3.75	36.5	33.3	34.8	52.5	70.0	61.3
	5.00	29.3	34.3	31.8	60.0	62.5	61.3
	Mean	31.9	34.8	33.3	55.0	60.5	57.8
CCP-Zn	1.00	20.3	22.8	21.9	47.5	50.0	48.8
	1.25	23.5	30.5	27.0	50.0	55.0	52.5
	2.50	28.3	37.3	33.0	65.0	60.0	62.5
	3.75	32.5	37.0	33.1	50.0	52.5	51.3
	5.00	29.3	32.3	30.3	52.5	55.0	53.8
	Mean	27.5	30.8	29.1	53.0	54.5	53.8
CCP-GLM-Zn	0.00	27.0	24.5	25.8	42.5	45.0	43.8
	1.25	35.0	33.0	34.0	55.0	52.5	53.8
	2.50	34.0	36.5	35.0	65.0	70.0	67.5
	3.75	28.0	31.8	29.9	60.0	65.0	62.5
	5.00	29.3	32.3	30.8	50.0	55.0	52.5
	Mean	31.0	31.2	31.1	54.5	57.5	56.0
	Mean	29.4	32.0		53.3	56.5	
			CD			CD	
		Zn	2.4			4.65	
		OM	2.4			NS	
		S	1.52			2.94	
		Zn x OM	5.37			NS	
		Zn x S	NS			NS	
		OM x S	NS			NS	

significantly increased organic carbon content in the post harvest soil. Levels of Zn failed to influence the organic carbon content of the soil. This indicated that Zn addition did not have any influence on organic carbon content. An increase in organic carbon content was noticed due to addition of 2.5 mg Zn kg^{-1} ZnE CCP+GLM in post harvest soil. Addition of different organic manures increased organic carbon content at all stages of the crop. However, the interaction effect revealed that application of FYM+GLM @ 12.5 $t.ha^{-1}$ performed better than others. This might be due to the application of large quanitity of organic manures which provided sufficient quantity of carbonaceous materials for decomposition by microorganisms and converting them to mineralised organic colloids, besides adding them to soil reserves. Sharma and Mitra (1988) obtained similar results in rice crop.

DTPA extractable-Zn

The DTPA-Zn data are also presented in Table 1. Increasing levels of Zn increased the DTPA-Zn content in post harvest soils. Applications of Zn at 5.0 mg $Zn.kg^{-1}$ resulted in the highest DTPA- Zn in the post harvest soils. The higher solubility, diffusion and mobility of the applied Zn might be the reasons for enhanced DTPA extractable-Zn. Similar observation was reported earlier by Rajarajan (1991).

The ZnE organic manures were found to be better than the soil application of organic manures in increasing the Zn content of the soil. This was due to the enrichment of organic manures with different levels of fertilizer Zn which might have supplied additional Zn to crop growth. The application of CCP+GLM enriched with 5.0 $mg.Zn.kg^{-1}$ increased the DTPA-Zn at post harvest stage of crop growth. The release of Zn from organic manures during decomposition, coupled with acidic nature of CCP+GLM might have increased the Zn availability. This is in accordance with the results of Duraiswamy *et al.* (1988). Metalo-organic complexes formed by the addition of organics and initial Zn status of Kaliannanpudur soil might be the reasons for increased Zn content in that soil.

Yield

The application of $ZnSO_4$ significantly increased the grain and staw yield (Table 2). The highest grain and straw yield were associated with Zn application at 3.75 $mg.Zn.kg^{-1}$ but it was on par with 2.5 and 5.0 $mg.Zn.kg^{-1}$. Though Zn application at 1.25 $mg.Zn.kg^{-1}$ recorded the lesser yield, when compared to other levels, it increased the grain and straw yield over no Zn application. The increased yield due to Zn application might be due to the involvement of Zn in metallo-enzyme systems, regulatory functions and in auxin production (Sachdev *et al.*, 1988). Among the Zn enriched organic manures, addition of 2.5 $mg.Zn.kg^{-1}$ ZnE FYM+GLM gave better rice yield. The increased yield might be due to the increased availability of of native and applied Zn by the formation of organo-metallic complexes and the present results are in accordance with the earlier findings of Udayasoorian (1988). Consistently higher yield has been obtained from clay loam soils of Kaliannanpudur than the sandy clay loam soils of Nasiyanur. The above trend may be due to better availability of nutrients coupled with inherent fertility status of Kaliannanpudur soils.

REFERENCES

DURAISWAMY, P., KOTHANDARAMAN, G.V. and CHELLA MUTHU. S. (1988). Effect of amendments and Zinc on the availability, content and uptake of Zn and Fe by rice Bhavani in sodic soil. **Madras Agri. J. 75:** 119-124.

KATYAL. J.C. (1975). Zinc deficient in the rice soils in India. **Int. Rice Res. Conf. IRRI,** 10PP.

REJARAJAN. A. (1991). Radio tracer studies of Zinc nutrition of Rice. Ph.D thesis, Tamil Nadu Agricultural University, Coimbatore.

SACHDEV. P., Deb. D.L. and RASTOGI. D.K. (1988). Effect of varying levels of Zn and Mn on dry matter yield and mineral composition of wheat plant at maturity. **J. Nuclear agric Biol., 17:** 137-143.

SHARMA. A.R. and MITRA. B.R. (1988). Effect of green manuring and mineral fertilizers on growth and yield of crops in rice based cropping on acid lateritic soils. **J. Agric. Sci., 110:** 605-608.

SINGH. C.P. (1987). Preparation of high grade compost by an enrichment technique. I. Effect of enrichment on organic matter decomposition. **Biol. Agric. Hort., 5:** 41-49.

UDYASOORIAN. C. (1988). Effect of organic manures and fertilizers on crop yield in rice-rice cropping systems. **Madras Agric. J., 75:** 442-445.

(Received : August 1993 Revised : September 1995)