

Optimizing Fertilizer Zinc Requirements through Organic Enrichment in Pearl Millet –Wheat Sequence in Sandy Loam Soil of Gujarat, India

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INTRODUCTION

Crops utilize very low amounts of fertilizer-Zn but very high doses of fertilizer-Zn are often applied to correct Zn deficiencies in crops due to a high fixation of applied Zn in the soil. Fertilizer-Zn use efficiency is hardly 1 to 5%. The integrated use of micronutrients in combination with organic manures (8-10 t ha⁻¹) serves as a better option due to high chelation and slow availability which prevent micronutrient losses through precipitation, fixation, oxidation and leaching. In recent years, availability of organic manure has decreased. Therefore, efforts were made to enrich low doses of organic manure (fresh cow dung) with Zn for ameliorating Zn deficiency in a pearl millet-wheat sequence on sandy loam soil of Anand. The enrichment technique appears to be helpful in reducing requirements for organic manure with high efficiencies and also in reducing input costs for resource-poor farmers.

METHODS

The experimental soil has a loamy sand texture (Typic Ustochrepts), is alkaline in nature, medium in NPK fertility but was deficient in DTPA-Zn. Zinc treatments consisted of Zn-control, 1.25, 2.5 and 5 kg Zn ha⁻¹ applied with and without organic enrichment. The enrichment was done by mixing Zn with 200 kg of fresh cow dung. For this process, fresh cow dung was mixed with different Zn doses of ZnSO₄, and the material was incubated for 5-6 weeks at 60-65% moisture content. The cowdung was intermittently mixed for aeration and to enhance Zn chelation. At the end of the 5th week, the cow dung was dried, ground and homogeneously mixed for a uniform application in the field. The same amount of Zn was applied to pearl millet (*Pennisetum typhodium*) and groundnut (*Arachis hypogaea* L) without enrichment. Zinc was added to both crops grown by adopting recommended agronomic practices. Treatments were replicated three times in a randomized block design. Plant uptake was calculated, and soil available Zn was determined using a DTPA method (Lindsay and Norvell 1978).

RESULTS AND DISCUSSION

Field studies revealed that the highest pearl millet grain and straw yields were obtained under the recommended NPK treatment applied with cow dung enriched with 5 kg Zn ha⁻¹. It improved grain yield by 25.7% compared to the NPK / Zn-control. Furthermore, dry matter yield at 2.5 kg Zn ha⁻¹ was comparable with organically enriched 5 kg Zn ha⁻¹. The application of 1.25 kg Zn ha⁻¹ resulted in low yields (Table 1). Thus, the lower rate of 2.5 kg ha⁻¹ was found sufficient with the enrichment to meet the Zn requirements of pearl millet and groundnut in sequence. The Zn application of 1.25 and 2.5 kg Zn ha⁻¹ without enrichment led to lower yields than enriched Zn treatments. Zinc enrichments also resulted in a higher uptake of micronutrients, helped in increasing use-efficiency of fertilizer-Zn and reduced cost for Zn fertilizer by 50 % without a loss in crop yields for resource-poor farmers.

Table 1. Effect of Zn enriched FYM on yield, Zn uptake and DTPA Zn in pearl millet wheat crop sequence (pooled, 2001-04).

Treatment	Yield (kg ha ⁻¹)		Total Zn uptake (g ha ⁻¹)		DTPA-Zn mg kg ⁻¹
	Pearlmillet	Wheat	Pearlmillet	Wheat	
Zn 0	1919	3084	161	223	0.61
Zn 1.25	2015	3110	201	234	0.66
Zn 2.5	2167	3383	208	251	0.85
Zn 5.0	2137	3410	193	257	1.17
Zn 0 200 kg Cowdung	2138	3170	192	236	0.66
Zn 1.25 En 200 kg Cow dung	2171	3192	193	246	0.86
Zn 2.50 En 200 kg Cow dung	2255	3435	198	264	0.98
Zn 5.00 En 200 kg Cow dung	2413	3416	219	283	1.27
CD (p=0.05)	185	351	29.5	34.6	0.39

CONCLUSIONS

The results showed that a regular Zn application at the rate of 2.5 to 5 kg increased the grain yield of pearl millet- groundnut sequence significantly when compared to the Zn-control and 1.25 kg Zn ha⁻¹ soil application treatments. When Zn was enriched with organic manure (fresh cowdung) for 5-6 weeks, the availability of Zn increased in the soil, and the efficiency of applied Zn improved by 200%. It increased the Zn status and its uptake by plants compared to the no-enrichment treatments. Thus, Zn enrichment is helpful in saving the resource-poor farmers as much as 50% fertilizer-Zn requirements for a pearl millet-groundnut cropping system.

REFERENCES

- Lindsay, W. L. and Norvell, W.A. (1978) Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J. 42: 421- 428.