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Direct and residual effect of zinc and zinc amended organic manures on the zinc nutrition of field crop

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Abstract- Zinc (Zn) deficiency is the most widespread micronutrient disorder in rice (*Oryza sativa*) The objective of this paper was to examine alternative evaluation methods and to identify the most informative traits that would provide realistic information for rice breeders and to map quantitative trait loci (QTLs) associated with tolerance The most severe symptom in the field was high plant mortality. Zinc interfered with translocation of iron from roots to above ground parts of *Glycine max.* (L.) Merrill var. Hawkeye. During periods in which zinc impeded iron translocation, it also suppressed the production of reductant by roots. Addition of iron, as a ferric metal chelate (iron ethylenediaminedihydroxyphenylacetic acid), to the growth medium overcame the interference of zinc. In the root epidermis, potassium ferricyanide formed a precipitate (Prussian blue) with ferrous iron derived from the previously supplied iron ethylenediaminedihydroxyphenylacetic acid. The reduction of ferric iron was suppressed by zinc. In a field experiment on silt loam calcareous soil, the direct and residual effect of zinc and zinc amended organic manures were studied on rice (*Oryza sativa L.*) followed by barley (*Hordeum vulgare L.*) and rice respectively. Visual Zn deficiency symptoms were observed on rice in on zinc plots. Application of zinc significantly increased the crop yield. The magnitude of yield response was intensified where zinc was applied in conjunction with organic manures. The highest Zn uptake in these three crops was recorded at 5 kg Zn amended with 10t compost /ha.
Keyword- Oryza, Zinc Sulphate, Organic Manure, Organometallic Complexes, Calcerous soil

Introduction

Among different micronutrients, the deficiency of zinc is widespread in Indian soil [2]. Micronutrients delineation in soils and plants revealed that 70 to 80% soils in calcareous belt are deficient in available zinc (Anonymous, 1980-81) where apparent zinc deficiency symptoms have been observed on several field crops [7]. Increasing demand of zinc sulphate to migrate the zinc problem is leading a continuous rise in its price. Hence it was felt necessary to enhance the efficiency of native and applied Zn in such soils where Zn availability is an obstacle. The present investigation was therefore, initiated to study the direct and residual effect of zinc and amended organic manure on crops grown in succession.

Material and Method

A field experiment was conducted on a silt loam calcareous soil. There were fifteen treatments as shown in table 1. Two sources of manure i.e. farm yard manure (FYM) and compost were used. This organic manure were mixed with zinc sulphate, slightly moistened, kept in polythene bags for 10 days to complete the chelation reaction and then applied in appropriate treatment plots and mixed with plough layer soil. The treatments were replicated thrice in a randomized block design. Rice variety “Sita” was taken as first test crop followed by barley variety “DL 36” and rice variety “Sita” in order to study the residual effect of treatment applied with first crop. A basal dose of 110 kg N, 60 kg P2O5and 50 kg K2O /ha in rice and 60 kg N, 0 kg P2O5 and 30 kg N2O /ha in barley was applied as urea, single super phosphate and muriate of potash, respectively. In third crop (rice) the levels of N, P2O5 and K2O, and corresponding carriers were same as in first crop rice. The grain and straw yields were recorded. The plant samples were washed in acidified detergent solutions, rinsed in distilled water and dried in oven at 65oC. the plant samples were pulverized in a waring blender, digested in tri- acid mixture [6]The initial soil sample collected at the start of the experiment was analyzed for some important characteristics [3]Available Zn was extracted with DTPA as per procedure of [4]. The pH, EC, OC, free CaCO3 and available Zn were 8.6, 0.58, mhos/cm, 0.46%, 36% and .58 PPM, respectively. The zinc content in soil and plants extract was determined with the help of atomic absorption spectrophotometer. DTPA extractable Zn in FYM and compost was 10 and 15 PPM, respectively.

Results and Discussion

Direct effect on rice (1st crop): The grain and straw yields as influenced by Zn and Zn amended organic manure is presented in Table 1. It is evident that applications of Zinc alone or in combination with organic manure significantly increase the grain and straw yields over control. The grain yield response ranged from 4.2 to19.5 and straw yield response from 7.7 to35.4q/ha. Mixing of 2.5 kg Zn either with 50-q FYM/ compost or100-q FYM/ compost produced the similar yields. The grain yield response obtained due to amendment of 2.5 kg Zn with 50 q FYM/ compost was equivalent to 5kg Zn/ ha application. Hence with the use of organic manure the optimum level of Zn can be reduced to about 50%. This beneficial effect of organic

mangers may be attributed to the formation of organometallic complexes with Zn, which resulted in the increase of its efficiency. These results are in accordance with the findings of several workers [5,7,1,8]The Zn uptake in grain and straw ranged from 41.2 to 111.2 and 81.2 to 244.1g/ha respectively. The total Zn uptake at 2.5 kg Zn +50 q FYM is at par with 2.5 kg Zn +100 q FYM/ compost +2.5 kg Zn/ha. It is also interesting to record that total Zn uptake in 5 kg Zn +100 q FYM/ compost treatment is identical to 2.5 kg Zn mixed with 100 q FYM/ compost/ha. The experimental soil was deficient in available Zn as its value was below the critical limit of 0.78-PPM [9]. Residual effect on barely (2nd crop) and rice (3rd crop): the residual effect of Zn and Zn amended organic manure on Barley is shown in Table 2. The residual response in grain and straw yields of barley ranged from 1.4 to 9.5 and 1.3 to 15.1 q/ha respectively. It was further observed that the residual value of either 100 q FYM+2.5 kg Zn or 100 q composite +2.5 kg Zn/ha was equivalent 50q FYM +5 kg Zn/ha wit respect to grain and straw yields. However maximum grain and straw yields response was recorded at 100 q composite +5kg Zn/ha level with corresponding value of 9.5 & 15.1 q/ha respectively. The uptake of Zn progressively increase with increasing level of Zn and organic manure showing the highest value of 292.6 at 100 q composite + 5kg Zn /ha treatment. The residual effect of these treatments was studied on rice as third crop (Table 3). The rice variety was same that was grown as 1st crop but the yield was lower as compared to 1st crop. This low yield is due to prolonged submergence of field as a result of flood during the early period of crop growth, which accrued poor tilering. The grain and straw yield response ranged from 0.3 to 9.1 and 0.3 to 19.2 q/ha respectively. The magnitude of response was quite low as compared to 1st rice crop. The residual value of Zn and Zn amended organic manure was still higher than with respect to yields and Zn uptake. The total Zn uptake ranged from 94.8 to 241.2 g/ha. The highest Zn uptake was noted in the treatment receiving 100 q composed + 5kg Zn /ha. From this study it may be inferred that the residual value of soil applied amending it with organic manure can enhance Zn.

Abbreviations

Zn = Zinc
N2O = Nitrous Oxide
P205 = Phosphorus Pentaoxide
N = Nitrogen
K2O = Pottasium dioxide
FYM = Field Yard Manure
EC = Electrical Conductance
OC = Optical conductance
PPM = Parts Per Million
AAS = atomic Absorption Spectrophotometer

References

[1] Gupta V.K, Gupta A.P. and Raj H. (1983) *Indian J. agric.Sci*. 53(59): 826-830.
[2] Katyal J.C. and Agarwala S.c. (1982) *Micronutrient Research in India. Fert. News*. 27(2): 85-86.
[3] Jackson M. (1967) *Soil chemical analysis. Prentice Hall of India, Pvt. Ltd., New Delhi*.
[4] Lindsay W.L. and Norvell W.A. (1978) *Soil Sci. Soc. Am. J*. 42: 421-428.
[5] Miller B.F., Lindseed W.L. and Parsa A.A. (1969) *Use of poultry manure for correction of zinc and iron deficiencies in plants. Proc. Conf. On animal*.
[6] Piper C.S. (1966) *Soil and plant analysis. Hans Publishers, Bombay*.
[7] Sakal R. and Singh A.P. (1979) *Zinc hunger in Kharif crop of north Bihar. Indian Fmg*. 28 : 3-5.
[8] Singh A.P., Sakal R. and Singh B.P. (1983) *Pl. and soil*. 73 : 315-322.
[9] Sakal R., Singh B.P. and Singh A.P. (1982) *Pl. and soil*. 66: 129-132.

Table 1: Direct effect of zinc and organic manures on rice yields and zinc uptake

Treatment	**Yield q/ha**	**Zinc uptake**	**Total**		
g/ha					
Grain	Straw	Grain	Straw		
Control	22.5	45.3	41.2	81.2	124.4
2.5 kg zinc/ha	33.7	66.7	70.2	135	205.2
5.0 kg zinc/ha	36.3	71.8	81.1	169.4	252.5
5t FYM/ha	27.3	53	55.5	111.2	166.6
5t FYM + 2.5kg zinc/ha	38	75.2	85.5	205.3	290.8
5t FYM + 5.0 kg zinc/ha	42	80.7	100.4	230.9	331.3
10t FYM/ha	29.7	59.7	62.3	140.7	203
10t FYM + 2.5kg zinc/ha	39.3	78.3	85.5	231.2	318.7
10t FYM + 5.0 kg zinc/ha	33.5	69.8	81.8	211.2	295.4
5t Compost/ha	30.2	57.8	61.3	115.9	177.2
5t Compost + 2.5kg	39.7	77	88.6	209.5	298.1
zinc/ha					
5t Compost + 5.0 kg	39	77.5	99.4	217.7	317.1
zinc/ha					
10t Compost/ha	31.8	64.3	68	139.6	207.6
10t Compost + 2.5kg	40.2	79.2	93.6	237.9	331.5
zinc/ha					
10t Compost + 5.0 kg	38	75	111.2	244.9	355.3
zinc/ha					
C.D. at 5%	1.3	8.1	14.4	31.2	34.7

Table 2: Residual effect of zinc and organic manures on barley (second crop) yields and zinc uptake

Treatment	Yield q/ha		Zinc uptake g/ha		Total
	Grain	Straw	Grain	Straw	
Control	31	47.4	82.2	61.8	144
2.5 kg zinc/ha	32.4	48.7	94.9	75.3	170.2
5.0 kg zinc/ha	34.8	52.6	108.9	100.3	209.2
5t FYM/ha	32.5	49	91.1	68.8	159.9
5t FYM + 2.5kg zinc/ha	35.4	54.1	113.8	95.9	209.7
5t FYM + 5.0 kg zinc/ha	37.6	59	125.4	115.6	241
10t FYM/ha	31.1	49.4	103.7	80.8	184.5
10t FYM + 2.5kg zinc/ha	37.3	57	131.8	116.1	247.9
10t FYM + 5.0 kg zinc/ha	39.7	62.1	146.9	138.4	285.3
5t Compost/ha	32.6	49.7	95.8	74.3	170.1
5t Compost + 2.5kg zinc/ha	34.7	55.8	116.4	106.1	222.5
5t Compost + 5.0 kg zinc/ha	38.5	59.2	136.9	128.9	265.8
10t Compost/ha	33.6	50.5	106.2	83.8	190
10t Compost + 2.5kg zinc/ha	37.7	58.3	127.1	119.2	246.3
10t Compost + 5.0 kg zinc/ha	40.5	62.5	148.9	143.7	292.6
C.D. at 5%	4	5.7	14	15.9	25.5

Table 3: Residual effects of zinc and organic manures on rice (third crop) yield and zinc uptake

Treatment	Yield q/ha		Zinc uptake g/ha		Total
	Grain	Straw	Grain	Straw	
Control	16.7	34.2	30.1	64.7	94.8
2.5 kg zinc/ha	18.8	38.4	40.3	80.1	120.4
5.0 kg zinc/ha	22.5	43.9	49.8	99.1	148.9
5t FYM/ha	17	34.5	31.2	72.1	105.3
5t FYM + 2.5kg zinc/ha	22	42.5	49.3	101.2	152.5
5t FYM + 5.0 kg zinc/ha	24.4	49.4	58.1	126	184.1
10t FYM/ha	20.4	42.1	41	82.5	123.9
10t FYM + 2.5kg zinc/ha	23.8	46.2	51.3	110.6	163.9
10t FYM + 5.0 kg zinc/ha	25.8	52.1	64	149.2	211.2
5t Compost/ha	19	36.4	36.5	78.2	114.7
5t Compost + 2.5kg zinc/ha	22.3	45.6	46.3	115.7	162
5t Compost + 5.0 kg zinc/ha	24.2	50.3	57.6	137.5	195.1
10t Compost/ha	20.7	45	44.6	94.4	139
10t Compost + 2.5kg zinc/ha	22.9	48.6	51.3	137.5	190.8
10t Compost + 5.0 kg zinc/ha	25.8	53.4	72.5	170.7	241.2
C.D. at 5%	1.2	5.1	12.1	19.6	28.8