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EFFECT OF AMMONIUM POLYPHOSPHATE AS A CARRIER FOR ZINC IN LOWLAND RICE

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Abstract : A field trial was conducted for four seasons to evaluate the efficacy of ammonium polyphosphate (APP) for its sequestering effect of zinc and to find out the optimum level of zinc for the rice crop. The results revealed the sequestering effect of APP to zinc. Among the three levels of zinc application tried, 25 kg $ZnSO_4$ per ha was found to be the optimum level of zinc for the rice crop.

Key words : Ammonium polyphosphate, rice, sequestering, zinc.

INTRODUCTION

Zinc deficiency has been reported to be more wide spread in submerged rice *Oryza sativa* than in other crops (Prasad *el al.,* 1991). Ammonium polyphosphate (APP) is a new group of complex phosphatic fertiliser reported for its high phosphate use efficiency as it is less prone to soil fixation and has been reported to improve the availability of micronutrients like zinc through a mobilising mechanism (Tisdale *et al.* 1985). In order to examine this effect on zinc nutrition and to fix the optimum level of zinc for rice crop, the present experiment was taken up.

MATERIALS AND METHODS

Field experiments were conducted at the Rice Research Station, Moncompu, Kerala during the period 1991-93, using the variety Pavizham (MO-6) as test crop. The soil of the experimental field was silty clay in texture, having pH 5.0, EC 0.2 dS m^{-1}, organic C 1.37%, available P 10.5 kg ha^{-1}, available K 92 kg ha^{-1} and DTPA extractable Zn 0.032 ppm. The experiment was laid out in randomised block design with nine treatments replicated four times. The treatments were as follows: (1) P_0Zn_0 (No P and No Zn); (2) P_0Z_n (No P but Zn ® 25 kg $ZnSO_4$ per ha; (3) P_0Zn_2 (No P but Zn @ 50 kg $ZnSO_4$ per ha; (4) P_1Zn_0 (60 kg P_2O_5 per ha as diammonium phosphate (DAP) and no Zn; (5) P_1Zn_1 (60 kg P_2O_5 per ha as DAP and Zn @ 25 kg $ZnSO_4$ per ha); (6) P_1Zn_2 (60 kg P_2O_5 per ha as DAP and Zn @ 50 kg $ZnSO_4$ per ha); (7) P_2Zn_0 (60 kg P_2O_5 per ha as ammonium polyphosphate (APP) and no Zn; (8) P_2Zn_1 (60 kg P_2O_5 per ha as APP and Zn @ 25 kg $ZnSO_4$ per ha) and (9) P_2Zn_2 (60 kg P_2O_5 per ha as APP and Zn @ 50 kg $ZnSO_4$ per ha). Nitrogen and potassium were given @ 100 kg N and 60 kg K_2O per ha to all the plots irrespective of the treatments. The phosphatic fertilisers and zinc sulphate were given as basal at the time of land preparation. The nitrogenous and potassic fertilisers were given in three splits as basal, at active tillering and panicle initiation stages. The field trial was taken up for four seasons viz., two kharif and two rabi at the Rice Research Station, Moncompu. The surface soil samples at a depth of 15 cm were collected after the harvest of the crop and analysed for DTPA extractable Zn (Lindsay and Norvell, 1978). The statistical analyses of the data were carried out as per Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth parameters

The pooled (four seasons) analytical data of growth characters like plant height at vegetative stage, number of vegetative tillers per hill, plant height at harvest stage and number of productive tillers per hill, showed no significant difference between treatments.

Yield and yield parameters

The treatments had a significant influence on the grain and straw yield of rice (Table 1). Among the treatment combinations, APP at 60 kg P_2O_5 ha^{-1} along with 50 kg $ZnSO_4$ ha^{-1} gave the maximum yield of 3610 kg ha^{-1}. The same

Table 1. Effect of P and Zn on the yield parameters of rice crop

Treat-ments	Grain yield kg ha^{-1}	Straw yield kg ha^{-1}	No. of grains / panicle	1000 grain weight g
$P_0 Zn_0$	3189	3960	112	24.1
$P_0 Zn_1$	3533	4566	151	24.4
$P_0 Zn_2$	3425	4228	109	24.4
$P_1 Zn_0$	3284	4088	109	24.2
$P_1 Zn_1$	3278	4203	102	24.0
$P_1 Zn_2$	3514	4566	103	24.3
$P_2 Zn_0$	3355	4362	108	24.3
$P_2 Zn_1$	3514	4471	110	24.4
$P_2 Zn_2$	3610	4617	102	24.6
CD(0.05)	260	331	NS	NS
P_0	3380	4254	111	24.3
P_1	3361	4286	108	24.3
P_2	3495	4483	107	24.4
CD(0.05)	NS	191	NS	NS
Zn_0	3278	4139	110	24.2
Zn_1	3444	4413	112	24.4
Zn_2	3514	4471	105	24.4
CD(0.05)	150	191	5.15	NS

trend was shown for all the four seasons. On comparing the grain yield between the two types of fertilizers, the APP applied plots gave an increased yield of 4 per cent and straw yield of 4.6% over the DAP applied plots. With regard to straw, the APP applied plots recorded a significantly higher yield than that of the DAP applied plots. At all levels of Zn application, the APP given plots gave a higher yield of grain and straw than the DAP given plots, positively due to the sequestering effect of APP on Zn availability. Similar results in rice were reported earlier (Anon, 1992). The factorial analysis of the data revealed that the levels of zinc applied gave the a significant variation in the straw and grain yield of rice. At 25 kg $ZnSO_4$ ha^{-1} the recorded grain yield was 3444 kg ha^{-1} i.e., 5.1% more than the treatment without zinc application. However, the treatment that received 50 kg $ZnSO_4$ ha^{-1} recorded the maximum grain yield of 3514 kg ha^{-1} which was on par with $ZnSO_4$ at 25 kg ha^{-1}. Increased grain yield in rice due to zinc application was reported by Reddy *et al.* (1985) and Prasad and Umar (1993). At 25 kg $ZnSO_4$ ha^{-1}, the straw yield was 4413 kg per ha i.e., 6.6 per cent higher than no zinc application But the straw yields at 25 and 50 kg $ZnSO_4$ ha^{-1} were on par.

Soil and plant zinc content

The pooled data on soil and plant Zn content is given in (Table 2). On examining the data of the factorial analysis, it is seen that, availability of soil zinc increased on increasing the zinc application level from 0 to 25 kg $ZnSO_4$ ha^{-1}. But available Zn content at 25 kg and 50 kg $ZnSO_4$ ha^{-1} was on par. So, for maintaining the zinc level in an optimum condition for availability and yield, 25 kg $ZnSO_4$ ha^{-1} was enough. In plots where $ZnSO_4$ was applied along with phosphatic fertilizers, the APP applied plots recorded a lesser content of soil zinc than that of the DAP applied plots, indicating the carrier effect of APP to the micronutrient zinc. With regard to zinc content in grain and straw, an increased amount was observed in both the cases for APP applied plots. This again confirmed the carrier effect of APP to the micronutrient zinc. The levels of zinc application from 0 level to 50 kg $ZnSO_4$ ha^{-1} showed a graded increase of zinc content in straw and grain. In the case of straw that graded increase was more with statistical significance. The increased uptake of zinc in straw than grain was in conformity with the results of Reddy *et al* (1985). Even though the plant Zn content was increased up to 50 kg $ZnSO_4$ ha^{-1} level, that was not reflected in yield. The grain and straw yields at both the levels of 25 and 50 kg $ZnSO_4$ ha^{-1} were on par. So, $ZnSO_4$ application @ 25 kg ha^{-1} is found to be sufficient for the rice crop.

Table 2. Effect of P and Zn application on the Zn content of soil and plant in rice

Treatments	Soil Zn, ppm (DTPA)	Grain Zn ppm	Straw Zn ppm
$P_0 Zn_0$	1.54	20.8	68.4
$P_0 Zn_1$	2.13	23.4	85.9
$P_0 Zn_2$	2.43	9.7	121.6
$P_1 Zn_0$	1.40	23.8	67.6
$P_1 Zn_1$	2.40	25.3	109.8
P, Zn,	3.28	29.5	124.8
$P_2 Zn_0$	1.61	30.1	68.1
P, Zn_1	2.23	27.2	107.1
$P_2 Zn_2$	2.27	25.1	128.1
CD(0.05)	NS	NS	24.4
P_0	2.04	24.5	91.9
P_1	2.36	26.2	100.7
P_2	2.04	27.4	101.1
CD(0.05)	NS	NS	NS
Zn_0	1.52	24.9	68.0
Zn_1	2.25	25.3	100.9
Zn_2	2.66	27.9	124.8
CD(0.05)	0.43	NS	14.1

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