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EFFECT OF VARYING LEVELS AND METHODS OF APPLICATION OF ZINC ON THE YIELD OF RICE*

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The importance of zinc in rice nutrition has received considerable attention during the recent years, particularly after the introduction of high yielding varieties and adoption of intensive methods of cultivation. Nene and Sharma (1969) observed that the *'khaira'* disease of paddy was due to zinc deficiency. The deficiency appears to be very common in alkali soils and in water-logged acid soils. Trials conducted under IRRI (1971) indicated the possibility of zinc deficiency even in acid soils, if continuously water-logged. Presence of excess organic matter tends to inactivate soil zinc and retard zinc uotake by rice plant (Yoshida *et al.*, 1973). Excess application of phosphorus may also lead to unavailability of zinc in these soils. Symptoms similar to those due to zinc deficiency in rice have been reported in the water-logged acid rice soils in Kuttanad, Kerala. Zinc sulphate application has proved helpful in alleviating such symptoms (Tomy *et al.*, 1975). However, pot culture trials conducted by Mariam and Koshy (1977) on the effect of zinc applied alone and in combination with lime, on rice yield in the Vellayani acid soil failed to record significant yield increase. Although a preliminary survey conducted in the water-logged acid soils of Kuttanad revealed zinc deficiency, systematic investigation on the effect of zinc application on rice yield in these soils has not been carried out. A field experiment was conducted at Edathua, Kuttanad (Alleppey district) to study the effect of different levels and methods of zinc application on the yield and yield attributes of rice (variety Jaya) during 1980.

Materials and Methods

The experiment was laid out in RBD in a zinc deficient soil in a farmer's field. The soil type was river alluvium surrounded by river and containing 8.1 % organic matter, 0.042% total P_2O_5 and *0.32%* total K_2O. The initial pH of the soil was 4.5 and specific conductivity 0.212 millimho/cm. The soil analysed 78 ppm total zinc and 1 ppm available zinc (EDTA).

The 21 treatment combinations of zinc and lime tried with 2 replications were as fallows representing one fourth, one half and full dose of lime recommended in the package of practices for rice by the Kerala Agricultural University.

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Zinc

Zn_0 No zinc
Zn_1 Soil application @ 10 kg/ha zinc sulphate
Zn_2 Soil application @ 20 kg/ha zinc sulphate
Zn_3 Soil application @ 30 kg/ha zinc sulphate
Zn_4 Foliar application 0.25% zinc sulphate
Zn_5 Foliar application 0.50% zinc sulphate
Zn_6 Root dip of seedling root in *2%* zinc oxide suspension.

Lime

L_0 150 kg/ha fully burnt lime
L_1 300 kg/ha ,, ,,
L_2 600 kg/ha ,, ,,

Farm yard manure @ 5 t/ha and N: P_2O_5: K_2O @ 90:45:45 kg/ha were applied uniformly to all the plots. Soil application of zinc was done just before transplanting while foliar spray with zinc was given on the third week of planting. In the root dip treatment the seedling roots were dipped in *2%* zinc oxide suspension in water for 30 min just before planting. The spacing followed was 20 cm x 15 cm.

Results and Discussion

Yield: The data on the grain and straw yield per hectare as influenced by the different levels and methods of zinc application are given in Table 1. The yield of grain was siginficantly influenced by zinc application. Treatments which received 20 kg and 30 kg $ZnSO_4$/ha applied to soil and foliar spray of 0.25 and 0.50% $ZnSO_4$ were found to yield significantly higher grain than no-zinc treatment. Root dip method and soil application of zinc at 10 kg though recorded an increase in yield over control were on par. The highest mean grain yield of 6817 kg/ha was recorded from the plot which received foliar application of 0.5% $ZnSO_4$ followed by 20 kg/ha soil application. Soil application of 20 kg/ha and foliar spray of 0.25% $ZnSO_4$ were on par. Soil application of 30 kg/ha $ZnSO_4$ however, resulted in a decrease in the mean grain yield. The results indicate the usefulness of soil or foliar application of zinc to zinc dificient acid soils which are water-logged. The present results agree with the findings of Prabha *et al.* (1975), Tomy *et al.* (1975), Mahapatra and Gupta (1978) and Katyal *et al.* (1979). Application of lime showed an increasing trend of grain yield. The non-significance in the grain yield by lime application might be due to the decreased availability of zinc at higher pH values brought about by lime application and is supported by the findings of Mariam and Koshy (1977).

Data on straw yield indicate that the levels of zinc influence significantly the straw yield. However, lime and zinc-lime interaction did not significantly influence the straw yield. An increase in straw yield could be observed with the application of zinc at all levels. The highest mean yield of 7861 kg/ha was recorded from foliar application of *0.50%* $ZnSO_4$, followed by soil application of 20 kg/ha $ZnSO_4$.

Table 1

Influence of zinc and lime on the yield of grain and straw in rice

Treatment	Grain yield, kg/ha				Straw yield, kg/ha			
	L_0	L_1	L_2	Mean	L_0	L_1	L_2	Mean
Zn_0	5817	6000	5900	5906	7250	7167	7500	7306
Zn_1	6183	6317	6350	6283	7583	7750	7417	7583
Zn_2	6733	6750	6650	6711	7500	7750	7667	7639
Zn_3	6433	6283	7050	6589	7500	7516	7583	7533
Zn_4	5833	6850	6966	6550	7417	7500	7583	7500
Zn_5	7300	6350	6800	6817	7750	7833	8000	7861
Zn_6	6800	6583	5767	8383	7750	7667	7167	7528
Mean	6443	6448	6498		7536	7598	7560	

CD(0.05) Zn marginal means 571
L ,, NS
Zn x L combination NS

CD(0.05) Zn marginal mans 295
L ,, NS
Zn x L combination NS

Table 2

Influence of zinc and lime on the yield of grain : straw ratio and on thousand grain weight in rice

Treatment	Grain: straw ratio				Thousand grain weight (g)			
	L_0	L_1	L_2	Mean	L_0	L_1	L_2	Mean
Zn_0	0.802	O.S36	0.795	0.812	27.20	27.95	28.32	27.82
Zn_1	0.815	0.815	0.856	0.829	27.78	27.15	27.85	27.59
Zn_2	0.897	0.874	0.863	0.879	26.95	27.10	27.14	27.06
Zn_3	0.857	0.829	0.928	0.872	27.37	27.25	26.44	27.02
Zn_4	0.786	0.904	0.920	0.870	27.27	27.55	27.12	27.31
Zn_5	0.940	0,809	0.848	0.866	27.68	26.57	27.17	27.14
Zn_6	0.878	0.858	0.804	0.847	27.35	27.25	26.50	27.03
Mean	0.854	0.846	0.859		27.37	27.26	27.22	

CD (0.05) Zn marginal means NS
L ,, NS
Zn x L combination NS

CD (0.05) Zn marginal means NS
L ,, NS
Zn x L combination NS

Data on the grain : straw ratio and thousand grain weight are presented in Table 2. The grain : straw ratio was not significantly influenced by application of zinc or lime or their combination.

The data on thousand grain weight indicate that the effect of zinc or lime or their interaction was not significant.

Yield attributes: Data on the total number of tillers at harvest, percentage of productive tillers, length of panicles and the number of grains per panicle are given in Tables 3 and 4.

Table 3
Influence of zinc and lime on the tiller count at harvest and percentage of productive tillers

Treatment	Tiller count				Percentage of productive tillers			
	L_0	L_1	L_2	Mean	L_0	L_1	L_2	Mean
Zn_0	19.00	17.20	16.75	17.65	82.91	84.86	82.62	83.47
Zn_1	18.75	17 95	17.55	18.08	82.13	82.45	82.86	82.48
Zn_2	21.40	2255	23.10	22.35	83.36	84.93	86.93	85.07
Zn_3	21.05	20.20	19.90	20.38	84,91	84.83	87.33	85.72
Zn_4	15.80	20.60	18.70	18.36	82.46	87.13	80.36	83.32
Zn_5	17.35	18.30	19.70	18.45	84.59	87.46	81.79	84.61
Zn_6	18.40	20.40	20.10	19.63	80.75	88.10	85.41	84.75
Mean	21.96	22.87	22.63		83.02	85.69	83 90	

CD (0.05) Zn marginal means 2,684 CD(0.05) Zn marginal means NS
L ,, NS L ,, NS
Zn x L combination NS Zn x L combination NS

Table 4
Influence of zinc and lime on the length of panicle and the number of grain/panicle

Treatment	Length of panicle (cm)				Number of grain/panicle			
	L_0	L_1	L_2	Mean	L_0	L_1	L_2	Mean
Zn_0	22.70	23.85	21.85	22.80	124.35	143.85	129.40	132.53
Zn_1	24.15	23.35	22.00	23.16	151.50	143.35	133.00	142.61
Zn_2	24,50	22.30	23.30	23,36	155.65	126.50	161.20	147.78
Zn_3	24.35	23.20	24.00	23 85	173.65	139.50	156.20	156.45
Zn_4	25.00	23.15	22.50	23.55	192.00	141.85	140.50	158.11
Zn_5	23.15	24.15	23.00	23.43	148.85	149.00	139.15	145.70
Zn_6	23.34	22.00	22.50	22,80	14200	126 80	151.80	140.20
Mean	23.88	23.14	22.73		155.44	138.69	144.40	

CD (0.05) Zn marginal means NS CD (0.05) Zn marginal means 5.86
L ,, NS L ,, NS
Zn x L combination NS Zn x L combination NS

Significant increase in the tiller number could be obtained at harvest for the soil application of 20 kg/ha and 30 kg/ha $ZnSO_4$. The effect due to lime or its interaction with zinc was, however, not significant.

The effect of zinc or lime or their interaction on the percentage of productive tillers was not significant.

Significant influence on the length of panicle could not be obtained either due to zinc or due to zinc lime interaction.

The number of grains per panicle was markedly influenced by zinc applied at different levels and by different methods. The highest number of 158.11 grains/panicle was obtained with foliar application of 0.25% $ZnSO_4$. This was

followed by 156.45 for soil application with 30 kg/ha $ZnSO_4$ while the control plot yielded 132.53 only. However, the effect of lime or its interaction with zinc was not significant.

Summary

A field experiment was laid out in a zinc deficient soil in Kuttanad area, Alleppey district, Kerala to study the effect of different levels and methods of zinc application with and without lime. on the growth and yield of rice. Foliar application of 0.5% and soil application of 20 kg/ha zinc sulphate resulted in significantly higher yield of grain. Root dip treatment with zinc oxide suspension recorded an increase in grain yield over control. The effect of application of lime alone and in combination with zinc, however, could not result in a significant increase in the yield of grain or straw. The study revealed the importance of zinc application to rice grown in the water-logged acid soils of Kuttanad.

സംഗ്രഹം

നെല്ലിന്റെ വളർച്ചയ്ക്കിലും ഉല്പാദനത്തിലും നാകത്തിനുള്ള പങ്കിനെപ്പറ്റി കുട്ടനാട്ടിലെ ഒരു കൃഷിക്കാരന്റെ നിലത്തിൽ നടത്തിയ പരീക്ഷണത്തിൽനിന്നും, ഒരു ഹെക്ടറിന് 20 കി. ഗ്രാം എന്ന തോതിൽ സിങ്ക്സംഫേറ്റ് മണ്ണിൽ ചേർക്കുന്നതും, 0.5 ശതമാനം വീര്യമുള്ള സിങ്ക്സംഫേറ്റ് ലായനി ഇലകളിൽ തളിക്കുന്നതും നെല്ലിന്റെ ഉല്പാദനം വർദ്ധിപ്പിക്കുവാൻ സഹായകമാണ് എന്നു് കണ്ടു.

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