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Effect of Varying Levels of Zinc and Phosphorus in Kharif Rice of Upper Assam

T.J. Ghose, P.K.Borkakati*, Nirupoma Gogoi Barua, A.K. Pathak ** and R.K. Chowdhury
Regional Agricultural Research Station, A. A. U., Titabar-785 630

ABSTRACT

An investigation was carried out for consecutive three years (1990-92), at Regional Agricultural Research Station, Titabar on an alfisol, in kharif rice to study the effect of varying levels Zn and P on the grain yield of rice, uptake pattern of Zn and P and its interaction, if any. Results indicated that application of 30 kg $ZnSO_4$/ha alongwith 60 kg P_20_5/ha produced the highest grain yeild in first year. Single effect of $ZnSO_4$ @ 30 kg/ha showed highest grain yield (49.67 q/ha) while effect of phosphate application was pronounced at 60 kg P_2O_5. Skipping $ZnSO_4$ application for 2nd and 3rd year did not show consistent trend in terms of grain yield. However, in third year, the residual effect of Zn was very prominent in terms of grain yield. In general, residual Zn @ 45 Kg/ha in presence of continuous phosphate application produced better effect in grain yield, Zn and P uptake. Available Zn in soil was found to decrease with years of cropping and marginal build up of available P was noticed with increasing levels of P application.

The relationship between Zn and P in lowland alfisol of Assam in rice cultivation has not been studied properly. Simultaneous application of Zn and P in soil has been reported to be antagonistic. However, Meisherii and Deb (1985) reported it as beneficial in increasing dry matter yield and uptake by plants, Apparently, the interrelationship of Zn and P is still contradictory. Nevertheless, such interaction effect of Zn and P is important under rice cropping because the condition in which rice is grown, are relatively more conducive to Zinc deficiency. Therefore, the present study was undertaken during kharif (1990-92) to determine the effect of varying levels of P and Zn on the yield uptake of P and Zn by rice, its availability in soil and to evaluate the residual utilization of Zn by rice over continuous phosphate application.

MATERIALS AND METHODS

A field experiment was conducted at the Regional Agricultural Research Station, Assam Agricultural University, Titabar in a zinc-deficient soil (available zinc = 0.45 ppm) for continuous three years during Sali season (June-Dec) which comes under kharif rice. Zinc was applied during 1990 while phosphate application was done for three years. Four levels of soil application viz. 0,15, 30 and 45 kg as $ZnSO_4$/ha and three levels of single super phosphate i.e. 0, 30 and 60 kg/ha were applied following split plot design with three replications using the long duration rice variety IET 6666 as the test crop in all the three season of cultivation (1990-1992). Normal doses of nitrogen and potassium were applied in terms of urea and muriate of potash as per soil

* Water Management Scheme, AAU, Jorhat. ** Director of Research (Agri.), AAU, Horhat.

test values. All the cultural practices were followed as per recommendation for the state of Assam. Five plants were randomly selected from each plot and after harvesting grains were threshed and collected for recording data on grain yield. Phosphorus and zinc were analyzed following standard methods.

RESULTS AND DISCUSSION

Grain yield of rice: Application of phosphate @ 60 Kg P_2O_5/ha alongwith 30 kg $ZnSO_4$/ ha was found effective in increasing grain yield of rice (Table 1). Average effect of Zn over P showed that application of Zn upto 30 kg/ha significantly increased the yield in all the three years of experimentation and raising the level of Zn beyond 30 kg/ha declined the response. On an average application of P @ 60/ha is seen to have produced a better response in all the three years of experimentation. Skipping of Zn application during 1991 and 1992 further enhanced the grain yield of rice. The treatment combination of P @ 60 kg P_2O_5 alongwith 30 kg $ZnSO_4$/ha was found best in first year crop (1990) and the same treatment with no Zn application also maintained better yield performance during 1991 except in 1992, though $ZnSO_4$ applied plot @ 45 kg/ha showed highest grain yield during 1992. However, the comparison with 30 kg $ZnSO_4$/ ha only showed marginal difference in respect of grain yield. Regression analysis for grain yield with different levels of Zn and also for P levels is shown in the Fig 1.

Zinc uptake by grain : The soil application of $ZnSO_4$ significantly increased the Zn uptake by the crop during 1990 and 1991. The Zn uptake by rice grain increased from 10 g/ ha under no Zn application to 80.50 g/ha under 30 kg $ZnSO_4$ soil application. The residual effect of soil application on Zn uptake during 1991 and 1992 declined as compared to 1990. The rate of decrease in Zn uptake by grain was, however, consistently maintained with the residual effect of Zn leftover in soil. The Zn uptake further decreased during 1992 with no application and thereby showed the least response in typical monocrop rice. Similar trend was also reported by Prasad and Umar, (1993) and Singh (1993).

Available phosphorus and zinc status in post harvest soil : The highest and lowest amount of available phosphorus in soil were found to be 16.75 kg/ha in treatment combination of 60 kg P_2O_5 alongiwith 30 kg $ZnSO_4$ level of application and the lowest value was found to be 4.12 kg/ha under no phosphorus treatment during 1990. The continuous application of phosphorus showed highest build up and increased its available status under 60 kg $ZnSO_4$/ha. On the whole, during kharif 1992, the post-harvest soil test indicated the value of available P increased significantly in all the treatments over the preceding years i.e. 1990 and 1991. Similarly, available Zn status during 1990 was found to contain highest value under 60 kg P_2O_5 alongwith 45 kg $ZnSO_4$ treatment combination and the value was 5.0 mg/kg. The consistency of available Zn status in soil was maintained with the level of $ZnSO_4$ application resorted during 1990 and the crop removal also maintained the same trend.

In all the three kharif seasons, application of $ZnSO_4$ @ 30 kg/ha applied once in three years was found to be conducive in boosting up the grain yield of rice. Besides, this was augmented by application of 60 kg P_2O_5 continuously for three years alongwith 30 kg $ZnSO_4$

Table 1 Grain yield (q/ha) of rice (var. IET 6666) as affected by direct and residual zinc under continuous phosphate application

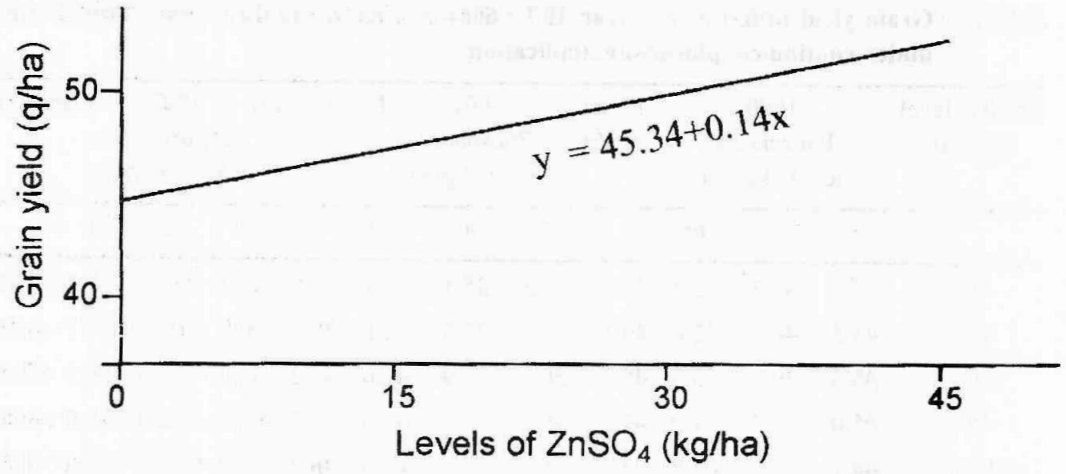
Zn SO_4 level (kg/ha)	1990 Phosphorus level (kg/ha)			Mean of Zn	1991* Phosphorus level (kg/ha)			Mean of Zn	1992* Phosphorus level (kg/ha)			Mean Zn
	0	30	60		0	30	60		0	30	60	
0	43.0	45.3	45.3	44.6	32.3	35.1	40.1	36.2	45.3	56.7	60.1	54.2
15	43.3	44.0	42.0	43.1	35.7	37.5	41.8	38.3	56.7	61.7	64.7	61.0
30	45.0	49.0	55.0	49.7	36.8	37.9	46.0	40.2	56.0	67.0	64.5	62.5
45	45.0	47.7	49.0	47.2	36.5	37.7	44.0	39.4	61.7	68.0	70.0	66.6
Mean	44.1	46.5	47.8	42.3	35.6	37.1	43.0	46.2	54.9	63.3	65.0	38.8
C.D 5%												
P mean			3.2				3.2				N.S	
Zn mean			4.7				N.S				2.0	
Zn at same P			4.0				1.7				1.7	
P at same Zn			6.4				4.7				N.S	

**1991 and 1992 residual Zine plots*

Table 2. Available Zinc content in soil (mg/kg) and available phosphorus (kg/ha) for post-harvest soil samples

Zn SO_4 level (kg/ha)	1990 Phosphorus level (kg/ha)			1991 Phosphoruslevel (kg/ha)			1992 Phosphoruslevel (kg/ha)		
	0	30	60	0	30	60	0	30	60
0	0.7 (4.0)	1.0 (9.2)	1.1 (11.2)	0.3 (6.8)	1.4 (10.1)	2.3 (18.2)	0.3 (8.8)	0.6 (20.2)	0.4 (26.2)
15	2.7 (4.1)	3.7 (9.5)	3.6 (13.2)	0.3 (6.8)	2.9 (12.7)	2.6 (18.0)	0.2 (10.2)	0.6 (22.1)	0.5 (28.2)
30	3.2 (4.2)	4.8 (9.8)	4.3 (16.8)	0.6 (6.9)	2.1 (14.8)	2.7 (18.9)	0.4 (12.7)	0.5 (24.5)	0.6 (29.7)
45	4.3 (4.3)	4.5 (10.2)	5.0 (12.1)	1.7 (6.9)	2.0 (16.3)	2.9 (20.2)	0.6 (14.5)	0.5 (27.6)	0.5 (30.2)
C.D. 5%									
Zn levels	0.1			0.1			N.S		
P levels	2.1			2.0			2.1		
Zn x P	1.7			N.S			N.S		

Fig. in paretheses indicate available phosphorus status in soil



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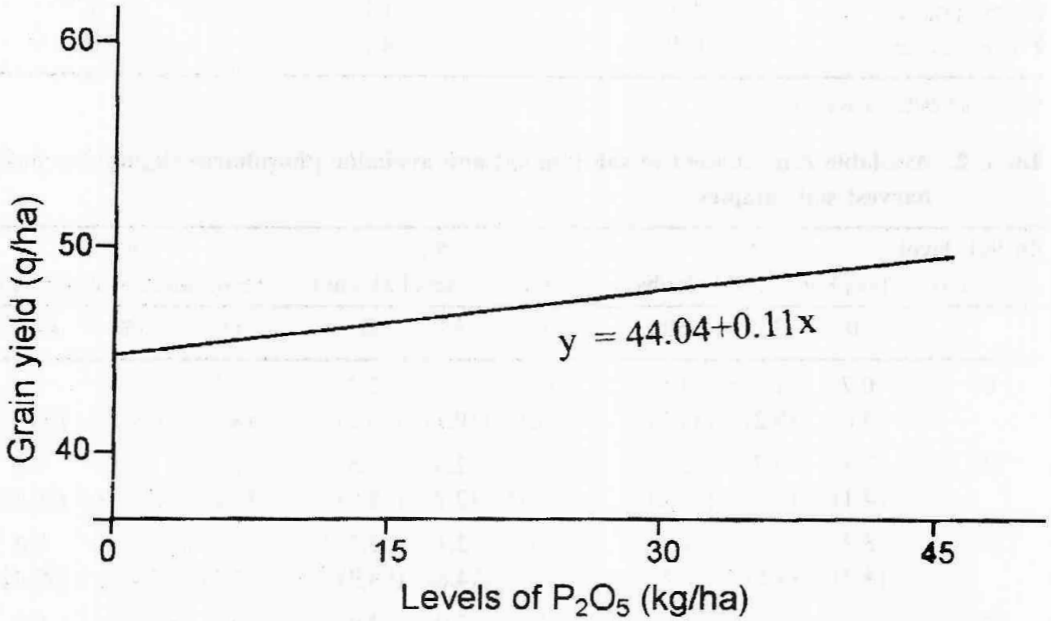

Fig. 1 Regression equation showing relationships between levels of $ZnSO_4$ and grain yield (a) and P_2O_5 and grain yield of rice (based on three years average)

application/ha as applied during 1990 only. Therefore application of $ZnSO_4$ @ 30 Kg/ha will be more economical and beneficial for subsequent kharif rice crop under monocropped area if it is applied only once in three years cropping season.

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