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ASSESSING INFLUENCE OF PHOSPHORUS BUILD UP ON THE AVAILABILITY OF ZN NUTRIENT IN SOILS AND ITS FORTIFICATION ON PADDY CROP (*ORYZA SATIVA*, VAR.MTU-1010) AS DIRECT AND RESIDUAL EFFECT

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ABSTRACT

The continuous and indiscriminate use of P-fertilizers resulted in accumulation of High P-soils throught the state of Andhra Pradesh was estimated to 42 per cent. This affects the availability of zinc to rice crop. Zinc and Phosphorous interaction was to be antagonistic. In view of the increased P-accumulated soils, the information generating on availability of cationic micronutrients in soils and their nutrition is essential to maintain the balanced fertilization to increase the productivity of the crop. Grain yield of paddy in the direct crop ranged from 4.75 to 6.17 q /ha, where as only in foliar spray it was 5.15 q /ha with a mean of 5.54 q /ha, There was significant increase in yields by Zn application over control. There was no significant difference in yields between control (4.75 q /ha), 25 kg ZS/ha (5.24 q /ha) and soil application of 50 kg 25 ZS / ha (5.89 q /ha) and 75 kg ZS / ha (6.05 q /ha). Foliar sprays with 3 rates doses have significant increase over the control. The percent response was varied from 8.67 to 29.89; the highest was at Soil Application of 75-kg ZS/ha + 3-Foliar Sprays treatment. In residual Rabi rice, the yield was ranged from 4.43 to 5.65 q /ha and there was significant increase in the yields from 20 kg ZS /ha to 70 kg ZS /ha along with 3 foliar spray. Straw yields ranged from 5-11 to 6.96 and 4.84 to 6.71 q /ha and response was varied from 10.37 to 36.01 and 7.85 to 38.64 percent. The effect of Zn on residual crop was significant increase in the yields from 20 kg ZS /ha to 70 kg ZS /ha along with 3 foliar spray. The phosphorus content in the grain samples of direct crop ranged from 0.30 to 0.45 per cent. The highest P content was in 75 kg ZS/ha with 3 foliar sprays as well in residue crop(0.25 to 0.42 per cent). Zinc content in the index leaves increased with increasing in zinc levels from 25 kg ZS to 50 kg ZS as basal and along with foliar sprays in conjunction with soil application both in direct and residual crops over the control i.e. from 14.21 to 22.17 in direct and 14.42 to 17.92 per cent in residual crop where as in foliar sprays, it was increased greatly i.e. from 19.9 to 22.17 in direct and 14.86 to 15.84 per cent in residual crop. The extent of fortification was observed in soil application of 50 kg ZS/ha along with 3-foliar sprays of zinc (56.02) in direct crop.

KEYWORDS: High P-soils, mode of zinc application, Zinc content, zinc fortification, direct band residual crop, paddy crop.

INTRODUCTION

In the present trend of accumulation high P-soils in top layers in Andhra Pradesh state was estimated to 42 percent (Reddy etal, 2013) in 13 districts of 292 mandals. This was due to the continuous and indiscriminate use of P-fertilizers as basal in particular and as top dressings in-general in all most all the crops. The consumption of P-fertilizers increased from < 1 kg to 34 kg/ha from 1950 to 2000's (Sharma and Thaker, 2011). The P accumulation in top layers gets fixed by forming strong bonds between P-with Ca and Mg in alkaline soils and some bonds with the Fe and Al in acidic soils and affecting the availability of Zinc. Zinc and Phosphorous interaction was to be antagonistic. The management of plant nutrients is largely governed by their status in soils and their availability depends upon the soil type and crop variety. In view of the increased P-accumulated soils, the information generating on availability of cationic micronutrients in soils and their nutrition is essential to maintain the balanced fertilization to increase the productivity of the crop. Therefore an experiment was carried out to investigate the Zn requirement, dose and mode of application in rice crop in high P-soils with the following objectives.

1. Determination of Zn requirement to rice crop in high P-soils having marginally higher available zinc.

2. Determination of the mode of Zn-application to rice crop, if Zn, is required in high P and marginally higher Zn soils.

MATERIALS AND METHODS

The experiment was carried out at College farm, College of Agriculture, Rajendranagar, Hyderabad, India located at N- 17.324637 E- 78.4091164 during *kharif* & *rabi* seasons with 8-treatments and three replications in Randamized Block Design.

T1- Control
T2- Soil Application of 25-kg ZS/ha
T3- Soil Application of 25-kg ZS/ha + 3-Foliar Sprays
T4- Soil Application of 50-kg ZS/ha
T5- Soil Application of 25-kg ZS/ha + 3-Foliar Sprays
T6- Soil Application of 75-kg ZS/ha
T7- Soil Application of 75-kg ZS/ha + 3-Foliar Sprays
T8- Only Foliar Sprays.

Initial and Post harvest soil samples were analysed for physico-chemical properties. These soils were sandy loam in texture**.** pH & EC was determined in 1:2.5 soil water suspension by using pH meter with glass electrode and digital conductivity meter expressed in dsm^{-1} (Jackson, 1973). Organic carbon was determined by Walkley and Black (1934) rapid titration method.

The soils were estimated for available nitrogen by alkaline permanganate method as described by Subbaiah and Asija (1956), available phosphorus was extracted by using Olsen's reagent as described by Olsen et.al.(1954) and phosphorus in the extract was determined by using ascorbic acid as reducing agent as outlined by Watnabe and Olsen (1965) at 680 mm wavelength, available potassium by employing neutral normal ammonium acetate (Jackson,1973) and available Zn estimated by AAS employing the method given by Lindsey and Norvell,1978. The index leaves were collected from maximum tillering stage, plant and grain samples were collected at harvest and these were digested with di-acid mixture and were analysed for Phosphorus by Vandomolybdo phosphoric acid yellow method (Piper, 1966) at 420mm Wavelength.

RESULTS AND DISCUSSIONS

Initial soils were sandy loam in texture with alkaline pH (8.10), normal in soluble salt content (0.19 dsm^{-1}) and these were low in available nitrogen (125 kg/ha), high in phosphorus (59 kg/ha) high in potassium (286 kg/ha) and high in Zn (0.78 mg/kg).

Table 1: Effect of different doses and modes of Zn application on its grain and straw yields (q /ha) of the Direct and Residual rice crops.

Treatment No	Treatment Details	Grain (q /ha)				Straw (q /ha)			
		Direct (*kharif*)	% response	Residual (*rabi*)	% response	Direct (*kharif*)	% response	Residual (*rabi*)	% response
T1	Control	4.75	-	4.43	-	5.11		4.84	-
T2	Soil Application of 25kg ZS / ha	5.16	8.63	4.82	8.80	5.64	10.37	5.22	7.85
T3	SA of 25kg ZS / ha + 3 Foliar Sprays of Zn	5.24	10.32	4.8	8.35	5.85	14.48	5.64	16.53
T4	Soil Application of 50kg ZS / ha	5.89	24.00	5.4	21.90	6.42	25.64	5.86	21.07
T5	SA of 50kg ZS / ha + 3 Foliar Sprays of Zn	5.91	24.42	5.51	24.38	6.74	31.90	6.24	28.93
T6	Soil Application of 75kg ZS / ha	6.05	27.37	5.62	26.86	6.84	33.86	6.48	33.88
T7	SA of 75kg ZS / ha + 3 Foliar Sprays of Zn	6.17	29.89	5.65	27.54	6.95	36.01	6.71	38.64
T8	Only Foliar Sprays of Zn	5.15	8.42	4.67	5.42	5.86	14.68	5.64	16.53
	Mean	5.54	19.01	5.11	17.61	6.18	23.85	5.83	23.35
	CD	0.66		0.56		0.64		0.55	

Table 2: Effect of different doses and modes of Zn application on its P content in the grain samples of the direct and residual rice crops.

Treatments		P content (%)	
		Direct (*kharif*)	Residual (*rabi*)
T1	Control	0.31	0.28
T2	Soil Application of 25kg ZS / ha	0.32	0.29
T3	SA of 25kg ZS / ha + 3 Foliar Sprays of Zn	0.30	0.30
T4	Soil Application of 50kg ZS / ha	0.37	0.35
T5	SA of 50kg ZS / ha + 3 Foliar Sprays of Zn	0.38	0.36

T6	Soil Application of 75kg ZS / ha	0.42	0.38
T7	SA of 75kg ZS / ha + 3 Foliar Sprays of Zn	0.45	0.42
T8	Only Foliar Sprays of Zn	0.33	0.34
	Mean	**0.36**	**0.34**

Table 3: Effect of different doses and modes of Zn application on its Zn content and extent of fortification in index leaves, grain and straw samples of the direct and residual rice crop.

S. No	Treatments	Index leaves				Grain				Straw			
		Zn content (%) in Direct crop	EF	Zn content (%) in Residual crop	EF	Zn content (%) in Direct crop	EF	Zn content (%) in Residual crop	EF	Zn content (%) in Direct crop	EF	Zn content (%) in Residual crop	EF
T1	Control	14.21		13.55		14.42		13.14		17.88		16.38	
T2	Soil Application of 25kg ZS / ha	15.67	10.27	15.41	13.73	15.63	8.39	14.86	13.09	19.87	11.13	16.64	1.59
T3	SA of 25kg ZS / ha + 3 Foliar Sprays of Zn	19.90	40.04	14.86	9.67	16.25	12.69	15.14	15.22	20.93	17.06	18.96	15.75
T4	Soil Application of 50kg ZS / ha	18.92	33.15	16.05	18.45	17.08	18.45	16.78	27.70	20.35	13.81	18.26	11.48
T5	SA of 50kg ZS / ha + 3 Foliar Sprays of Zn	22.17	56.02	15.84	16.90	17.92	24.27	17.08	29.98	21.01	17.51	20.19	23.26
T6	Soil Application of 75kg ZS / ha	18.48	30.05	16.49	21.70	17.71	22.82	17.06	29.83	20.89	16.83	19.8	20.88
T7	SA of 75kg ZS / ha + 3 Foliar Sprays of Zn	20.73	45.88	16.42	21.18	17.96	24.55	17.17	30.67	21.65	21.09	20.96	27.96
T8	Only Foliar Sprays of Zn	21.42	50.74	14.1	4.06	18.33	27.12	13.95	6.16	18.02	0.78	16.84	2.85
	Mean	18.94	38.02	15.34	15.10	16.91	19.75	15.65	21.81	20.08	14.03	18.43	14.29

EF= Extent of Fortification

Grain yield of paddy in the direct crop ranged from 4.75 to 6.17 q /ha, where as only in foliar spray it was 5.15 q /ha with a mean of 5.54 q /ha, There was significant increase in yields by Zn application over control. There was no significant difference in yields between control (4.75 q /ha), 25 kg ZS/ha (5.24 q /ha) and soil application of 50 kg 25 ZS / ha (5.89 q /ha) and 75 kg ZS / ha (6.05 q /ha). Foliar sprays with 3 rates doses have significant increase over the control. The percent response was varied from 8.67 to 29.89; the highest was at Soil Application of 75-kg ZS/ha + 3-Foliar Sprays treatment. These results are in collaborating with Rahman et al, 2011 Reddy et al. 2011 Sriramya. 2014 and Rasvel and Ravichandran, 2012.

In residual Rabi rice, the yield was ranged from 4.43 to 5.65 q /ha and there was significant increase in the yields from 20 kg ZS /ha to 70 kg ZS /ha along with 3 foliar spray. These results are in accordance with Reddy et al. 2011. The percent response of grain yield was ranged from 8.82 to 27.54. The foliar sprays & Zn in earlier crop i.e kharif did not affect the yields in residual Rabi and the residual yields of the only foliar spray (4.67 q /ha) is similar to that of control (4.43 q /ha) (Table-1).

Straw yields ranged from 5.11 to 6.96 and 4.84 to 6.71 q /ha and response was varied from 10.37 to 36.01 and 7.85 to 38.64 percent. The effect of Zn on residual crop was significant increase in the yields from 20 kg ZS /ha to 70 kg ZS /ha along with 3 foliar spray.

The phosphorus content in the grain samples of direct crop ranged from 0.30 to 0.45 per cent. The highest P content was in 75 kg ZS/ha with 3 foliar sprays. Whereas is residue crop, it was 0.25 to 0.42 per cent and the highest was in the same treatment but based on the mean content of P the treatment soil application of 50 kg ZS with 3 foliar sprays gave good amounts of P content i.e. 0.38 and 0.36 percent in direct and residue crop respectively (Table: 2) These results were or par with Reddy et, al.2011.

Zinc content in the index leaves increased with increasing in zinc levels from 25 kg ZS to 50 kg ZS as basal and along with foliar sprays in conjunction with soil application both in direct and residual crops over the control i.e. from 14.21 to 22.17 in direct and 14.42 to 17.92 per cent in residual crop where as in foliar sprays, it was increased greatly i.e. from 19.9 to 22.17 in direct and 14.86 to 15.84 per cent in residual crop. The extent of fortification was observed in soil application of 50 kg ZS/ha along with 3-foliar sprays of zinc (56.02) in direct crop but it was observed in soil application 75 kg ZS/ha in residue crop. These findings are in accordance with Sriramya, 2014. The grain and straw Zn content was increased with increasing Zn levels over the control and the extent of fortification was more in (27.12) only in foliar sprays in direct crop but in residual crop it was (30.67) in Soil Application of 75-kg ZS/ha + 3-Foliar Sprays. In case of straw, on the basis of overall mean and along with increased Zn level the content and fortification was more with foliar sprays (Table:3)

CONCLUSSION

According to literature P and Zn are known to be either antagonistic or synergetic in natures. Therefore to know the availability of Zn in soil and its nutrition in paddy

crop under high P soils with different levels of soil application and in conjunction with foliar sprays it was revealed that in high P-soils having sufficient status of Zn given higher yields and fortification in 50 kg Zn /ha as soil application.

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