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IMPACT OF DISTINCTIVE MEASUREMENTS OF ZINC SULPHATE MICRONUTRIENTS ON TRANSPLANTED RICE DEVELOPED IN SOIL CONDITIONS OF SIALKOT

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ABSTRACT

Rice is one of the major staple food items in Pakistan. Zinc is vital micronutrient for plants and its insufficiency extensively spread in paddy soils in the Pakistan. Zinc deficiency showed its negative impact on rice crop. The experiment was conducted at Adaptive Research Station, Sialkot during kharif 2014-2016 with randomized complete block design. In each location, pre soil analysis was conducted according to protocol. Zinc sulphate (33%) was broadcasted in different doses i.e T-2 ($ZnSO_4$ @ 12.50kgha^{-1}), T-3 ($ZnSO_4$ @ 18.75kgha^{-1}), T-4 ($ZnSO_4$ @ 25.00kgha^{-1}), T-5 ($ZnSO_4$ @ 15.00 kgha^{-1}) compared to control. The productive tillers showed significant (P<0.05) result in T-3 (227.0 and 223.67) followed by T-4 (221.67) at Mitral and T-2 (222.33). Maximum productive tillers recorded in T-2 (287.67) followed by T-4 (287.33) compared to control at both places during kharif-2015. Maximum productive tillersm^{-2} recorded non-significant observation in T-4 (296.55) & T-5 (294.01) at Bagowala. Thousand grain weight (g) found maximum in T-3 (22.53g) followed by T-5 (22.25g) recorded non-significant result compared to control (20.11g) at Mitral. Non-significant grain weight was recorded in all treatment at Bagowala compared to control (T-1) showed significant investigations during 2015. Maximum yield (P<0.05) were recorded in T-2, T-4 and T-5 at Mitral and Bajwat compared to control. Significant yield (tha^{-1}) was recorded T-4 and T-5 compared to control (T-1). At the end it is concluded that zinc sulphate broadcasted @ 15kgha^{-1} found maximum yield and yield attributes in different areas at Sialkot.

Introduction

Rice (*Oryza sativa* L.) provides 21% of energy and 15% of protein requirements of human populations globally. In Pakistan rice is the 2nd main foodstuff yielded after wheat and it is grown on about 2.531 million hectares with the total production of 5.5 million tones to feed ever growing world population [1]. The micronutrients are also necessary items for growth and development of the plants. Irrigation, balanced supply of macro and micronutrients played a vital role in yield gap. Zinc deficiency has been found responsible for yield reduction in rice crops [2, 3]. Zinc deficiency symptoms in rice crop observed first time in calcareous soils of northern India [4, 5]. Zinc deficiency is a major micro-nutrient disorder in alkaline calcareous soils in Pakistan (Anonymous, 1998). Due to clayey, alkaline and calcareous soil, zinc is absorbed by soil and little is available by the plants [6]. To overcome this problematic issue the study has been planned to evaluate the impact of diverse doses of zinc sulphate broadcasted in transplanted rice at Adaptive Research Station, Sialkot during Kharif 2014-2016.

Materials and Methods

The study was conducted at Adaptive Research Station, Sialkot during Kharif 2014-2016 with Randomized Complete Block Design. Soil analysis was conducted according to Kharif plan from each location (Table-1).

Table-1 showing the properties of soil sampled before transplantation

Properties of Soil	Mitral		Bagowala		Bajwat	
	0-15	15-30	0-15	15-30	0-15	15-30
Zinc Sulphate dose adjusted after soil analysis	$15kgha^{-1}$					
Texture	Loamy	Loamy	Loamy	Loamy	Loamy	Loamy
Saturation (%)	38	36	40	40	42	42
Soil pH	7.7	7.6	7.8	7.8	7.56	7.66
Electric Conductivity ds/m	0.08	0.07	0.07	0.08	0.15	0.10
Organic Matter (%)	1.00	0.66	1.03	0.85	1.22	0.86
Available-P (ppm)	4	4	5	4	5	4

Whereas ppm (parts per million); Kg (kilogram); ha^{-1} (Hectare); % (Percentage)

Zinc sulphate (33%) was broadcasted manually in different doses i.e T-2 ($ZnSO_4$ @ $12.50kgha^{-1}$), T-3 ($ZnSO_4$ @ $18.75kgha^{-1}$), T-4 ($ZnSO_4$ @ $25.00kgha^{-1}$), T-5 ($ZnSO_4$ @ 15.00 $kgha^{-1}$ i.e. dose adjusted on the basis of soil analysis) compared to T-1 (control). Recommended dose of Diammonium phosphate (DAP) and sulphate of potash (SOP) were applied in the field just before planking [7]. Basmati rice was transplanted manually upto 3rd week of July every year. Acetachlor @ 250 $mlha^{-1}$ was broadcasted 03 days after transplantation (DAT) in the field with shaker bottle and keep water level upto 3 inches in rice field for 20 days [7]. The efficacy of different doses of Zinc sulphate (33%) were evaluated after broadcasting 20 DAT. Urea fertilizer was broadcasted in the field @ $250kgha^{-1}$ 35 DAT and 75 DAT. Copper sulphate was broadcasted in the field 25 DAT. Cartap insecticide @ $22kgha^{-1}$ was broadcasted in transplanted rice at one time in a season. For the management of diseases in rice crop difenaconazole @ $312mlha^{-1}$ were sprayed in transplanted rice with the help of knap sac hand sprayer. The parameters i.e productive tillers (m^{-2}), thousand grain weight (g) and yield (tha^{-1}) were measured according to prevailing rates [8, 9]. All the data were analyzed statistically by using analysis of variance technique at 5% level of probability [10] by Tukey's HSD test [11]. The graphical representation performed through Sigma plot 10 software [7, 12].

Results and Discussion

Effect of zinc sulphate on productive tillers (m^{-2})

The productive tillers (m^{-2}) showed significant (P<0.05) result in T-3 (227.0 and 223.67) followed by T-4 (221.67) at Mitral and T-2 (222.33) compared to control (Figure 1A). Similarly the data showed highly significant (P<0.05) productive tillers (m^{-2}) in T-2 (287.67) followed by T-4 (287.33) compared to control at both places (Figure 1B). Similarly maximum productive tillers (m^{-2}) recorded non-significant (P<0.05) results in T-4 (296.55) & T-5 (294.01) at Bagowala (Figure 1C). The increase in productive $tillersm^{-2}$ might be attributed to improve enzymatic activity and auxin metabolism in plant by the application of zinc sulphate [13]. Our results are in line with the researchers who gave similar recommendations [14, 15].

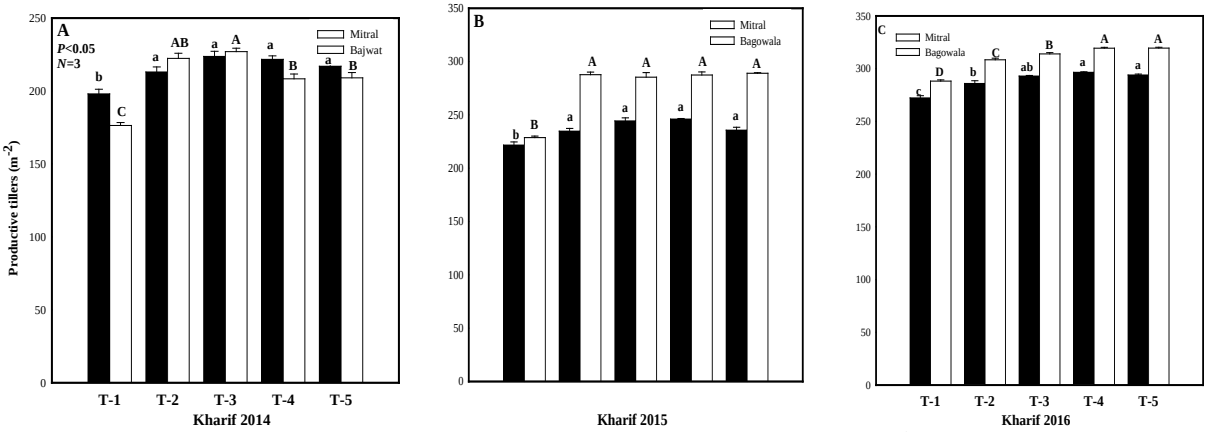

Figure 1 showing effect of different doses of zinc sulphate on productive tillers (m^{-2}) in rice crop during Kharif 2014-2016

Whereas T-1 (Control), T-2 ($ZnSO_4$ @ $12.50kgha^{-1}$), T-3 ($ZnSO_4$ @ $18.75kgha^{-1}$), T-4 ($ZnSO_4$ @ $25.00kgha^{-1}$), T-5 ($ZnSO_4$ @ $6kgha^{-1}$ i.e. dose adjusted on the basis of soil analysis)

Effect of zinc sulphate on thousand grain weight (g) of rice crop

Thousand grain weight (g) found maximum in T-3 (22.53g) followed by T-5 (22.25g) recorded non-significant (P>0.05) results and found significant (P<0.05) weight compared to T-1 (20.11g) at Mitral (Figure 2A). Similarly non-significant (P>0.05) grain weight (g) was recorded in all treatment at Bagowala compared to control (T-1) found significant weight in Figure 2B, however at par results was also found (Figure 2C). Maximum yield were recorded in T-2, T-4 and T-5 at Mitral and Bajwat compared to control during 2014 and 2015. The researchers reported that thousand grain weight (g) influenced by the application of zinc compared to control [15, 16].

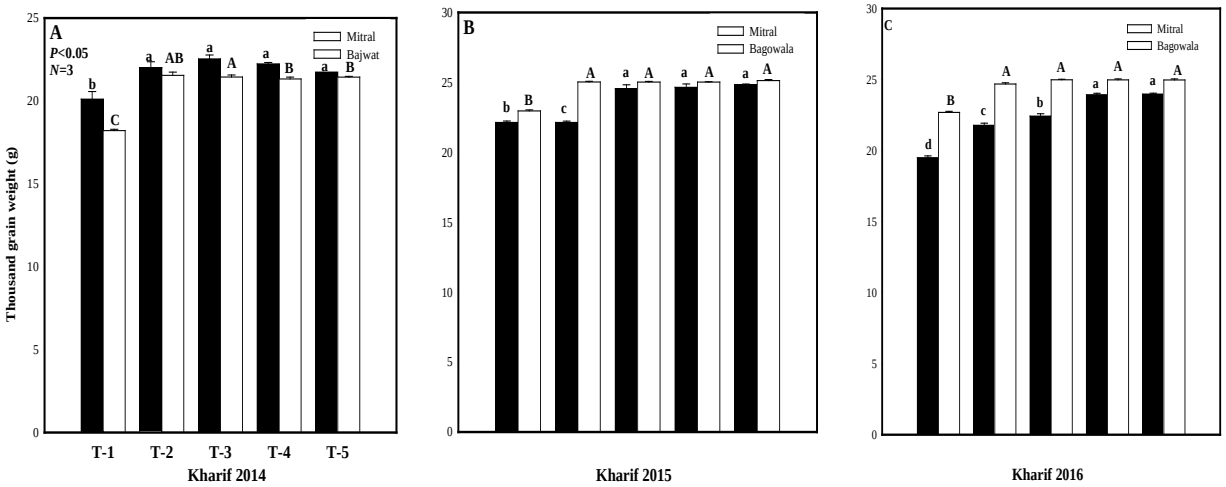

Figure 2 showing effect of different doses of zinc sulphate on 1000 grain weight (g) in rice crop during Kharif 2014-2016

Whereas T-1 (Control), T-2 ($ZnSO_4$ @ 12.50kgha^{-1}), T-3 ($ZnSO_4$ @ 18.75kgha^{-1}), T-4 ($ZnSO_4$ @ 25.00kgha^{-1}), T-5 ($ZnSO_4$ @ 6kgha^{-1} i.e. dose adjusted on the basis of soil analysis)

Effect of zinc sulphate on yield (tha^{-1}) of rice crop

Non-significant yield recorded in T-2, T-4 and T-5 at Mitral and Bajwat compared to control (Figure 3A and 3B). Significant yield (tha^{-1}) was recorded in T-4 and T-5 compared to control (Figure 3C). The results are in line with the researchers who used two levels of zinc sulphate @ 5kgha^{-1} and 10kgha^{-1} may increase 39% and 45% yield over control [14]. Our results are contradictory with the researchers who reported that increase level of zinc significantly influenced yield and yield attributes in rice crop [13]. The researchers reported that different levels of zinc sulphate i.e. 0, 5kgha^{-1}, 10kgha^{-1}, 15kgha^{-1}and 20kgha^{-1} broadcasted in rice field found 15kgha^{-1} dose found maximum yield i.e. 3800kgha^{-1} in line with our recommendations. Significant yield was attributed to increase number of productive tillersm^{-2} in this treatment compared to control [15, 17].

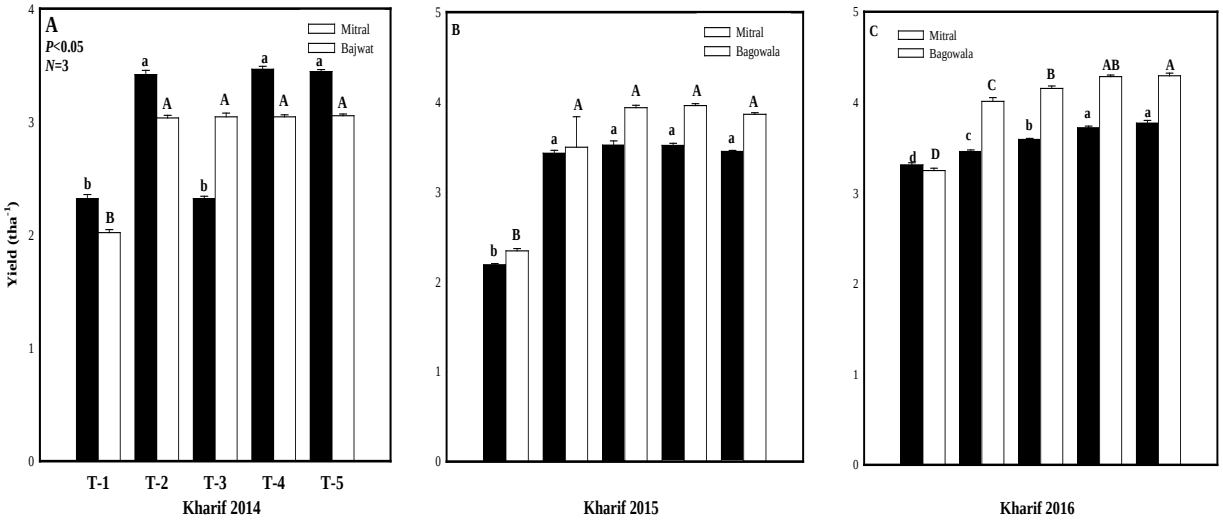

Figure 3 showing effect of different doses of zinc sulphate on 1000 grain weight (g) in rice crop during Kharif 2014-2016

Whereas T-1 (Control), T-2 ($ZnSO_4$ @ 12.50kgha^{-1}), T-3 ($ZnSO_4$ @ 18.75kgha^{-1}), T-4 ($ZnSO_4$ @ 25.00kgha^{-1}), T-5 ($ZnSO_4$ @ 6kgha^{-1} i.e. dose adjusted on the basis of soil analysis)

The application of zinc sulphate produced statistically non significant (P>0.05) results, however the quality of paddy yield was increased [18]. The application of zinc sulphate was found helpful to reduce zinc deficiency in rice crop under the climatic conditions of Sialkot, Punjab-Pakistan. At the end it is concluded that zinc sulphate broadcasted @ 15kgha^{-1} found maximum yield and yield attributes in different areas at Sialkot.

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