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Impact of Varioussources of Zinc on Growth, Production and Nutrient Uptake of Rice Crop

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Abstract

A field experiment was conducted in 2018-2019 having title 'Impact of various sourcesof Zinc on growth, production and nutrient uptake of Rice crop' in kharif season at Lovely Professional University, Phagwara Punjab. In rice crop, Zinc deficiency is the major problem, which wasobserved from various states of the country. For overcome to this problem, Zinc is applied as a fertilizer to soil. Three sources of Zinc were applied in this experimental trail- $ZnSO_4$. $7H_2O$, $ZnSO_4$.$3H_2O$,Zn- EDTA.The sources were applied at different doses @5kg ha^{-1}Zn and @10 kg ha^{-1} Zn. Theworkrole was to analyses the availableness of Zinc by Zinc sulphate and Zn chelate. The Zn-EDTA is a chelate which helps in sorption and desorption of Zn ions and helps in better adsorption. Zn-EDTA @ 10 kg Zn ha^{-1} gave the best result in case of plant height, tillers, panicle numbers, panicle length, grain yield, straw yield and harvest index followed by $ZnSO_4$ @ 10 kg ha^{-1}. The minimum plant height, tillers, panicles, panicle length, grain yield, straw yield was recorded in control. The Zn uptake and N uptake was also recorded highest in Zn-EDTA.

Key words- Zn –EDTA, Chelate and $ZnSO_4$, Tillers, Panicles, Plant height

Impact of various sources of Zinc on growth, production and nutrient uptake of Rice crop

Introduction

Rice (*Oryza sativa*) is one of the major staple food of around half of the world's population. The various 100 countries has produced rice crop, especially in Asia. By rice 22% of energy and 16% of protein requirement to population is fulfilled by rice (Maclean *et al.,* 2002 and Depar*et al.*, 2011).World population is increased day by day, which is estimated to be 10.5 billion by this century. To feed this much of increasing population increment in rice production is very important (Van Gremberer*et al.,*2008). High production and hybrid varieties produces by researchers but a barrier always exist between farmers field and research stations. To cover this gap only adequate irrigation water is not enough but balanced supply of macro and micro nutrients is also important. In Punjab, after N,Pand K,Zn deficiency in soil is responsible for yield reduction in rice. Rice is the crop which is highly responding to Zinc deficiency (MU Khan *et al.*, 2002, BJ Alloway*et al.*, 2004). Out of the essential micro nutrients zinc is the nutrient which is essential for better growth, enhancement and yield most of the crops and mainly for lowland rice.Half of the (50%) Mostly Indian soils having deficiency in Zn nutrient especiallyalkaline soil due to the insoluble $Zn(OH_2)$ and its CO_3^{2-} (Hajiboland, 2005and Alloway 2008). In 30% of soils zinc is present in plant un-available form (Hacisalihaglu, 2003 and Alloway 2008).Zinc deficiency found more in cereals as compared to legumes, which leads to the loss in production (Fageria*et al.,* 2002). One of the vital nutritional stresses which restrict the yield in Asia by the zinc deficiency (Quijano- Guera*et al.,* 2002). Zinc was the only first one

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micronutrient which is essential for all living beings. It plays avitalrole in various physiological processes and gene expression regulation.

In rice crop the deficiency of rice rapidly occurs in submerged soils and half of total rice cultivation is also found deficient with zinc. Due to the water scarcity now in these days,dry rice field preparation has been started (Farooq*et al.*, 2009) which decreased zinc availability(Gao*et al.,* 2006). High soil pH and high carbonated content are also the main reasons of deficiency of zinc in rice soils (Alloway 2009).

To overcome the problem of zinc deficiency appliesZn fertilizer in soil is a normal practisewhich can increase Zinclevel in grains (Hussain*et al.*, 2012). Different sources of zinc like $ZnSO_4$.7 H_2O, Zn-EDTA and $ZnSO_4$.3 H_2O show different response to the crop. Zinc deficiency most probably covered by the uses of organic saltHeptahydrate Zinc. Otherrootagesof Zinc such as Zn-EDTA and $ZnSO_4$.3 H_2O, Zn-EDTA is a chelate which supplied the some more part of Zn to plant without mixing with the soil and Positive ions are surrounded by the plant roots and present always in available form. Zn-EDTA is a chelate in which have positive zinc ion is covered by chelate due to which Zn is not interact with soil components and more zinc provided to plant.

DTPA, HEDTA and EDTA are hard chelating agents with Zincthan another chelate. Zinc is required in rice crop for many biochemical processeslike cytochrome and nucleotide synthesis, auxins metabolism, chlorophyll production, enzyme activation and membranes integrity. The concentration of zinc in grain is also vital for seedling vigor and field establishment.Upto now very few research trials has been conducted about the different sources of zinc and their chelates (Zn-EDTA) with the soil properties related to rice growing. Foliar or soil application of zinc is also a major issue in flooded condition.Therefore, it is compulsory to find the efficient source of

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zinc supply to plant and their method of application. So, there is a need to conduct an experiment to find the impact of various source of zinc on growth, production and nutrient uptake of rice crop. Themain role of this research was to examine the effect of different zinc sources on growth yield of rice crop and toevaluate the effect of zinc on soil properties and nutrient uptake.

Material and method

In order to find out the effect of various zinc forms on paddy growth, yield and nutrient uptake a field experiment was carried out at experimental farm, school of agriculture of Lovely Professional University Phagwara, Punjab during Kharif, 2019. The experimentalfarm geographically situated at latitude31.25^o N and longitude75^o Eat an altitude of 232 m above sea level. The soil samples were collected from 0-15 cm depth and examined for its different Physical and chemical propertieslike, pH, EC, N,P,K, organic carbon and zinc. The soil was sandy loamy in texture. Thisresearch was done in RCBD by 3 replicas. The research field was laid out with measuring 5 * 4 (meter) long and wide area of 20m^2.Thebunds were made of 0.25m, width to avoid the effecting to other chemicals. There were 7 treatments, the treatments combinations were:-

T0- Control (RDF)

T1- 5kg Znha^{-1}as Zn-EDTA+ RDF

T2- 5kg Znha^{-1}as $ZnO_4.7H_2O$+RDF

T3- 10Kg Znha^{-1} as Zn-EDTA+RDF

T4- 10Kg Znha^{-1} as $ZnSO_4.7H_2O$+RDF

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T5- 5KG Znha^{-1} as $ZnSO_4.3H_2O$+RDF

T6- 10Kg Znha^{-1} as $ZnSO_4.3H_2O$+RDF

For the proper water movement of irrigation waterbetween the replications 0.5 m wide irrigation channels were made. Every plot was individually irrigated. The recommended fertilizer application applied in the all the plots with the ratio of 100:60:60 kg ha^{-1}as Nitrogen:Phosphorous: Potassium at the time of transplanting. The sources of Nitrogen Phosphorous and Potassium were applied by Neem coated Urea, SSP and MOP. All zinc applications treatments were applied by soilat 14 DAT. The spacing maintained was 20x15 cm. The variety used for experiment was Pusa *basmati* 1121.

Soil and plant specimens were collected near maturity of crop. 10g of soil sample was collected from each plot for estimation of pH, Ec, N, P, K and DTPA- extractable zinc content of soil, 0.005M DTPA solution was used to extract the available pool of zinc(Table no.1). Initially plant samples were properly cleaned by normal H_2O followed by dilute hydro chloric acid. Each plant sample was cut into separate portions and dried under sunlight. After that, plant analyses were performed. When crop fully matures, the data related to grain yield, straw yield and nutrient uptake by grain and different parts of plant were collected and analyzed by SPSS software.

Result and Discussion

The effect of different sources of zinc with different doses was recorded in case of plant growth parameters, yield parameters and nutrient uptake which was discussed as followed. Plant height was very important factor of growth and yield in rice crop. Plant height was measured at four internal 30, 60, 90 and 120 DAT. There was a remarkable variation recorded at different stages

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at different levels of zinc. Plant height response to Zn application was more pronounced, high plant height was recorded with zinc application as compared to control. The highest plant height 141 cm was recorded by T3 (10 kg $Znha^{-1}$ as Zn-EDTA+RDF) followed by T4 (10kg $Znha^{-1}$ as $ZnSO_4.7H_2O$+RDF) and minimum plant height 110 cm was recorded in control T0 (Table no.2).The numbers of tillers were counted at different intervals 20, 40 and 60DAT. There was a significant variation recorded at different intervals. The maximum number of tillers/m^2 (407) was recorded by T3 followed by T4 and minimum (352) number of tillers recorded in control. Number of panicles m^{-2} was significant at 1% probability level under zinc fertilizer. The highest no. of panicles m^{-2}(380.8) was recorded by 10kg $Znha^{-1}$ as Zn-EDTA and least panicle number m^{-2} was obtained (285) in control. Panicles numbers are essential for plant production. 5% rice panicle was increased by just zinc fertilizer application as compared to control (Table3). Panicle length affects grain yield. More the length of panicle more is the transport of photosynthesis material. Maximum panicle length (28.78cm) was observed by T3 with Zn-EDTA @ 10 Kg ha^{-1} and minimum (22.4) was recorded in those plots where no Zinc application was done. The number of filled grains per panicle was also a yield contributing character. More the number of filled grains per panicle more are the yield. The highest number of filled grains per panicle (92) was recorded in T3 at par T4, minimum (58) was recorded in T0. The lowest filled grains/panicle was recorded in control.The maximum grain yield was recorded in T3 which was at par with T4, minimum grain yield was recorded in control that the case of low number of panicles m^{-2}. The yield of rice was increased significantly by Zinc application compared to control. With increase in dose level from 5 to 10kg $Znha^{-1}$ there was increase in grain yield. Similarly, straw production was also observed maximum in T3 at par T4, minimum in control (Table4). Zinc application increased the plant height, panicle length, number of tillers, panicle number per m^2, grain yield,

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straw yield when applied in chelated from Zn-EDTA @ 10kgha^{-1} along with RDF. So, when we applied zinc along with RDF, it increases growth and yield of a particular crop. The panicle number, length of panicle and filled grains per panicle increased due to application of Zinc might be due to tryptophan concentration in grains of rice (Irshad*et al.*, 2004). Zinc application increased the pollen production and number of filled grains per panicle. It increased the grain and straw yield might be due to cell proliferation and differentiation.

The results showed that the dry matter accumulation was increased with the zinc fertilizer application at starting growth time. The amount of Zinc EDTAwas recorded maximum than zinc sulphate fertilizer application. Zinc content in grain (22.25 mg/kg) was observed with T3 and least was observed with control. In case of straw Zn content varied from 8.62 to 9.62 mg/kg and least content of Zinc in straw (6.48 mg/kg) had recorded from control. Zn content in straw increased due to application of Zn to soil. The uptake of zinc in grain and straw is also highest in T3- Zn-EDTA followed by T4 and minimum in T0. There was a significant variation in Zn uptake by grain and straw(Table no.5) .Nitrogen content in grain varied due to application of zinc supplied from fertilizer. There was a significant variation in zinc content at varies fertilizer levels. All treatments showed better effect on N content of rice grain over control. Application of zinc showed a decreasing effect on N concentration of rice grain while an increasing effect was recorded in case of rice straw(Table no.5).Nail and Das (2007) and Shivay*et al.* (2008). Naik and Das (2007) also suggested that the zinc fertilizers up to 10kgha^{-1} increased the Zn amount in leaves of rice, due to more uptake with Zn-EDTA than Zinc sulphate.

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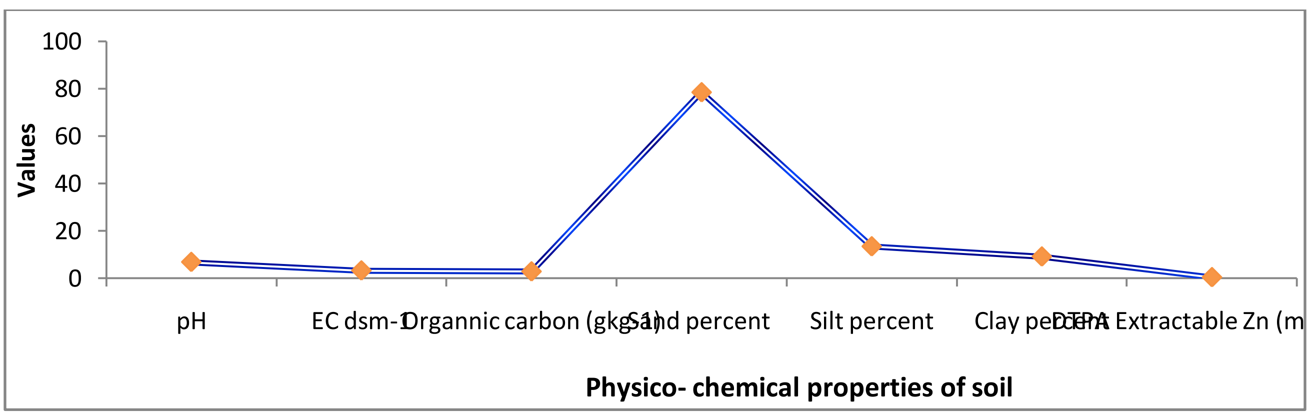
Conclusion

The level of Zinc in soil and plant was more in Zn-EDTA plots at par $ZnSO_4$. The result findings suggested that chelated Zn (Zn-EDTA) applied as basal or 14 DAT was observed more efficient than Zinc sulphate in maintaining Zn in soil, biological and economical production was founded maximum $ZnSO_4.7H_2O$ also gave good result. But best result recorded by Zn-EDTA as compared to Zinc sulphate. This is research trail emphasis is only on the Zinc fertilizer applied in soil towards rice production, But there is further investigation required on the method of Zinc application either foliar or soil.

Graphs and figures



Graph 1: Physico - chemical properties of soil

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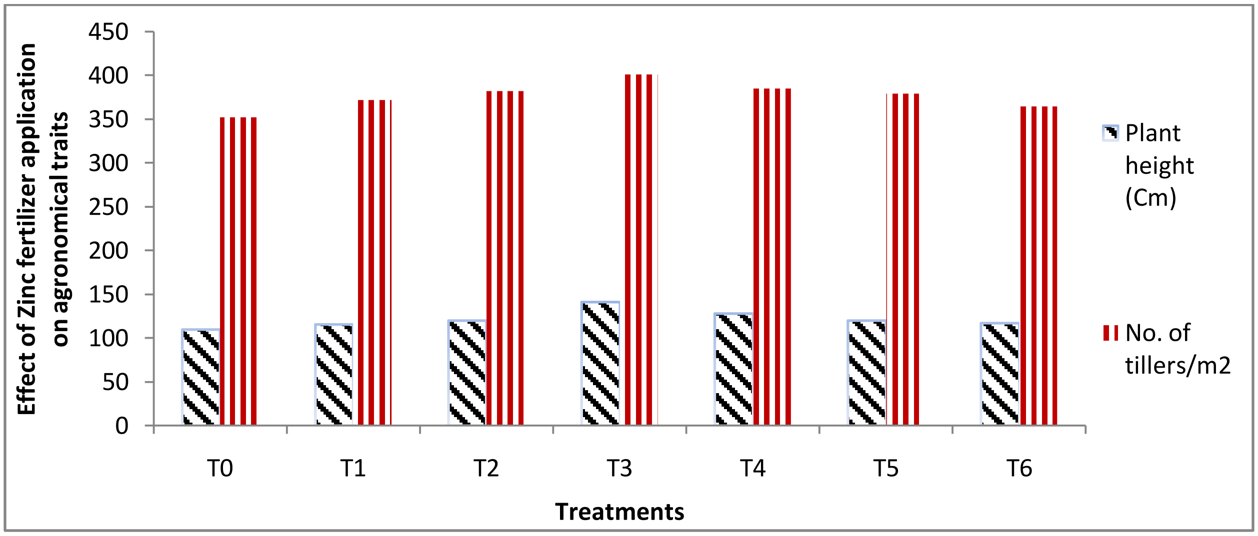
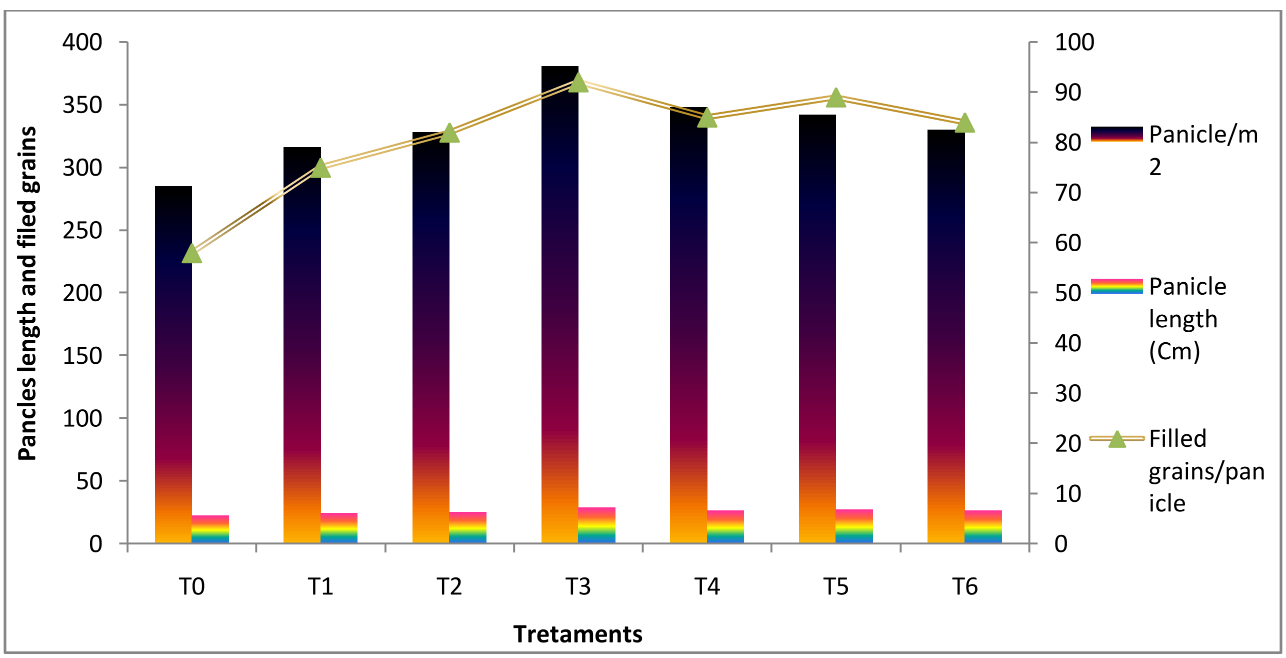


Graph 2. Effect of Zinc fertilizer application on agronomical traits



Graph 3: Effect of zinc fertilizers on yield parameters

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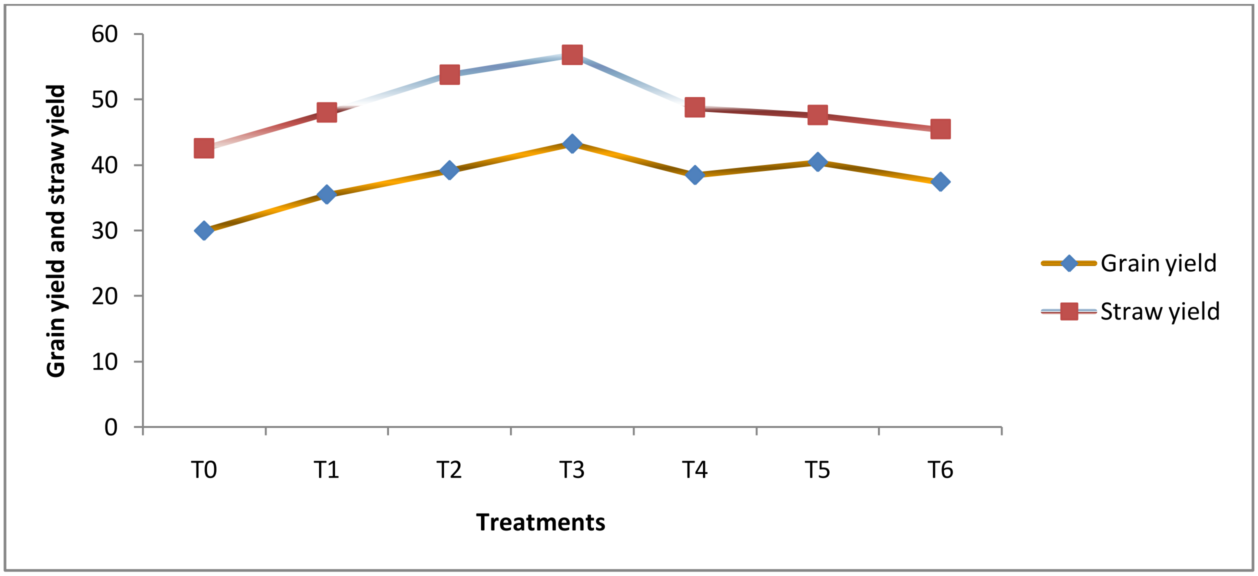
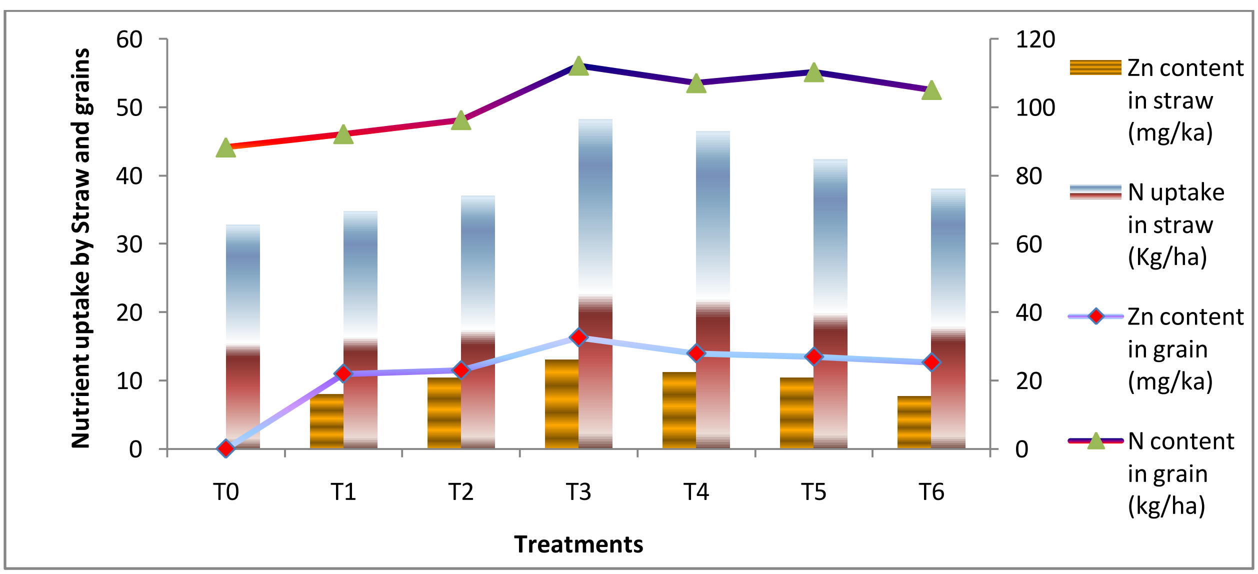


Graph4. Effect of fertilizers on grain yield and straw yield



Graph5. Effect of zinc on nutrient uptake by grain and straw

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