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# IMPACT OF DIFFERENT DOSES OF BORON AND COPPER SULPHATE ON THE YIELD OF BASMATI RICE

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## ABSTRACT

Micronutrients played a significant role in the defense mechanism in plant cell. Micronutrients are essential for the growth and yield of the agricultural crops. These develop resistance against pathogens and pests that may enhance the yield through quality grains. In the present study we evaluate the effect of boron and copper sulphate applied in different doses i.e. T-2 (Boron @ 1000gha$^{-1}$); T-3 (Boron @ 2000 gha$^{-1}$); T-4 (Copper Sulphate @ 2000gha$^{-1}$); T-5 (Copper Sulphate @ 4000gha$^{-1}$) compared with T-1 (Control) treatment during kharif 2015-2016. Non-significant ($P$>0.05) difference found in productive tillers (Pt) found by the application of boron and copper nutrients, however 21.44% to 22.36% Pt increased compared to control at tehsil Daska. When boron was applied @ 2000 gha$^{-1}$ may increase 10.70% and 25.93% in grain weight (g) and yield. The trial was conducted in Gujrat showed significant ($P$<0.05) Pt by the application of boron and copper nutrients; however 23.31% to 22.76% Pt increased. The treatment T-3 found highly significant ($P$<0.05) increase in grain weight (g) 10.51%. Significant ($P$<0.05) productive tillers in T-3 (27.92%) recorded followed by 1000 grain weight (25.43%) and yield (28.13%) at Sambrial. Significantly ($P$<0.05) positive impact of productive tillers in T-3 (10.39%) found similar results and significant trend (14.77%) found in 1000 grain weight resulting highly significant yield (12.86%) recorded at Kharian. Significantly ($P$<0.05) positive impact of productive tillers was found in T-3 (9.43%) compared to all treatments. Thousand grain weight (g) found non-significant ($P$>0.05) grains in T-3 (14.18%) and T-5 (14.29%) but recorded significant ($P$<0.05) results with other treatment recorded at par trend in yield (11.16% and 9.77%) at Jalal Pur Jattan.

## Introduction

The paddy crop well known as rice (*Oryza sativa* L.) is a leading food grain staple food crop that provides dietary energy and protein up to 2.5 billion people in the world. Rice provides twenty three percent of the global human per capita energy and sixteen percent of the per capita protein. The present conditions of the soil in Pakistan are calcareous alluvium and are low in nutrients. The frequency of free carbonates, low organic matter and high pH create a risk of micronutrient deficiencies [1-5]. The major fertilizers used in Pakistan are nitrogen, phosphorus and potassium with minimum or no application of essential nutrients [6].

The micronutrient deficiency is deemed one of the major causes of the yield reduction trends. The soil situation of rice cultivation manipulates electro- and biochemical reactions that alter pH and the concentration of certain ions. Calcareous coarse-textured soils with decrease organic matter suffered copper micronutrients [7].

Productive tillers and grain weight have also shown significant rise by copper and boron treatment [8]. Copper (Cu) and boron (B) micronutrients play significant concern in securing rice production but unfortunately neglected by the farming community.

Copper deficiency causing confining appearance of new leaves in rice that reduced tillering capacity and promoted pollen sterility, while boron deficiency resulted in stunted growth resulted to reduce the number of panicles and yield [9].

In the past scenario, copper compound had been developed to prepare Bordeaux mixture that was used as fungicides for the management of bacterial leaf blight [10] and other rice diseases [11]. Copper nutrient has the capability to denature the spores and conidia that create hurdle in spores germination [12]. Copper helps in ligninification which produces primary defense mechanism in the plants and create resistance against pathogens [13, 14]. Boron (B) is involved in cell wall structure and the maintenance of membrane function [13] and improve the strength of the membrane and cell wall with the cross-linked polymer that toughen the plants vascular bundles which hold back the invasion mechanism of pathogens [14]. To overcome the deficiency of micronutrients in rice plants the experiment was conducted to evaluate the different doses of boron and copper sulphate in enhance the growth and yield of the paddy crop in the different tehsils of agro-ecological systems in District Sialkot and Gujrat during Kharif 2015-2016.

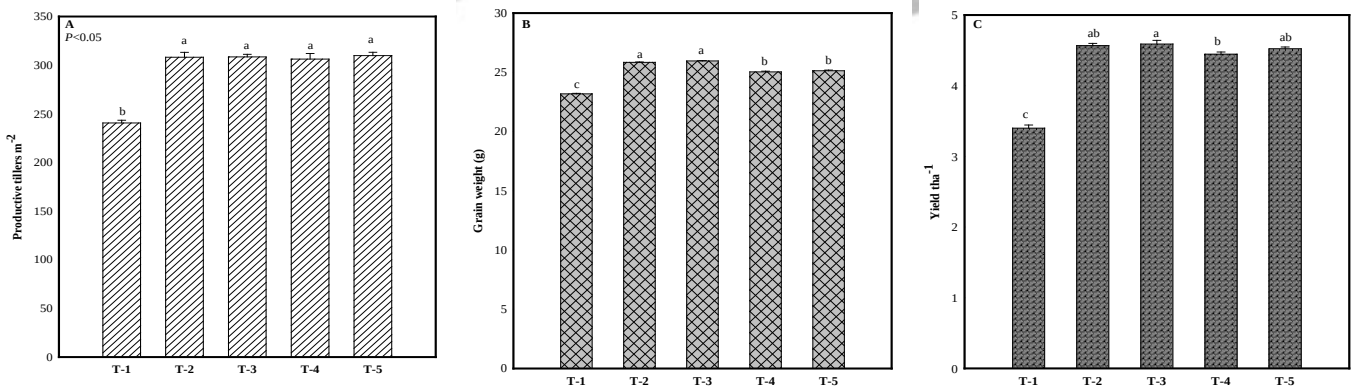
## Materials and methods

The present study was conducted to evaluate the effect of different doses of boron T-2 (1000 $gha^{-1}$); T-3 (2000 $gha^{-1}$) and copper sulphate T-4 (2000 $gha^{-1}$) and T-5 (4000 $gha^{-1}$) compared to control with randomized complete block design (RCBD) with three replications during kharif 2015-2016. The soil was well prepared with rotavator initially in dry land and puddling was done after irrigation followed by planking. The recommended dose of Diammonium phosphate (DAP) applied @ 185$kgha^{-1}$ along with Murate of potash (MOP) broadcasted @ 125$kgha^{-1}$ in the field condition. The rice plants were transplanted after the second week of July each year. The economically cheap and better herbicide acetachlor broadcasted @ 250$mlha^{-1}$ in the transplanted rice field with shaker bottle keeping in view the level of water upto 7.62 centimeter for 10 days. Zinc Sulphate (21%) was broadcasted in the field in crystalline form @ 25$kgha^{-1}$ ten days after transplantation. The first dose of Urea was broadcasted in the field @ 125$kgha^{-1}$ at the tillering stage in rice plant. Boron and copper doses were broadcasted in the field after thirty days after transplantation according to well organized protocol. The granular insecticide Cartap @ 22$kgha^{-1}$ was applied on the first week of September each year for the control of borers and sucking insects. The number of productive tillersm-2, 1000 grain weight (g) and paddy yield ($tha^{-1}$) were recorded during these seasons. The increase in growth parameters regarding yield over control ($tha^{-1}$) was recorded by taking mean yield of each season. The data was analyzed statistically by using analysis of variance technique at through Duncan's Multiple Range (DMR) test with 5% level of probability [15].

## Results and Discussion

Non-significant ($P$>0.05) difference in productive tillers (Pt) recorded by the application of boron and copper. The results showed that maximum Pt (21.44% to 22.36%) increased compared to control at tehsil Daska. The results revealed that boron was used @ 2000 $gha^{-1}$ may increase 10.70% and 25.93% grain weight and yield production during 2015 (Figure-1).

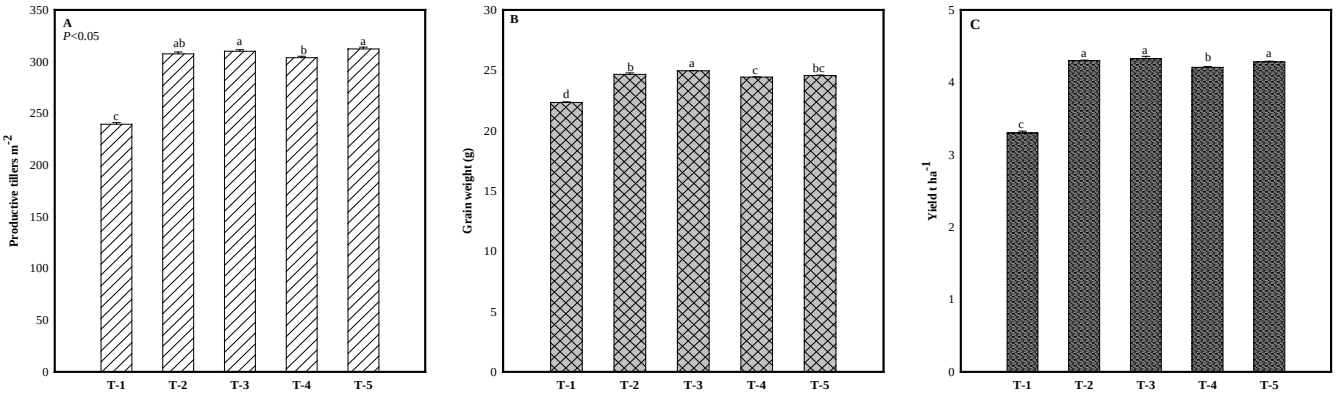
**Figure 1 showing the impact of different doses of boron and copper sulphate on growth of rice at Daska during 2015**




Whereas T-1 (Control); T-2 (Boron @ 1000$gha^{-1}$); T-3 (Boron @ 2000 $gha^{-1}$); T-4 (Copper Sulphate @ 2000$gha^{-1}$); T-5 (Copper Sulphate @ 4000$gha^{-1}$)

Significant ($P$<0.05) productive $tillersm^{-2}$ (Pt) recorded by the application of boron and copper nutrients at Gujrat and 23.31% to 22.76% Pt increased significantly compared to control. Boron was used @ 2000$gha^{-1}$ in the rice crop found significant ($P$<0.05) increase in grain weight i.e. 10.57% (Figure-2).

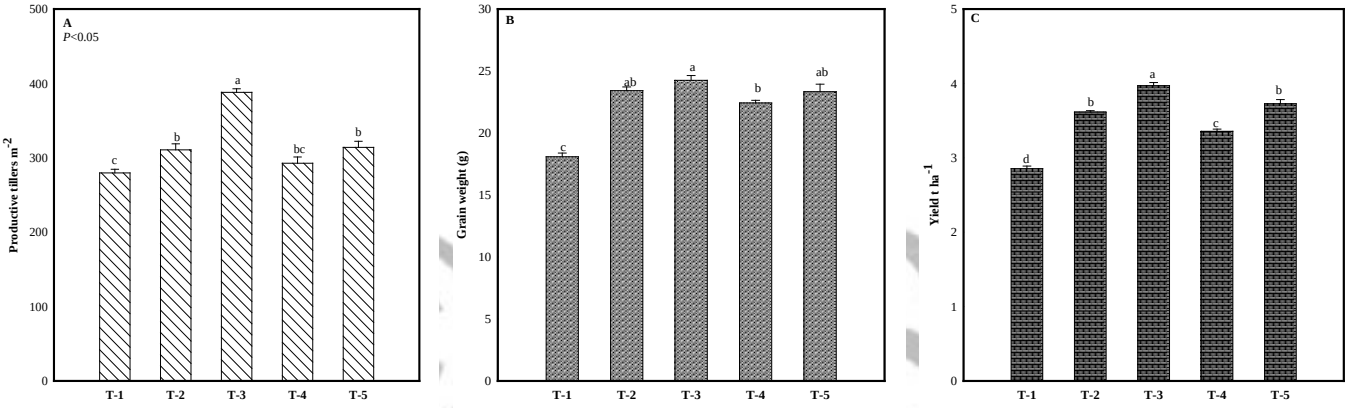
**Figure 2 showing the impact of different doses of boron and copper sulphate on the growth of rice at Gujrat during 2015**




Whereas T-1 (Control); T-2 (Boron @ 1000gha$^{-1}$); T-3 (Boron @ 2000 gha$^{-1}$); T-4 (Copper Sulphate @ 2000gha$^{-1}$); T-5 (Copper Sulphate @ 4000gha$^{-1}$)

The results showed significant (*P*<0.05) increase in productive tillers in T-3 (27.92%) recorded having similar trend in 1000 grain weight (25.43%) and yield (28.13%) production at Sambrial during 2016 (Figure-3).

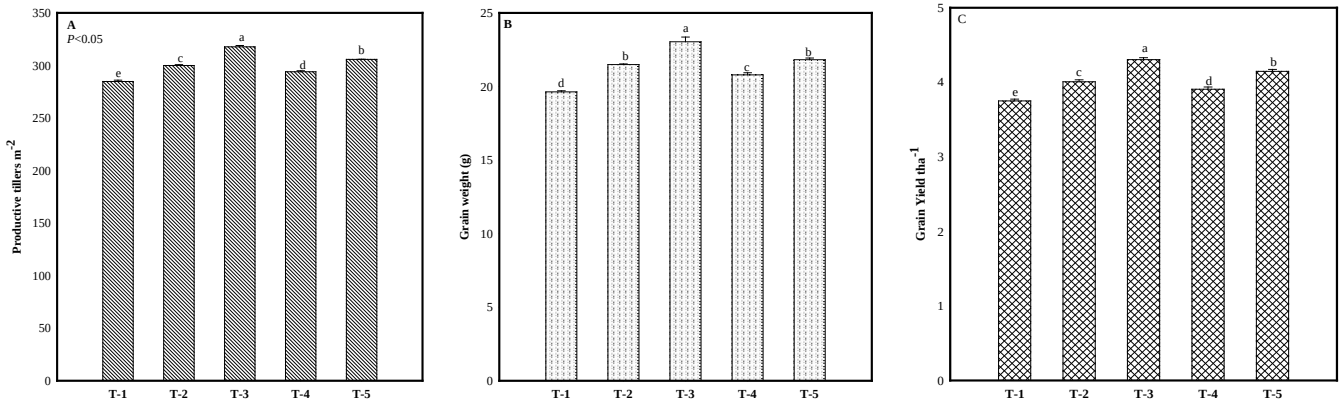
**Figure 3 showing the impact of different doses of boron and copper sulphate on yield of rice at Sambrial during 2016**




Whereas T-1 (Control); T-2 (Boron @ 1000gha$^{-1}$); T-3 (Boron @ 2000 gha$^{-1}$); T-4 (Copper Sulphate @ 2000gha$^{-1}$); T-5 (Copper Sulphate @ 4000gha$^{-1}$)

Significantly (*P*<0.05) positive impact on productive tillers in T-3 (10.39%) recorded increase having similar significant trend in 1000 grain weight (14.77%) and yield production (12.86%) at Kharian during 2016 (Figure-4).

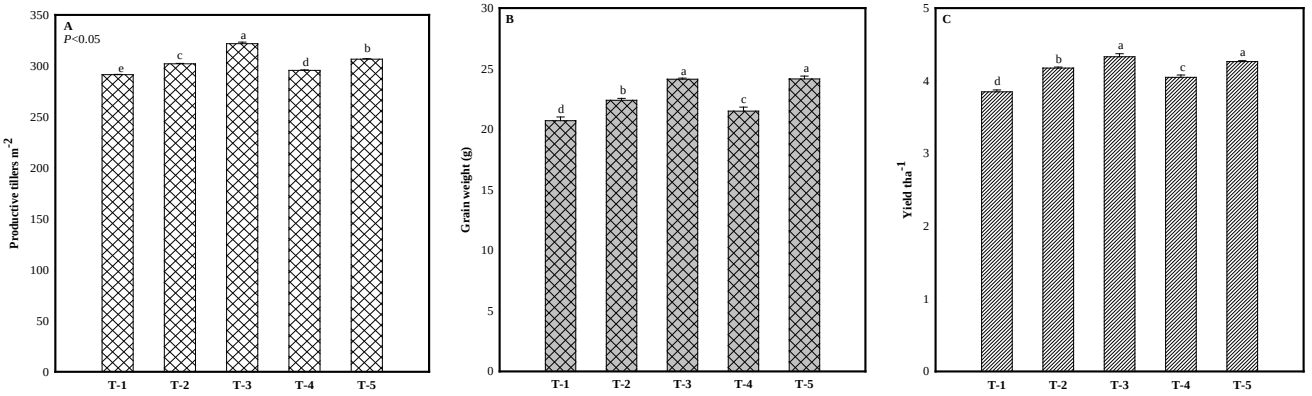
**Figure 4 showing the impact of different doses of boron and copper sulphate on the yield of rice at Kharian during 2016**




Whereas T-1 (Control); T-2 (Boron @ 1000gha$^{-1}$); T-3 (Boron @ 2000 gha$^{-1}$); T-4 (Copper Sulphate @ 2000gha$^{-1}$); T-5 (Copper Sulphate @ 4000gha$^{-1}$)

The results showed significantly (P<0.05) positive impact on productive tillers in T-3 (9.43%) recorded significant increase compared to all other treatments. Thousand grain weight found non-significant (P>0.05) results in T-3 (14.18%) and T-5 (14.29%) with each other but recorded significant results in other treatment i.e. 11.16% and 9.77% at Jalal Pur Jattan during 2016 (Figure-5).

**Figure 5 showing the impact of different doses of boron and copper sulphate on yield of rice at Jalalpur Jattan during 2016**




Whereas T-1 (Control); T-2 (Boron @ 1000gha$^{-1}$); T-3 (Boron @ 2000 gha$^{-1}$); T-4 (Copper Sulphate @ 2000gha$^{-1}$); T-5 (Copper Sulphate @ 4000gha$^{-1}$)

The scientists reported that micronutrient applications are beneficial for rice growth and yield of crops [7]. The researcher reported that micronutrient deficiencies are very common under salt stress conditions having high pH [16]. The fertility of the soil played a vital role which determines the growth and development of the rice plant. The role of micronutrients also enhances the plant productivity and grain yield resulting to enhance the enzymatic action of the plants. Levels of micronutrients in soil is depleted continuously due to the growing of hybrid and high yielding varieties of crops and non addition of farm yard manures having these elements required for normal growth and development. Our results are in line with the researchers who reported that micronutrients improve the yield and production of different crops [17, 18]. The soil pH in our experimental sites was 8-8.2 and organic matter was recorded 0.85-1.02 in range resulted in micronutrients deficiencies are expected which are in line with our studied investigations [19].

Our results are in line with the researchers who reported that the application of B and Cu aimed to supply nutrients which are important in promoting plant growth and grain formation in rice crop [9]. The micronutrients were found able to supply copper and boron timely to the rice plant for its growth and development at the critical stage, as these elements were relatively immobile [9, 20]. The additions of micronutrients, Cu and B were able to increase crop productions [21-24] are in line with our recommendations. Secondly the foliar applications of Cu and B were found to have enhanced photosynthesis and resulted in better plant growth and grain formation, so that copper compound is needed in photosynthesis and respiration. It also plays a critical role in the formation of pollen and fertilization in rice [9]. The scientists reported that high nitrogen supply to the rice plant may increase the yield that may highlight Cu deficiency due to the lower availability of Cu in plants of high nitrogen nutritional status [25]. On the other hand, the researchers reported that boron plays a vital role in carbohydrate metabolism, sugar transport and pollen grain viability in rice crop [9]. In micronutrients especially boron has long been identified as one of the major constraints for grain crop production in the world [26, 27]. The scientists have documented that boron deficiency as a limitation for achieving high yield in major rice planting areas [22]. In particular, the application of boron is capable to improve grain production drastically [22, 26, 27]. The foliar application of boron has been proven to be the most effective way for countering boron deficiency in standing crop [28]. The scientists found that B deficiency impaired the function of anthers and resulted in severe reduction in yield [26, 27]. Other than that, boron deficiency also depresses pollen germination and the fertilization process [29]. The applications of Cu and B were able to increase grain filling by more than 5% [8] recorded in field crops.

## Conclusion

The application of micronutrients broadcasted in the rice crop significantly improved the growth in Basmati rice. In our investigations the growth parameters like productive tillers, grain weight and yield were significantly increased by the application of boron and copper micronutrients in the field conditions of different tehsils of District Sialkot and Gujrat. Therefore the farmers of this region are advised to broadcast boron (2000gha$^{-1}$) and copper sulphate (4000gha$^{-1}$) in their rice fields thirty days after transplantation with the consultation of plant doctors in Punjab Agriculture Department to increase the productive tillers, grain weight and ultimately yield of rice crop.

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