

VALUE ADDED FERTILIZER IMPROVES EFFICIENCY OF NPK AND MICRONUTRIENTS IN COMPARISON OF STRAIGHT FERTILIZER FOR GROWTH AND YIELD OF COTTON

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ABSTRACT

A research study was executed at Central Cotton Research Institute (CCRI) Sakrand during 2021 to evaluate the efficacy of nutrient uptake from value added fertilizer in comparison of straight fertilizer. Eight treatments were kept with randomized complete block design (RCBD) with three times replicated plot. In the light of current research, it was concluded that uptake of nutrients from value added fertilizer Zarkhez Plus, Zabardast Urea and Zoron, these contain NPK, Zn and B caused significant difference with recorded highest growth parameters and increased bolls plant⁻¹, formed more fruiting points, less shedding was occurred, given higher boll weight and seed index. Their positive effects of earliness as maximum bolls opened at 150 days after planting (DAP). However, highest seed cotton yield was also achieved. It was noted that application of value-added fertilizer T₈ increased seed cotton yield 23.19%, 22.46%, 21.01%, 18.12% and 11.59% over T₁, T₂, T₃, T₄ and T₅, respectively. Hence it is recommended that farmers may apply new product of Engro Fertilizer Ltd. Zarkhas Plus, Zabardast Urea and Zoron for the growth, development and production of higher yield.

Keywords: Value added fertilizer, NPK, Zoron, Zingro, Zarkhez plus, Seedcotton Yield

INTRODUCTION

Cotton (*Gossypium* spp.) is significantly known as white gold and cash crop of Pakistan and it is also considered as major fiber crop in the world; it is the main source of raw material provide to the flourishing for textile industry. It is not only used for weaving, but also for other purposes like edible oil from its seed (16-24%) and seed cake used as fodder for animals. Pakistan is 4th largest country in cotton production subsequently China, U.S.A and India, it is also placed 3rd position for consumption in the world. Globally, cotton area estimates had been reduced through 9.1% to 31.665 million hectares in 2020-21 season as compared to 34.855 million hectares in 2019-20. International cotton production estimates were revised down to 24.110 million tons with increasing consumption presently enduring at 24.5 million tons in 2020-21 (Cotton Review 2021). Therefore, it is necessary to enhance production of cotton crop with increase financial condition of farmers and also strengthening Pakistan economy by increase productivity of cotton crop. The production did not increase cultivation area but produce higher yield per acre with the proper management of nutrients. Soils are poor in nitrogen, phosphorus and potassium (NPK) content, which are recognized principal elements for plant growth and development. In this situation fertilizer has become an important input to provide essential plant nutrients to get estimated crop yield. The role of essential micronutrients is well known in various physiological as well as biochemical processes in plant. The micronutrients i.e., Zinc (Zn) and Boron (B) also plays significant role in cotton physiology being a part of enzyme system of catalyst in enzymatic reactions.

Nitrogen (N) has important role that improve growth and abscission of squares as well as bolls with increase yield in cotton Pabuayon *et al.* (2021). Among the nutrients, nitrogen is very important for producing higher yield; its application needs to be keeping under strict control. Application of N depends upon the soil type and crop condition that how much should add, when and where. Because its need to evaluate temperature, insect pressure, water status and soil type etc. Phosphorus (P) is considered as a growth limiting macro-nutrient element that plays significant role in crop production (Simpson *et al.*, 2011). P-deficiency can severely impede crop yield (Wyngaard *et al.*, 2016). The insufficiency of phosphorus in soil is not only affects the photosynthesis but it also reduces the resistance stress and crops adaptability (Jemo *et al.*, 2007). Adequate application of phosphorus ensures to increase yield of crop and its quality (Wang *et al.*, 2017). The Potassium (K) fertilizer role at fruit formation as well as during the maturation period is mainly articulated in carbohydrate metabolism; translocation of metabolites from the leaves and other vegetative organs for boll development. The deficiency of potassium at the stage of reproductive period

can bound the buildup the biomass of crop. Improvement in seed cotton yield and quality traits are the resulting due to application of potassium (Gormus, 2002; Aneela *et al.*, 2003 and Pervez *et al.*, 2004). Zinc (Zn) is essential micro-nutrient for plants. Zinc fixes strongly to Zn-containing important metabolites in vegetative tissues i.e. Zn-activated enzymes such as carbonic anhydrase (Welch, 1995). Boron (B) is also an important micro-nutrient for optimum growth and development, improve yield and quality as well (Brown *et al.*, 2002). It performs many important functions in plant and is mainly involved in cell wall synthesis and structural integrations. Timely and balanced applications of fertilizers have great influence on crop response; to apply fertilizer since requirement of crop varies during various growth phases for getting maximum yield, efficiency of nutrients uptake and economic benefits with minimum losses of nutrient (Abbassi *et al.*, 2013; Mengel and Kirkby, 2001). Considering the status of cotton crop the current research was conducted to evaluate the efficacy of NPK from value added fertilizers like Zarkhez, Zabardast Urea along with composition micro-nutrients Zingro (Zn) and Zoron (B) with comparison of straight fertilizers DAP and Urea. The Zarkhez plus fertilizer was added with organic fillers and bio stimulants; that ensure extended nutrients availability as a resulting in high yield and good quality of produce. It has NPK in 8:23:18 ratio and it is used for all major crops. Zabardast Urea contains 42 percent nitrogen, one percent bioactive zinc and a consortium of beneficial microbes that mobilize nutrients in soil and enhance crop tolerance. Zingro contains 33 percent zinc with quick response and improve crop yield due to improved zinc efficiency. Zoron is 100 percent water soluble fertilizer that contains 20 percent boron.

MATERIALS AND METHODS

An experiment was executed at experimental farm of Central Cotton Research Institute (CCRI) Sakrand with collaboration of Engro Fertilizer Ltd. during the Kharif season 2021-22, it was jointly investigated the response of value-added fertilizers in comparison with straight fertilizers applications along with composition of micronutrients zinc and boron. The trial was layout with design in randomized complete block design (RCBD) with three times replicated plot with 2200 sq. ft. size. The row-to-row space was kept 75cm and plant-to-plant space was 30cm. The fertilizer applications were applied according to given in Table 1; the equal quantity of fertilizer (NPK) was applied in each treatment. In straight fertilizer doses NPK uptake was from DAP, Urea and MOP, whereas, similar macro nutrients uptake was from zarkhez plus fertilizer, it contains all three major elements of NPK. As per need of the crop, the plant protection measures were taken. Fifteen (15) plants were selected and tagged from each treatment and replication in order to collect the data. Data was analyzed statistically by using statistics software (Statistix-8.1). The analysis of variance and means were separated using Fisher's protected least significant difference (LSD), while the comparison of means were tested by Duncan Multiple Range Test (DRMT) at 5% and 1% using least significant difference (Steel and Torrie, 1980).

Table 1. Treatment wise fertilizer applications.

Treatments	Fertilizer Application
T ₁	Straight Fertilizer (NPK)
T ₂	Straight Fertilizer (NPK) + Zingro (Zn) @6 kg acre ⁻¹ (33%)
T ₃	Straight Fertilizer (NPK) + Zoron (B) @ 500 g acre ⁻¹
T ₄	Straight Fertilizer (NPK) + Zingro (Zn) @6 kg acre ⁻¹ (33%) + Zoron (B) @ 500 g acre ⁻¹
T ₅	Straight Fertilizer (NPK) + Zabardast Urea 50 kg acre ⁻¹ + Zoron (B) @ 500 g acre ⁻¹
T ₆	Zarkhez Plus (NPK)
T ₇	Zarkhez Plus (NPK) + Zingro (Zn) @6 kg acre ⁻¹ (33%) + Zoron (B) @ 500 g acre ⁻¹
T ₈	Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre ⁻¹ + Zoron (B) @ 500 g acre ⁻¹

RESULTS AND DISCUSSION

The data showed in Table 2 which revealed that mean square values of all the characters for treatments shown highly significant at 5% and 1%, it indicated that statistically treatments was significant different from each other. Similar findings reported by Gormus and El-Sabagh (2016) and Cevhri and Yilmaz (2018) who also found significant difference of fertilizers treatments at 5% and 1% for various traits of cotton.

It was observed in Fig. 1 that plant height was statistically significant different from each other in all treatments. It was noted that plant height was increased 173.7 cm at T₅ when combinations of Straight Fertilizer (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ were applied. Whereas, T₈ Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ also given second higher plant height 171.1cm as compared with

remaining treatments. As regards the plant height farmers and researchers avoid to choose higher plant height due to lodging, they also prefer short stature because of prevent yield losses. The minimum plant height (146.8 cm) was measured in T₁ when simply straighter fertilizer application was applied. Sympodial branches plant⁻¹ is also an important trait because boll setting occurs on these branches and contribute in enhancement of seed cotton yield; Fig. 2 indicated that sympodial branches plant⁻¹ was significantly differ in treatments. It was noted that maximum sympodial branches plant⁻¹ 31.6 were formed at application of T₅ Straight Fertilizer (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹, followed by T₈ Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ (31.1). The recommended dose of fertilizer (NPK) application with supplement of micro-nutrients (zinc and boron) increased result in growth characteristic, it might be due to healthier uptake trance-location of better and trans-location of plant micro and macronutrients to growing plants and more photosynthesis which in turn promoted more plant height and sympodial branches plant⁻¹. Our findings are in accordance with Sohair *et al.* (2014), Rawal *et al.* (2015), Singh *et al.* (2015) and Cevheri and Yilmaz (2018).

Table 2. Analysis of variance mean square values of cotton traits at different treatments.

Traits/SV	Replication	Treatments	Error
	DF=2	DF=7	DF=14
Plant Height	213.85	2185.75**	95.31
Sympodial Branches Plant ⁻¹	2.453	61.36**	1.183
Boll Plant ⁻¹	8.254	31.84**	2.156
Fruiting Points No.	45.36	230.93**	12.432
Shedding Fruiting Points No.	31.51	194.57**	10.13
Boll Weight	0.003	0.045**	0.0001
Seed Index	0.027	0.957**	0.0012
Boll Opened @150 DAP	53.68	219.23**	4.531
Seed Cotton Yield	213.54	21073.75**	18.842

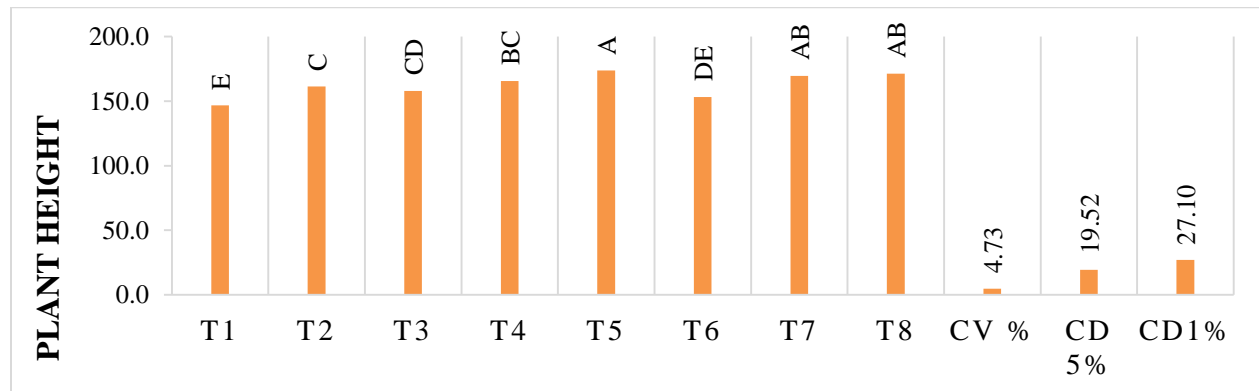


Fig 1. Response of various treatments for the trait plant height.

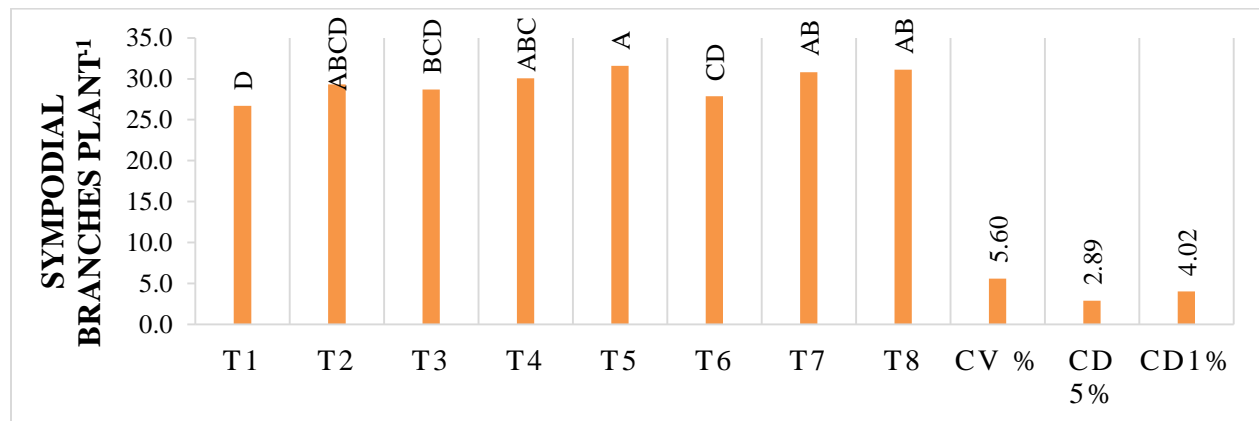


Fig 2. Response of various treatments for the trait sympodial branches⁻¹.

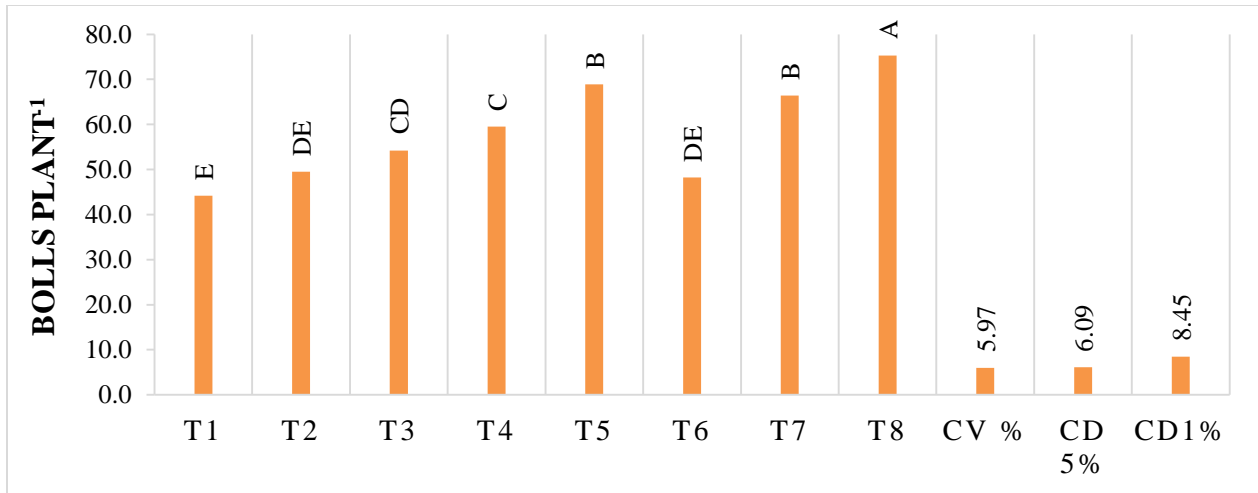


Fig 3. Response of various treatments for the trait bolles plant⁻¹.

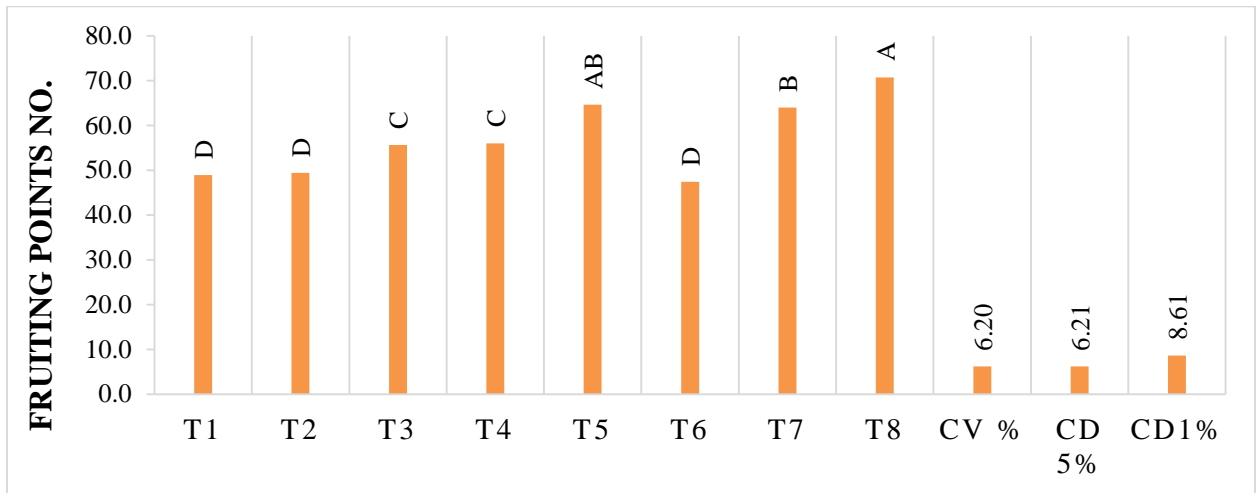


Fig 4. Response of various treatments for the trait number of fruiting points.

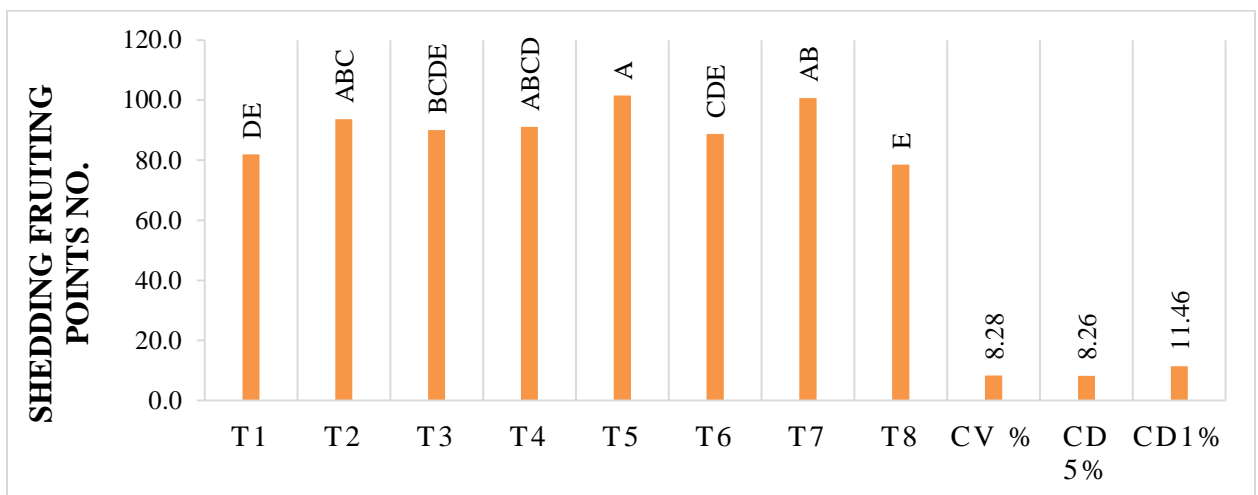


Fig 5. Response of various treatments for the trait shedding fruiting points.

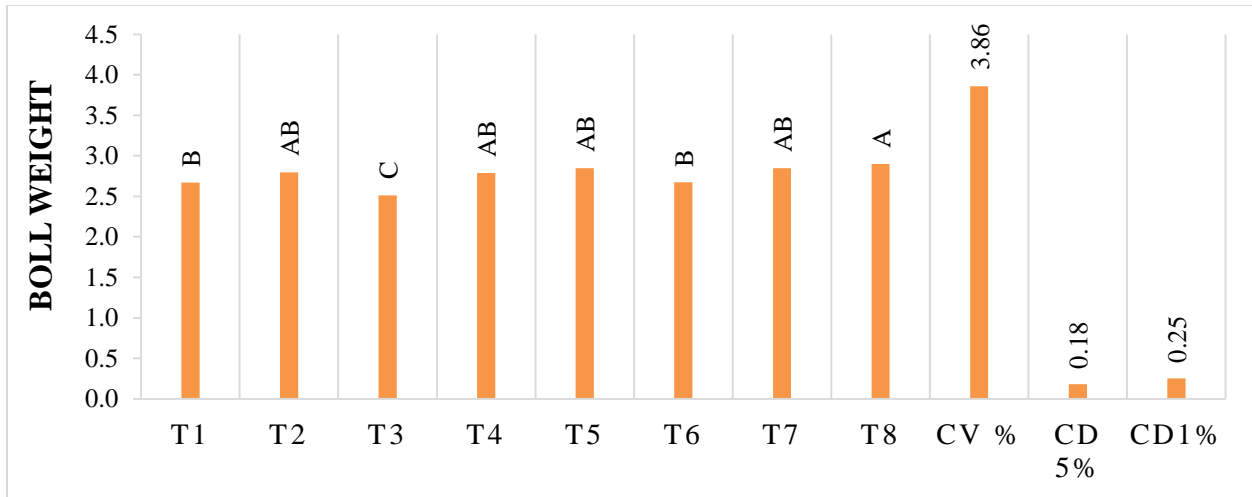


Fig 6. Response of various treatments for the trait boll weight.

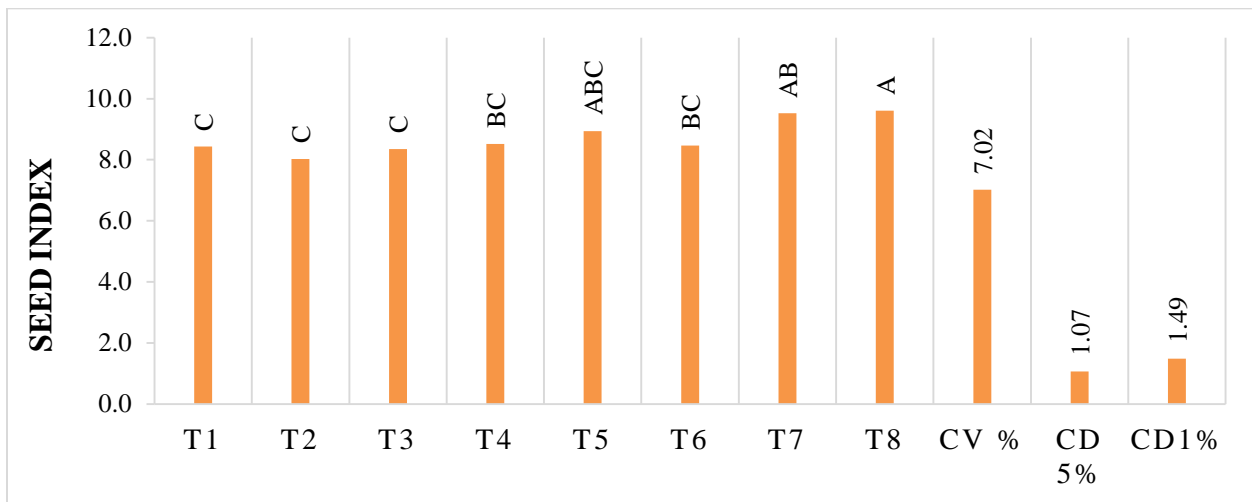


Fig 7. Response of various treatments for the trait seed index.

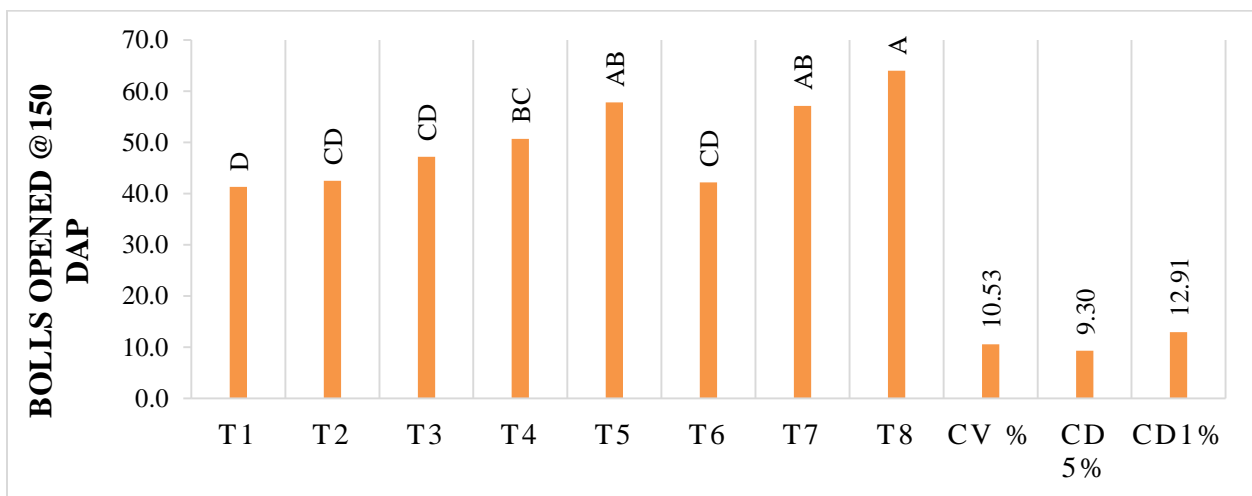


Fig 8. Response of various treatments for the trait bolls opened @150 DAP.

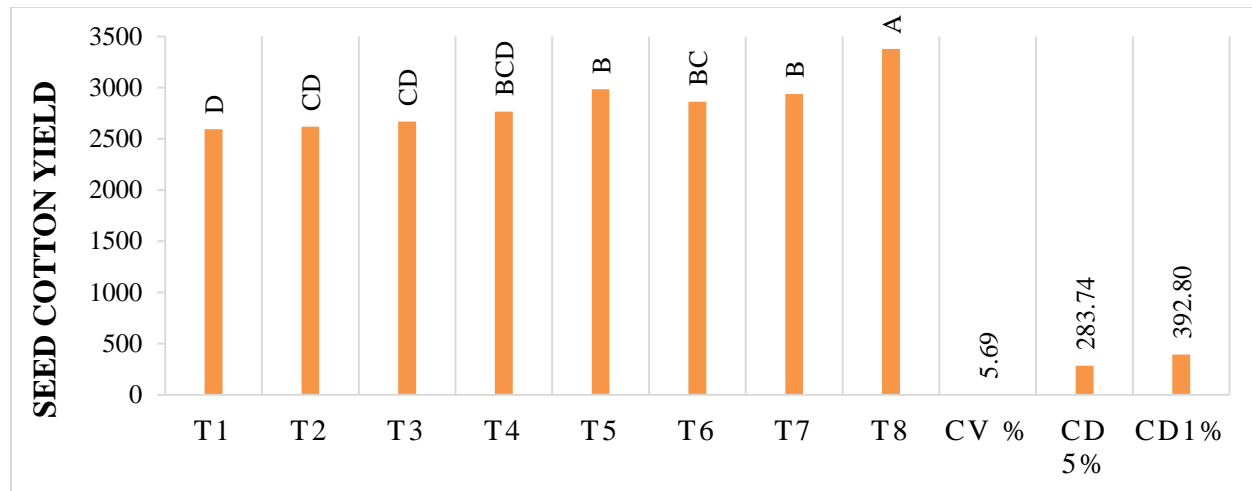


Fig 9. Response of various treatments for the trait seed cotton yield (kg ha⁻¹).

Number of bolls per plant is a significant and yield contributing character which affect the seed-cotton yield directly; if the number of bolls per plant will be increased or decreased then ultimately seed-cotton yield will also be decreased or increased. Fig 3 indicated that application of value-added fertilizer T₈ Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ resulted in significantly increased in bolls plant⁻¹ (75.3) followed by T₅ Straight Fertilizer (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ (68.9) and T₇ Zarkhez Plus (NPK) + Zingro (Zn) @6 kg acre⁻¹ (33%) + Zoron (B) @ 500 g acre⁻¹ (66.4). It is confirmed from current study that use of balanced fertilizer (NPK) along with zinc and boron significantly increased the number of bolls because it has a main role in regulating boll development. Shah *et al.* (2012) and Ahmed *et al.* (2013) suggested that NPK with different combinations of nutrients increase the bolls plant⁻¹. Singh *et al.* (2015) reported significant variation in boll plant⁻¹ with various treatments of fertilizer application. Fig 4. represents that treatment-8 significantly increased formation of fruiting points (squares, flowers and bolls) as compared with other treatments due to efficacy of value-added fertilizer. It proves that NPK value added fertilizer with composition of zinc and boron given good results in comparison with straight fertilizers. Fig 5 indicating the shedding status of fruiting parts i.e., squares flowers and bolls. In cotton shedding of fruiting parts is major problem that happening due to various reasons. In current research it was noted that less shedding was occurred with the application of T₈ Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ as compared with other treatments. The maximum boll formation, fruiting points and less shedding of fruiting points were occurred with application of value-added fertilizer along with zinc and boron. It is due to the fact that macronutrients and micronutrients increase the use efficacy and produce higher values with quality. However, the lowest observation was found with the application of straight fertilizer. It was noted that sufficient provision of macro and micronutrients results in efficient hormonal activities, uptake of zinc and boron also promote the synthesis of growth promoting hormones particularly the production of auxin resulting in enhance the growth i.e., boll formation, fruiting points and less shedding. It is because of the improvement in activities of enzymatic and photosynthetic that prevent the squares and boll shedding. This might be producing of maximum fruiting points, production of flowers; that leads to manifest influence in separation between reproductive and vegetative growth. It was noted that such nutrients perform a major role in formation of higher number of bolls by stunning bolls, flowers and square reduction. Yaseen *et al.* (2013) noted fruiting parts at various fertilizer treatments. Gandahi *et al.* (2016) and More *et al.* (2018) confirmed that shedding caused by deficiency of certain nutrient elements, but there was a significant influence of micronutrients occurs on shedding as it is reduced with the application of zinc.

Boll weight is also considered as an important trait that significantly contributes in enhancement of seed cotton yield. Fig 6. showed significant variation in boll weight at different treatments. High bigger boll weight was obtained at T₈ when value added fertilizer application was applied along with the composition of zinc and boron. Whereas, the lowest boll weight was obtained in application of straight fertilizer. Singh *et al.* (5015) and Cevheri and Yilmaz (2018) reported significant variation of boll weight at different fertilizer treatments. The seed index result presented in fig 7 it indicated that T₈ Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹ + Zoron (B) @ 500 g acre⁻¹ and T₇ Zarkhez Plus (NPK) + Zingro (Zn) @6 kg acre⁻¹ (33%) + Zoron (B) @ 500 g acre⁻¹ produced higher seed index 9.6 g and 9.5 g respectively compared with straight fertilizer treatments. Gandahi *et al.* (2016) reported that without NPK, zinc and boron have adverse effect on seed index, whereas, its proper application may increase

seed with of seed. Rahman *et al.* (2019) found significant difference at various application of fertilizer and obtained higher seed index weight at T₄. Boll opening is almost depending on influence of growth and vigor of plant. The impact of fertilizer applications (macro and micro nutrient) was investigated for number of opened bolls (Fig 8). It was observed that maximum bolls were opened by T₈ Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹+ Zoron (B) @ 500 g acre⁻¹ followed by T₅ and T₇. Scientists and farmers prefer earlier opening varieties, because it can prevent from various biotic and abiotic factors. Hence value-added fertilizer enables the plants to open boll earlier and picking will also be start earlier. It was noted that T₈ valued added fertilizer opened 35.47% more bolls as compared with T₁ straight fertilizer application. Our findings are in accordance with Gandahi *et al.* (2016), Darmanov *et al.* (2021) and Malik *et al.* (2021) who reported that various fertilizers treatments of macro and micro-nutrients had significant effect on seed cotton yield.

Seed cotton yield is an important and considered as value able character, it is a result bolls per plant and boll weight. The data presented in fig 9 also showed that different treatments of fertilizers have significant variation for seed cotton yield. The range was observed from 2593 kg ha⁻¹ to 3376 kg ha⁻¹. The maximum seed cotton yield (3376 kg ha⁻¹) was obtained at T₈ when value added fertilizers were applied Zarkhez Plus (NPK) + Zabardast Urea 50 kg acre⁻¹+ Zoron (B) @ 500 g acre⁻¹ as compared with all other treatments. In this study the nutritional analysis of cotton plants showed that the use of NPK with zinc and boron resulted in significantly higher uptake of nitrogen, phosphorus and potassium and given higher seed cotton yield. It was noted that application of value-added fertilizer T₈ increased seed cotton yield 23.19%, 22.46%, 21.01%, 18.12% and 11.59% over T₁, T₂, T₃, T₄ and T₅, respectively. Yaseen *et al.* (2013) reported that seed cotton yield reduced due to imbalance of nutrients. Ahmed *et al.* (2016) determined fertilizer treatments effect on yield and suggested positive effect of zinc and boron in combination with NPK fertilizer on production of more seed cotton yield. More *et al.* (2018) found variation in fertilizer treatments and achieved higher seed cotton yield on application of recommended dose of fertilizer with composition of zinc and boron. The significant difference in seed cotton yield was due to supplement of nutrients application of NPK with boron and zinc were recorded, this study is line with results reported by Rawal *et al.* (2015), Waikar *et al.* (2015), Gandahi *et al.* (2016), Rahman *et al.* (2019), Ahmad *et al.* (2021).

Conclusion

Cotton is an important cash crop of Pakistan and it is also considered as major fiber crop in the world; it provides raw material for flourishing to textile industry. In the light of current research, it was concluded that uptake of nutrients from value added fertilizer Zarkhez Plus, Zabardast Urea and Zoron these contain NPK, Zn and B caused significant difference and recorded highest growth parameters and increased bolls plant⁻¹, formed more fruiting points, less shedding was occurred, given higher boll weight and seed index. Their positive effects of earliness as maximum bolls opened at 150 days after planting. However, highest seed cotton yield was also achieved. Hence it is recommended that farmers may apply new product of Engro Fertilizer Ltd. Zarkhas Plus, Zabardast Urea and Zoron for the growth, development and production of higher yield.

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