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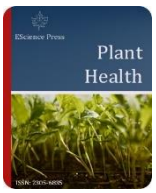

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Response of Wheat Crop to Various Foliar Applications of Nitrogen, Zinc and Boron Fertilizers

[a]Asif Ali Kaleri*, [b]Ghulam Mujtaba Khushk, [a]Qamarddin Jogi, [a]Muhammad Mithal Lund, [c]Manzoor Hussain Magsi, [a]Nazia Baloch, [a]Danish Manzoor, [a]Murad Ali Magsi, [d]Ghulam Sajjad Kaleri, [a]Aatif Ali Rajput, [a]Nisar Fatima Pathan, [a]Rabia Laghari

[a] Department of Agronomy, Sindh Agriculture University Tando Jam, Sindh, Pakistan.
[b] Department of Rural Sociology, Sindh Agriculture University Tando Jam, Sindh, Pakistan.
[c] Farm Power machinery, Sindh Agriculture University Tando Jam, Sindh, Pakistan.
[d] Plant Breeding and Genetics, Sindh Agriculture University Tando Jam, Sindh, Pakistan.

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ABSTRACT

The field experiment was carried out at the students' experimental farm Department of Agronomy at SAU Tando Jam.Our study results showed that growth and yield components of wheat Varity kiran-95 were significantly differences, extreme plant height (96.60cm), tillers (331.00 m^{-2}), spike length (11.79 cm), grains per spike(48.00), weight of grain per spike- (2.52 g), seed index (1000-grain weight) (47.90 g), biological yield (11950 Kg ha^{-1}) , grain yield (5775 Kg ha^{-1}) and harvest index (49. 82) was observed under T_9 = 2000 g ha^{-1} followed by plant height (93.15 cm), tillers (312.00 m^{-2}), spike length (11.64 cm), grains $spike^{-1}$ (56.00), weight of grain $spike^{-1}$ (2.08 g), seed index (1000-grain weight, 47.58 g), biological yield (11818 Kg ha^{-1}), grain yield (5514 Kg ha^{-1}) and harvest index (48.33%) were noted under T_7 = 1500g ha^{-1} Whereas, the least plant height (73.80 cm), tillers (248.00 m^{-2}), spike length (9.08 cm), grains $spike^{-1}$ (31.88), weight of grain $spike^{-1}$ (1.45 g), seed index (1000-grain weight, 33.01 g), biological yield (11950Kg ha^{-1}), grain yield (3022 Kg ha^{-1}) and harvest index (41.81%) was recorded in T_1 = (Control No fertilizer).

Corresponding Author: Asif Ali Kaleri
Email: asifalikaleri2013@gmail.com

INTRODUCTION

Wheat is the second largest grain produce in the world (Samar *et al*., 2019). Pakistan, Wheat is the primary crop of the population, and it is the most cultivated crop, covering around 9.1 million hectares of land. Pakistan heavily relies on wheat as its primary crop, making it a crucial component in ensuring the country's food security. Wheat cultivation contributes significantly, accounting for 9.2 percent in agricultural value added and 1.8 percent in the overall GDP of Pakistan (Pakistan Economic Survey 2020-21). Wheat is a main source of food for people worldwide, providing carbohydrates and essential micronutrients as iron, zinc, and vitamins B (Peter and Sandra 2015). Nitrogen is one of the major nutrients which reduce the yield of wheat if not applied in proper amount as it is needed for fast growth of plants and to get high production per hectare, nitrogen plays important role in all the metabolic processes of plants. Nitrogen is the main component and major constituent of plants especially in living tissues formation (Imdad *et al*., 2018). Zinc plays a crucial role as a micronutrient for plants, as it actively participates in various essential cellular functions these functions encompass vital metabolic and physiological processes, enzyme activation, and maintaining the balance of ions within the plant's system (Alsafran *et al*., 2022). Boron plays a

vital role in maintaining the integrity of wheat plant cell walls, ensuring their structural integrity. A deficiency in boron can have detrimental effects on root growth and ultimately result in a low grain yield (Reid *et al*., 2014). A deficiency of boron in wheat plants can lead to abnormal growth patterns, hindered development of shoots and roots, and ultimately result in decreased crop yield (Hu *et al*., 2013). Applying nitrogen through foliar spraying is highly advantageous for promoting increased growth and achieving higher yields (Bameri *et al*., 2012). Zinc is commonly used as a foliar application on wheat crops the application of micronutrients such as boron has been shown to greatly improve various aspects of plant growth, including increased plant height, enhanced tiller production, improved grain yield, and higher protein content (Zia *et al*., 2016). Foliar spray of zinc and boron significantly improved wheat grain yield and quality parameters Ali *et al*. (2017). Research conducted in India revealed that the application of zinc and boron through foliar spray led to an increase in grain yield and improved nutrient uptake in various crops the benefits of foliar spray application of zinc and boron were also observed in wheat, as emphasized by (Sikander *et al*., 2018). Foliar spray of zinc improved wheat grain yield, biofortification and nutrient absorption (Saeed *et al*. 2021). In another study (Farooq *et al*., 2017 and Khan *et al*., 2015). The researchers discovered that administering these essential micronutrients through foliar treatment led to notable improvements in the size of wheat grains, protein composition, and carotenoid levels. Different studies concluded that foliar application of macronutrients and micronutrients can significantly improve wheat yield and quality. They also suggested that the timing and concentration of foliar application should be optimized for maximum benefits.

MATERIALS AND METHODS

Experimental Layout and Treatments

The field experiment was carried out at Students Experimental Farm, Department of Agronomy SAU Tando Jam Sindh Pakistan during the Rabi, 2020-21. Information of the trail is below. (Randomized Complete Block Design)

Replication=03

Net plot size: 3 m x4 m ($12m^2$)

Variety= Kiran-95

Treatments=09

T_1= Untreated (No Fertilizer)

T_2= Foliar nitrogen 1.0 %

T_3 = Zinc 1.25 l ha^{-1})

T_4 = Boron 2.50 l ha^{-1})

T_5 = Foliar nitrogen 1.0 % + foliar zinc (Element 1.25 l ha^{-1})

T_6 = Foliar nitrogen 1.0 % + foliar Boron (2.50 l ha^{-1})

T_7 = Foliar Zinc 1.25 l ha^{-1}) + foliar boron 2.50 l ha^{-1})

T_8 = Foliar nitrogen 1.0 % + foliar zinc (1.25 L ha^{-1}) + foliar boron (2.50 l ha^{-1})

Culture Practices

A good seed bed was prepared by two dry plowings and leveling the land. The recommended dose of DAP was applied in all treatments during the sowing time. Throughout this study, during seeding, all N, Z, and B were applied to different stages of wheat. The agronomical traits of the plants were observed by selecting five plants in each plot at five-day intervals during the initial 10 days following crop formation.

Recorded Observations

1. Plant height (cm).
2. Tillers m^{-2}
3. Spike length (cm)
4. Grain per spike
5. Grain weight per spike
7. Seed index (1000) grain weight, g)
8. Biological yield (kg ha^{-1})
8. Grain Yield (kg ha^{-1})
9. Harvest Index

Statistical Analysis

Statistix 8.1 was used to conduct statistical analysis on the data, and the Least Significant Difference (LSD) test was employed to compare the means of different treatments with a significance level of 5 %.

RESULTS

The application of nitrogen, zinc, and boron onto the leaves of wheat plants had a significant and positive impact on various physiological yields, and yield component traits (refer to Table 1). When compared to the sole spray of nitrogen (T2), zinc (T3), and boron (T4), the plants that were sprayed with a combination of nitrogen + zinc (T5), nitrogen + boron (T6), zinc + boron (T7), and nitrogen + zinc + boron (T8) exhibited increased height and leaf production. Furthermore, there was a notable increase in plant height (cm), tillers per square meter, length (cm), grains per spike, grain weight per spike, seed index (1000 grain weight in grams), biological yield (kilograms per hectare), grain

yield (kilograms per hectare), and harvest index (kilograms per hectare). Compared to the unsprayed plants, those sprayed with a combination of nitrogen + zinc + boron (T8) demonstrated a 12 % height increase and a 20 % increase in various traits such as plant height (cm), tillers per square meter, length (cm), grains per spike, grain weight per spike, seed index (1000 grain weight in grams), biological yield (kilograms per hectare), grain yield (kilograms per hectare), and harvest index (kilograms per hectare), which were specifically measured as 95.60, 331.00, 11.79, 48.00, 2.52, 47.90, 11950, and 5775, respectively.

Table 1. Agronomic traits of wheat crop to various foliar applications of nitrogen, zinc and boron fertilizers.

Micronutrients Levels	Plant height (cm)	Tillers m^{-2}	Length (cm)	Grain per $spike^{-1}$	Grain weight per $spike^{-1}$	Seed index (1000) grain weight, g)	Biological yield (kg ha^{-1})	Grain Yield (kg ha^{-1})	Harvest Index (kg ha^{-1})
Untreated (Control	72.80f	248.00g	9.06 g	31.88h	1.45d	33.01e	7228h	3022g	41.81d
Foliar nitrogen1.0%	76.58e	263.0f	9.61 e	35.41f	1.61d	38.66d	7997f	3841e	47.94bc
Zinc (1.25 l ha^{-1})	81.68d	274.0e	9.92 d	37.16e	1.71cd	28.69cd	8485e	3975e	46.95c
Boron (2.50 l ha^{-1})	84.53c	286.0d	10.27 c	39.79d	1.74cd	42.21c	9202d	4466d	48.64ab
Foliar nitrogen1.0% + foliarzinc(Element 1.25 l ha^{-1})	85.36c	292.33c	10.33 c	41.58c	1.97bc	44.25c	9977c	4775c	47.89bc
Foliar nitrogen1.0% + foliarBoron (2.50 lha^{-1})	92.15b	312.0b	11.64b	46.83b	2.08b	47.58b	11818b	5514b	48.33bc
Foliar Zinc (1.25 l ha^{-1}) +foliar boron 2.50 l ha^{-1})	95.05a	327.0a	11.67ab	47.83 ab	2.47a	47.84a	11898ab	5775a	48.50ab
Foliar nitrogen1.0% + foliarzinc (1.25 L ha^{-1}) +foliar boron(2.50 l ha^{-1})	95.60a	331.0a	11.79a	48.00 a	2.52a	47.90a	11950a	5775a	49.82a
S.E± =	1.1040	1.8992	0.0592	0.5188	0.1507	5. 5993	41.261	94.475	0.5695
LSD $_{0.05}$ =	2.4523	4.1382	0.1367	1.0968	0.3307	12. 072	88.590	198.28	1.4191

DISCUSSION

Foliar fertilizers are an effective way to improve the nutrient uptake of plants, as they allow for the direct application of nutrients to leaves. Research carried out by (Rehman *et al*., 2019) found that foliar applications of boron increased wheat yield by 10.7 % and grain quality by improving protein content. Similarly, zinc foliar applications have been shown to improve wheat yield by increasing seed quality, specifically protein and micronutrient content (Riaz *et al*., 2016). Overall, the use of foliar fertilizers, specifically nitrogen zinc and boron, can significantly improve wheat growth, yield, and quality. Farmers and agronomists should consider including these fertilizers in their crop management practices to maximize productivity and profitability. The test results showed that trace elements are significant growth and yield characteristics of wheat Varity Kiran-95. The maximum plant height (cm), tillers m^{-2}, spike length (cm), grain per spike, grain weight per spike. Seed index (1000 grain weight), biological yield ha^{-1} grain yield ha^{-1}utilizing and harvest index, were observed with the application of Foliar nitrogen 1.0 % + foliar zinc (1.25 L ha^{-1}) + foliar boron (2.50 l ha^{-1}). Followed by with plant height (cm), tillers m^{-2}, spike length (cm), grain per spike plant height (cm), tillers m^{-2}, spike length (cm), grains per spike, grain weight per spike. Seed index (1000 grain weight), biological yield ha^{-1}, grain yield ha^{-1} and harvest index. However, minimum growth and yield traits were recorded in Untreated (Control) treatment. These findings are in alliance with (Rahman *et al*., 2014)

who found better crop responses with N spray as foliar spray. B also plays a significant role in grain setting. Current outcomes are in support of findings reported by (Tahir *et al*., 2009) who stated that grain spike-1 improved efficiently by the foliar spray of B. Result from this study are like those from (Aziz *et al*., 2019); Results of this study are supported by (Bameri *et al*., 2012) as they reported chlorophyll and Indole-acetic acid (IAA) formation were increased with the spray of boron which improved the height of plant. (Veesar *et al*., 2017) also observed increase in plant height with foliar spray of nitrogen.Noted that the foliar application of zinc improved (1000 grain weight) and (no. of grains spike^{-1}), (Grain yield), biological yield and zinc foliar applications have been shown to improve wheat yield by increasing seed quality specifically; protein and micronutrient content (Sharma *et al*., 2018). Number of grains spike^{-1},grain yield, biological yield and Zn use in grain and leaf flags, as well as wheat grain protein content (Yaseen *et al*., 2011). also indicated that foliar application of Zn in the tillering and ear stage significantly increases the yield of the wheat grain compared to the control. (Niyigaba et al., 2019) determined that the interactional impact of Zinc was significant increase the 1000 grain weight of wheat. The maximum weight of 1000 grains resulted from the folia application of zinc (Muhammad *et al*., 2006) reported that all aspects of the wheat crop were observed to be very significant when foliar application of zinc. (Nadim, et al., 2012) reported that the foliar application of Zn significantly increases the (plant height cm), (spike length cm),(grain spike^{-1}),(1000 grain weight g) and (grain yield (t ha^{-1}) of wheat. (Hafeez *et al*., 2013). Zinc foliar is effective in improving grain quality (Bameri *et al*., 2012). According to (Riaz *et al*., 2016) foliar Zn application had a considerable favorable influence on wheat grain production and its components. (Rehman *et al*., 2019) found that foliar applications of boron increased wheat yield by 10.7 % and grain quality by improving protein content. Similarly, zinc foliar applications have been shown to improve wheat yield by increasing seed quality, specifically protein and micronutrient content (Sharma *et al*., 2018). Overall, the use of foliar fertilizers, specifically nitrogen zinc and boron can significantly improve wheat growth, yield, and quality. Farmers and agronomists should consider including these fertilizers in their crop management practices to maximize productivity and profitability.

CONCLUSION

It is concluded that yield influencing characters of wheat variety KIRAN-95 occur significantly influenced by different soil applied micro-nutrients Based on the findings, it can be inferred that the yield and various factors contributing to the yields of wheat increased visibly affected by the application of micronutrients to the soil. The most effective combination for promoting the Wheat growth and grain production were discovered to be the application of micro-nutrients at a rate of 2000 g per hectare along with recommended dose of fertilizer (RDF).

CONFLICT OF INTEREST

The authors have not declared any conflict of interests.

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