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Growth, Yield and Quality Response of Three Wheat Varieties to Foliar Spray of Micro Nutrients

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Abstract. A field experiment was carried out to test the result of foliar application of micro nutrients on growth, quality and yield of three wheat verities. The trial was performed at Agronomic research area, University of Agriculture Faisalabad. Wheat varieties Jouhar 2016, Ujala 2015 and Gold 2016 were sown. Combination of micro nutrient (Zn 2%, B 0.5%, Fe 1%, Mn 1% and Cu 0.5%) with different amounts (no spray, water spray, 1000 mL/ha, 1250 mL/ha and 1500 mL/ha) was sprayed at booting stage. By results of this study,it is concluded that foliar spray of micro nutrients has significant effect on growth, yield and quality parameters. Statistically highly significant effect of 1250 mL/ha spray of micro nutrients mixture was observed on plant height (105.33 cm), grains/spike (48), grain yield (5336.3 Kg/ha), biological yield (12829 Kg/ha), carbohydrates (63.7%) and protein (11.4%) under V_2F_4 (Ujala 2015 + 1250 mL/ha micro nutrients).

Keywords: wheat varieties, foliar application, Zn, Fe, Mn and Cu

Introduction

Wheat is an important cereal crop of Pakistan. It is sown worldwide on wide range of different climatic conditions as compared to the other grain crops. Wheat is rich source of protein, vitamins, minerals and carbohydrates (Habib, 2009). Wheat contribution in diet is about 70-72% (Ali *et al*., 2013; Habbasha *et al*., 2013). Micro nutrients deficiency in world population is more than 40% (Faraji *et al*., 2014; Abbas *et al*., 2011). Growth, development and yield of wheat crop decreased due to deficiency of micro nutrients (Nadim *et al*., 2012; Cisse and Amar, 2000). In Pakistan about 1980 thousand hectares is wheat cultivated area and production is about 25.48 million tons. Agriculture's share in GDP is 18.9 % and out of which 9.1 % is contributed by wheat (Govt. of Pakistan, 2018). Different factors trigger yield losses like late sowing, non-judicious use of fertilizer, less irrigation, excess of weeds in fields and drought for long time. (Zeidan *et al*., 2010). These factors are responsible in various stages of crop and harmfully impact the crop yield. For various crops, micro and macro nutrients deficiencies have been examined (Hussain *et al*., 2006). To regulate different metabolic processes and yield, each micronutrient plays a vital role. Zinc, Boron, Iron, Copper, Manganese and Molybdenum are important for plant's optimum growth and development (Rawashdeh and Florin, 2015; Zain *et al*., 2015). Boron is most essential for reproductive parts, cell multiplication, cell stabilization, carbohydrate utilization and formation of cell wall in plants (Biswas *et al*., 2015; Khan *et al*., 2010). Fe functions in chlorophyll biosynthesis,respiration, chloroplast development, carbohydrate productions, enzyme activation, biological redox system and act as oxygen carrier in nitrogen fixation (Rasul *et al*., 2015). Manganese is compulsory for metabolic reactions, accelerates chlorophyll biosynthesis, enzyme activation, electron transport, progresses immune system, improves uptake of Ca and P and assists in photosynthesis (Abbas *et al*., 2011). Copper performs numerous metabolic processes, aids in physiological redox processes, lignification and improves the uptake of N and interfaces with the other micro nutrients (Monreal *et al*., 2015; Habbasha *et al*., 2013). Increase in crop production cause the micro nutrients deficiencies (Fageria *et al*., 2002). Pakistani soils have deficiency of different micro nutrients such as boron deficiency is about 51-60% (Rashid *et al*., 2002). Wheat production can be enhanced by enhancing the yield per unit area. Plants require proper amounts of macro nutrients and micro nutrients for better growth.

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Materials and Methods

A field trial was conducted at Agronomic Farm University of Agriculture, Faisalabad during growing season 2016-17. Texture of soil was sandy loam. An

experiment was laid out in randomized complete block design with factorial arrangements and three replications. Plot size was 6.0 m long x 2.25 m wide. Treatments were different wheat varieties: V_1=Jouhar 2016; V_2=Ujala 2015; V_3=Gold 2016 and foliar applications: F_1=control(no spray); F_2= water spray; F_3= 1000 mL/ micro nutrients (Zn 4.7%, B 1.0%, Fe 2%, Mn 2%, and Cu 3%)/ ha F_4= 1250 mL micro nutrients (Zn 4.7%, B1.0%, Fe 2%, Mn 2%, and Cu 3%)/ ha and F_5= 1500 mL micro nutrients(Zn 4.7%, B 1.0%, Fe 2%, Mn 2%, and Cu 3%)/ha. Only single dose of spray was applied at booting stage. Recorded data was analysed statistically by Fisher's analysis of variance technique and treatments means were compared by using least significant difference (LSD) test at 5% level of probability (Steel *et al*., 1997).

Results and Discussion

Plant height (cm). The data showed that the plant height was significantly affected by varieties, foliar spray of micro nutrients and their interaction. The response of different wheat varieties and foliar application was found significant. The maximum plant height (105.33 cm) was obtained in treatment V_1F_4 (Jouhar 2016 + 1250 mL/ha micro nutrients). and the Minimum plant height (94.33 cm) was obtained in V_3F_1 (Gold 2016 + Control), however, it is statistically at par with treatments V_2F_1 (Ujala 2015 + Control) and V_3F_2 (Gold 2016 + Water spray). The findings of present study are corelated with Khan *et al*. (2010) which stated increased plant height by the micro nutrient's spray applied at different stages. Hussain *et al*. (2005) and Nadim *et al*. (2012) also described the similar results.

Number of tillers. Numbers of total and productive tillers are statistically non-significant for different wheat varieties, foliar application and their interaction.

Number of grains per spike. Statistically a greater number of grains per spike (48) was found under V_2F_4 (Ujala 2015 + 1250 mL/ha micro nutrients) followed by V_1F_4 (Jouhar 2016 + 1250 mL/ha micro nutrients) that produced 46 grains per spike. The lowest number of grains per spike (37) was in V_1F_1 (Jouhar 2016 + control) and V_3F_1 (Gold 2016 + control) that is statistically similar with V_2F_1 (Ujala 2015 + control), V_1F_2 (Jouhar 2016 + water spray) and V_3F_2 (Gold 2016 + water spray). Tahir *et al*. (2009) represented that foliage use of micro nutrients efficiently improved grains per spike. Micro nutrients mixture enhanced the grains per spike in wheat (Yaseen *et al*. 2011). Same results were described by Khan *et al*. (2010).

1000- grain weight (g). Treatment V2F4 (Ujala 2015 + 1250 mL/ha micro nutrients) gained significantly maximum 1000-grain weight (49 g). However, the lowest 1000-grain weight (41 g) was found under the treatment V_3F_1 (Gold 2016 + control) that is statistically at par with treatments V_1F_1 (Jouhar 2016 + control) and V_2F_1 (Ujala 2015 + control). The findings are corelated with Yaseen *et al*. (2010). The results are also considered by Kassab *et al*. (2004) and Torun *et al*. (2001) which stated that thousand grain weight in case of wheat was significantly increased by foliar application zinc.

Grain yield (Kg/ha). The treatment V2F4 (Ujala 2015 + 1250 mL/ha micro nutrients) produced statistically highest grain yield (5336.3 Kg/ha) followed by V_3F_4 (Gold 2016 + 1250 mL/ha micro nutrients). Whereas the lowest grain yield was showed under response of V_3F_1 (Gold 2016 + control) that is statistically same with treatments like as V_1F_1 (Jouhar 2016 + control), V_2F_1(Ujala 2015 + control) and V_3F_2 (Gold 2016 + qater spray). Yaseen *et al*. (2010) stated that foliar use of all the nutrients cause enhance 24-38% yield of the wheat crop.

Biological yield (Kg/ha). The treatment V_2F_4 (Ujala 2015 + 1250 mL/ha micro nutrients) produced maximum biological yield (12829 Kg/ha). The lowest biological yield (9946 Kg/ha) was accumulated in treatment V_3F_1 (Gold 2016 + control) that is statistical similar with treatments V1F1 (Jouhar 2016 + control), V_2F_1 (Ujala 2015 + control), V_1F_2 (Jouhar 2016 + water spray) and V_3F_2 (Gold 2016 + water spray) which produced 10686 Kg/ha, 10484 Kg/ha, 10583 Kg/ha and 10538 Kg/ha respectively. The conclusions are union with Khan *et al*. (2010) and Hussain *et al*. (2005) they stated that total biomass enhanced with the foliar nourishing of micro nutrients. The results are also in line with Esfandiari *et al*. (2016).

Straw yield (Kg/ha). Treatment V_2F_4 (Ujala 2015 + 1250 mL/ha micro nutrients) collected highest straw yield amount (7492.7 Kg/ha) that is statistically at par with treatments of V_2F_3 (Ujala 2015 + 1000 mL/ha micro nutrients), V_3F_4 (Gold 2016 + 1250 mL/ha), V_1F_4 (Jouhar 2016 + 1250 mL/ha), V_2F_5 (Ujala 2015 + 1500 mL/ha),V_3F_3 (Gold 2016 + 1000 mL/ha micro nutrients) and V_1F_3 (Jouhar 2016 + 1000 mL/ha micro nutrients).

However, the lowest straw yield (6222.7 Kg/ha) was exhibited in treatment V_3F_1 (Gold 2016 + control) that is statistically same with treatments V_1F_1 (Jouhar 2016 + control), V_2F_1 (Ujala 2015 + control), V_1F_2 (Jouhar 2016 + water spray), V_2F_2 (Ujala 2015 + water spray), V_3F_2 (Gold 2016 + water spray), V_1F_5 (Jouhar 2016 + 1500 mL/ha) and V_3F_5 (Gold 2016 + 1500 mL/ha).The findings of the current study are considered by El-Ghamry *et al*. (2009) who documented that micro-nutrients application improved straw yield in wheat. The same results are also presented by Ananda and Patil (2005).

Harvest index (%). Harvest index percent is the ratio of total biological yield to economic yield. Data revealed that regarding harvest index the maximum amount (41.65%) was observed in treatment V_2F_4 (Ujala 2015 + 1250 mL/ha micro nutrients) than all other treatments but this treatment effect was statistically not differ with V_1F_4 (Jouhar 2016 + 1250 mL/ha micro nutrients), V_3F_4 (Gold 2016 + 1250 mL/ha micro nutrients), V_1F_3 (Jouhar 2016 + 1000 mL/ha micro nutrients) and V_3F_3 (Gold 2016 + 1000 mL/ha micro nutrients). Whereas, the lowest harvest index percent (37.44%) was counted in treatment V_3F_1 (Gold 2016 + control) that is statistical at par with V_2F_1 (Ujala 2015 + control), V_1F_1 (Jouhar 2016 + control), V_1F_2 (Jouhar 2016 + water spray), V_2F_2 (Ujala 2015 + water spray) and V_2F_5 (Ujala 2015 + 1500 mL/ha micro nutrients). The findings of current study are correlated with Khan *et al*. (2010) as they have stated that harvest index enhanced with micro nutrients application. Same findings are also reported by Zain *et al*. (2015) too who stated that foliar use of micro nutrients increases the harvest index.

Protein contents (%). Treatment V_2F_4 (Ujala 2015 + 1250 mL/ha micro nutrients) statistically highest protein contents (11.4%). Minimum protein percentage (9.0%) was recorded under treatment of V_3F_1 (Gold 2016 + control) that is statistically similar with treatment V_1F_1 (Jouhar 2016 + control). Micro nutrients contributions in physiological procedures plants like amino acid

Table 1. Individual comparison of treatment means

Treatments	Plant height (cm)	No. of tillers/m	No. of productive tillers/m^2	No. of grains per Spike	1000-Seed weight
V_1-Jouhar-2016	102.80 A	306.27	41.60 AB	301.80	45.20 AB
V_2- Ujala-2015	98.73 B	307.00	43.00 A	304.27	45.86 A
V_3- Gold-2016	96.47 C	306.53	41.20 B	303.47	44.66 B
LSD value at 5%	0.82	NS	NS	1.48	0.72
F_1-Control	97.00 C	306.33	37.33 D	300.22	41.66 E
F_2-Water Spray	98.00 C	306.22	39.66 C	303.89	44.44 D
F_3- 1000 mL micro nutrients/ha	99.56 B	307.89	44.00 B	305.00	46.44 B
F_4- 1250 mL micro nutrients/ha	102.22 A	308.78	46.66 AB	305.78	48.22 A
F_5- 1500 mL micro nutrients/ha	99.89 B	303.78	46.67 A	301.00	45.44 C
LSD value at 5%	1.07	NS	NS	1.91	0.93
$V_1 \times F_1$	101.33 bc	306.00	37.00 g	293.00	41.66 fg
$V_1 \times F2$	101.67 b	307.00	39.00 e-g	305.00	45.00 e
$V_1 \times F3$	103.00 b	307.00	44.00 b-d	306.00	46.33 c-e
$V_1 \times F4$	105.33 a	307.00	46.00 ab	304.33	48.00 ab
$V_1 \times F5$	102.67 b	304.00	42.00 c-e	300.67	45.00 e
$V_2 \times F_1$	95.33 fg	306.00	38.00 fg	303.33	42.33 fg
$V_2 \times F_2$	97.33 e	306.00	41.00 d-f	303.67	45.33 e
$V_2 \times F_3$	99.33 d	307.33	45.00 a-c	304.67	47.00 b-d
$V_2 \times F_4$	102.00 b	311.00	48.00 a	307.67	49.00 a
$V_3 \times F_5$	99.67 cd	304.67	43.00 b-d	302.00	45.66 de
$V_3 \times F_1$	94.33 g	308.67	37.00 g	304.33	41.00 g
$V_3 \times F_2$	95.00fg	305.67	39.00 e-g	303.00	43.00 f
$V_3 \times F_3$	96.3 ef	307.67	43.00 b-d	304.33	46.00 de
$V_3 \times F_4$	99.33 d	308.33	46.00 ab	305.33	47.66 a-c
$V_3 \times F_5$	97.33 e	302.67	41.00 d-f	300.33	45.66 de
LSD value at 5%	1.85	NS	NS	3.31	1.60

Table 2. Individual comparison of treatment means

Treatments	Grain yield (Kg/ha)	Biological Yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index	Protein content (%)	Carbohydrates (%)
V_1-Jouhar-2016	4424.9 AB	11145 B	6719.6 B	39.61	10.04 B	62.12 B
V_2- Ujala-2015	4555.0 A	11624 A	7069.4 A	39.09	10.28 A	62.36 A
V_3- Gold-2016	4314.0 B	11057 B	6742.7 B	38.93	9.98 B	61.92 C
LSD value at 5%	153.08	354.19	257.31	NS	0.11	596.26
F_1-Control	3848.7 E	10205 D	6356.8 C	37.71 D	9.13 E	60.76 E
F_2-Water Spray	4065.6 D	10664 C	6598.BC	38.11 CD	9.54 D	61.20 D
F_3- 1000 mL micronutrients/ha	4755.2 B	11901 B	7145.9 A	39.97 B	10.53 B	62.96 B
F_4- 1250 mL micronutrients/ha	5171.1 A	12498 A	7326.6 A	41.37 A	11.03 A	63.40 A
F_5- 1500 mL micronutrients/ha	4316.0 C	11108 C	6792.0 B	38.89 BC	10.26 C	62.33 C
LSD value at 5%	197.62	457.26	332.18	1.13	0.14	769.76
$V_1 \times F_1$	3876.0 hi	10186 de	6310.0 e	38.06 ef	9.10 hi	60.80 gh
$V_1 \times F_2$	4070.0 gh	10583 de	6537.7 de	38.43 ef	9.40 fg	61.10fg
$V_1 \times F_3$	4745.0 c-e	11713 b	6967.7 a-d	40.54 a-d	10.50 cd	63.00 cd
$V_1 \times F_4$	5170.3 ab	12411 ab	7240.7 ab	41.57 ab	10.90 b	63.40 ab
$V_1 \times F_5$	4263.3 fg	10830 d	6567.0 c-e	39.38 c-f	10.30 de	62.30 e
$V_2 \times F_1$	3946.7 g-i	10484 de	6512.7 de	37.65 f	9.30 gh	60.90 gh
$V_2 \times F_2$	4113.3 gh	10870 cd	6756.7 b-e	37.84 ef	9.63 f	61.40 f
$V_2 \times F_3$	4884.0 b-d	12306 ab	7422.3 a	39.689 b-e	10.70 bc	63.10 bc
$V_2 \times F_4$	5336.3 a	12829 a	7492.7 a	41.65 a	11.40 a	63.70 a
$V_3 \times F_5$	4494.7 ef	11632 bc	7137.7 a-c	38.70 d-f	10.40 d	62.70 d
$V_3 \times F_1$	3723.3 i	9946 e	6222.7 e	37.44 f	9.00 i	60.60 h
$V_3 \times F_2$	4013.3 gi	10538 de	6524.7 de	38.07 ef	9.60 f	61.10 fg
$V_3 \times F_3$	4636.7 de	11684 b	7047.7 a-d	40.544 a-d	10.40 d	62.80 cd
$V_3 \times F_4$	5006.7 a-c	12253 ab	7246.3 ab	40.88 a-c	10.80 b	63.10 bc
$V_3 \times F_5$	4190.0 f-h	10862 cd	6672.3 b-e	38.58 ef	10.10 e	62.00 e
LSD value at 5%	342.29	792.00	575.36	0.87	0.25	1333.3

biosynthesis, activation of enzymes, and starch utilization, improved the accumulation of assimilates in seeds, which results in more protein contents in grain (Rasul *et al*., 2015; Khan *et al*., 2010).

Carbohydrate concentration (%). Carbohydrate concentration revealed that statistically significant effect of foliar response of wheat varieties on concentration of carbohydrates. Maximum concentration (63.7%) was found in treatment V_2F_4 (Ujala 2015 +1250 mL/ha micro nutrients) followed by V_3F_4 (Gold 2016 + 1250 mL/ha micro nutrients) that is obtained (63.1%) carbohydrates. On the other hand, the statistically lowest carbohydrates concentration was gathered under treatment V_3F_1 (Gold 2016 + control) that is statistically at par with treatments V_1F_1 (Jouhar 2106 + control) and V_2F_1 (Ujala 2015). The micro nutrient plays a vital role in several carbohydrate production, metabolic reactions, nitrogen fixation acts as an oxygen carrier, membrane integrity, starch utilization, in enzyme system acts as a co-factor and phytochrome activities (Monreal *et al*., 2015; Bameri *et al*., 2012).

Conclusion

This study concluded that foliar application of micro nutrients mixture (@ 1250 mL/ha) on wheat varieties produced higher yield and better quality of grains.

Conflict of Interest. The authors declare no conflict of interest

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