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Research Article

Growth and yield of barley varieties response to micro nutrients

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Abstract

In Agriculture practices fertilizer management is an important source to improve yield. Among fertilizer application methods, one of the most important methods of application is foliar application because foliar nutrients facilitate easy and quick consumption of nutrients. Keeping the important of foliar application in view the present study was conducted to evaluate the "Growth and yield of barley varieties response to micro nutrients" study was conducted at Bacha Khan Agricultural Research Farm, Bacha Khan University Charsadda, Khyber Pakhtunkhwa Pakistan, during the year 2016-17. Four barley genotypes [Sanober, Awaran-2002, Bajaur-2000, AJJ] and foliar application of two micronutrients Zn and Cu [Control=water spray, Zn=4 kg ha^{-1}, Cu=1.0 kg ha^{-1}, Zn+Cu =4 kg Zn ha^{-1}+1.0 kg Cu ha^{-1}] were tested in the experiment. The experiment was laid out in a randomized complete block design (RCBD) replicated three times. The plot size 1.8m x 3m, having 30 cm row to row distance was used. It is concluded from the experiment that variety AJJ produce maximum (tillers $plant^{-1}$) (7), plant height (89 cm), long spikes (9 cm), thousand grains weight (41 g) and grain yield (3912 kg ha^{-1}), while in remaining three varieties variety Sanober produce maximum plant height (83 cm) and thousand grain weight (40 g), while variety Bajaur-2000 produced minimum plant height (82 cm), spike length (7 cm), thousand grain weight (37 g) and grain yield (3556 kg ha^{-1}). Application of micronutrients revealed that combine application of Zn+Cu improved yield and yield components of barley. Maximum tillers $plant^{-1}$ (7), plant height (95 cm), spike length (10 cm), thousand grains weight (42) and grain yield (4000kg ha^{-1}) was produced by combine application of Zn+Cu followed by sole Zn and Cu application as compared to control. Therefore it can be concluded from the results that Ajj barley variety performed better in terms of grain yield and with the combine application of Zn+Cu increase all yield components.

Keywords: Barley; Foliar Application; Genotype; Micronutrients (Zn + Cu); Varieties

Introduction

Barley is (*Hordeum vulgare L.)* annual winter seasonal and fast growing crop. It is used mostly for forage and will also use as a cover crop to maintain soil health and productivity through nitrogen fixation process **[1]**. It is important for many poor farmers because it is essential for the livelihood. Due to the resistance to environment and drought wheat could be replace by it, because it give better result in areas where rainfall is low and other crop fails like wheat **[2]**. It is one of the

important cereals crop in world for primary food source. In African countries it is consider the main and key source for food. It is cultivated for both grains and fodders purposes while in our country it mainly grown for animal feed or fodder purposes [3]. It is cultivated in our country on about 86thousand hectare area and production was 81.5 Thousand T while in our province (KPK) it is grown on 30.5 thousand hectare area while the production was maintain from the areas was 27.5 tons during 2012-13 [4]. It is grow mostly in rain fed areas because it shows more resistance as compare to wheat, but the production from irrigated areas is greater than none irrigated or rain fed areas [5]. Fertilizers application shows no effect or little on local varieties while on other hand some improved varieties which show resistance to adverse condition and the irregular condition of the environment [3]. Selection of well develop and improved and high yielding genotypes or varieties and wide range of adaptation to soil and environment is very necessary for maintaining more yield, or to increase yield [6, 7].Selection of variety is important and selection is based on different characteristics such as quality production, bio yield, and the main factor is adaptability to environment [8]. Fertilizers management is also play important role to improve production because improper and imbalance or inadequate use of chemicals or fertilizer can reduce yield so the use of optimum and balance proportion with proper method give better and positive result in form of yield [9]. Low yield in our country and in our province is attributing to different factor such as low quality seeds, high yielding varieties, plant protection measures, chemical fertilizers and proper or optimum seed rates levels. Selection of good or attractive assortments is a vital monetary administration choice for a particular region [10, 11]. Different varieties are selected on the basis of different characteristics like disease resistance, quality production and seed production, vivacious development and spike length, however no assortment contains every one of the qualities or requirement to fulfill the demands [12] because different varieties give different result at different location due to it is genetic variation but best choice in selection of varieties is based on higher yields, more tolerance or resistance to unwanted conditions and shorter maturity [13]. Every crop cultivar has it is own needs according to a particular environmental condition to maintain maximum yield and growth [14]. Micro nutrients are also very important and the agriculture soil show deficiency of iron, zinc and copper [15]. Primary deficiency of micro nutrients is may be the low rate or amount of MN in soil or may be MN present in the soil but due to various factor it is availability to plant is reduces [16]. Micro nutrients like zinc, iron, copper, manganese, boron, molybdenum and chlorine are require in very low amount but there availability is important for plant because it take part in different life process of plant [17]. [18] Stated that foliar application of MN at tillering, booting and jointing stages increase yield while zinc and copper play an important role to enhance different process in plant physiology like enzymatic activities and others physiological process which redirect positive effect on yield. [19] Reported the management of zinc and copper and stated that zinc and copper take a part in very important physiological process and it is require in very small amount or concentration (5-100 mg kg^{-1}). [20] Found that zinc application affected different parameters of plant such spike length, number of spikelet $spike^{-1}$, 1000 grains weight (g) and straw yield [21]. Reported that Zn spray increased grain yield and others relevant parameters of plants. [22] Resulted that foliar application of micronutrients give better result in term of different parameter of plant and increase yield and [23] discovered a huge increment in

number of spikes meter per square, grains in one spike, thousand grains weight, natural yield and grain yield for the use of Zn and boron as contrast with control **[17]** it also help in maintenance of photosynthesis and the regulation of transpiration **[24]**. It helps and plays an important role in transpiration metabolism and other physiological process in plant **[15]**. Micro nutrients deficiency affect greatly plant yield and quality and also affected domestic animals and humans health **[25]**.Thus keeping in view the importance of micronutrient of (Zn and Cu) in crop production and to maintained quality productions the present experiment was conducted to maintained quality production in barley from Zn and Cu by foliar application.

Materials and methods

A field test was done on growth and yield of barley varieties response to micro nutrients at Bacha Khan Agricultural Research Farm, Bacha Khan University Charsadda, Khyber Pakhtunkhwa Pakistan, during 2016-17. Four barley varieties [Sanober, Awaran-2002, Bajaur-2000, AJJ] and two micronutrients Zn and Cu [Control=water spray, Zn=4 kg ha^{-1}, Cu=1.0 kg ha^{-1}, Zn+Cu =4 kg Zn ha^{-1}+1.0 kg Cu ha^{-1}] were tested in the experiment by foliar application. RCB design replicated three times was used. Plot size (2m x 3m) having 30 cm R-R distances was used. Micronutrients were applied before boot stage and other agronomic practices were uniformly maintained. Data were collected on tillers $plant^{-1}$, plant height (cm), spike length (cm), thousand grains weight and grain yield (kg ha^{-1}). Number of tillers $plant^{-1}$were noted randomly five tillers of plant in every plot and then average. Height of plant data was recorded in randomly selected 10 plants in every subplot with meter rod. Spike length was measured in randomly selected ten spikes from each plot from end to top without awns length and was averaged. 1000-grains weight was recorded on electronic weight balance after counting TGW from the seed lot of every sub-plot. Central 4 rows of every plots were harvested and dried and the grains weight were recorded and then converted in to kilogram per hectare using formula

G yield = Grain y x 10000/Row-Row Distance (m) x Row length (m) x Number of Rows. Analysis of the data was done with CR Design analysis, and if in case the data was found significant than mean comparison was applied and using LSD test for comprising the means for statistical difference **[26]**.

Results and discussion

Tillers $plant^{-1}$

Data regarding tillers $plant^{-1}$ of barley varieties and micro nutrients is in (Table 1). Analysis of the data verify that barley varieties, MN and interaction MN x V differed significantly. Barley variety AJJ produced more tillers $plant^{-1}$ (7) as compare to others varieties. The difference found in term of tillers $plant^{-1}$ among barley varieties might be due to variation in the genetic makeup or genetic characteristics and environmental affect, the result are in line with the finding of **[27]** who also reported similar result. Application of MN revealed that more tillers $plant^{-1}$ (7), were recorded with Zn and the mix treatment of Zn+Cu in combination. Control and Cu application lead to lower tillers $plant^{-1}$(5 and 6 respectively). Finding are agreed with the result of **[15, 28]** who also reported that foliar application of MN increased tillers $plant^{-1}$. In case of interaction MN x V more number of tillers $plant^{-1}$ were recorded with the combine application of Zn+Cu, while among varieties variety AJJ produced more tillers $plant^{-1}$ (Figure 1).

Plant height (cm)

Barley varieties, MN and MN x V interaction significantly affected plant height (cm) (Table 1). Maximum height (89 cm) were keep by variety AJJ, as compare to others varieties, while variety Awaran-2002 and

Bajaur-2000 resulted smaller plant height (80 cm, 81 cm) respectively. Variation in plant height might be due to the inherited characters and it is also reported by [29, 30] and verify the same result in plant height. Regarding foliar application of MN, taller (89 cm) plant height was produced with the combine application of Zn+Cu, while Zn and Cu recorded (84 cm, 82 cm) as compare to control (78 cm). Finding are agreed with the result of [31, 32] who also report that plant height improved with the addition of these micro nutrients. The interaction of Mn x V found no significant.

Table 1. Tillers plant^{-1}, Plant height (cm) of barley varieties as affected by micro nutrients

Treatments	Tillers Plant^{-1}	Plant height (cm)
Barley Varieties		
Sanober	6c	83b
Awaran-2002	6b	80c
Bajaur-2000	6c	82c
Ajj	7a	89a
LSD Value	**0.31**	**1.72**
Micro Nutrients		
Control	5c	78d
Zn	7a	84b
Cu	6b	82c
Zn+Cu	7a	89a
LSD Value	0.31	1.72
LSD Value for interaction	**0.63**	
MN x V	**	**ns**

Means esteems with various letters differ significantly according to LSD test (P<0.05) while non-significant difference and * at P < 0.05 level, respectively

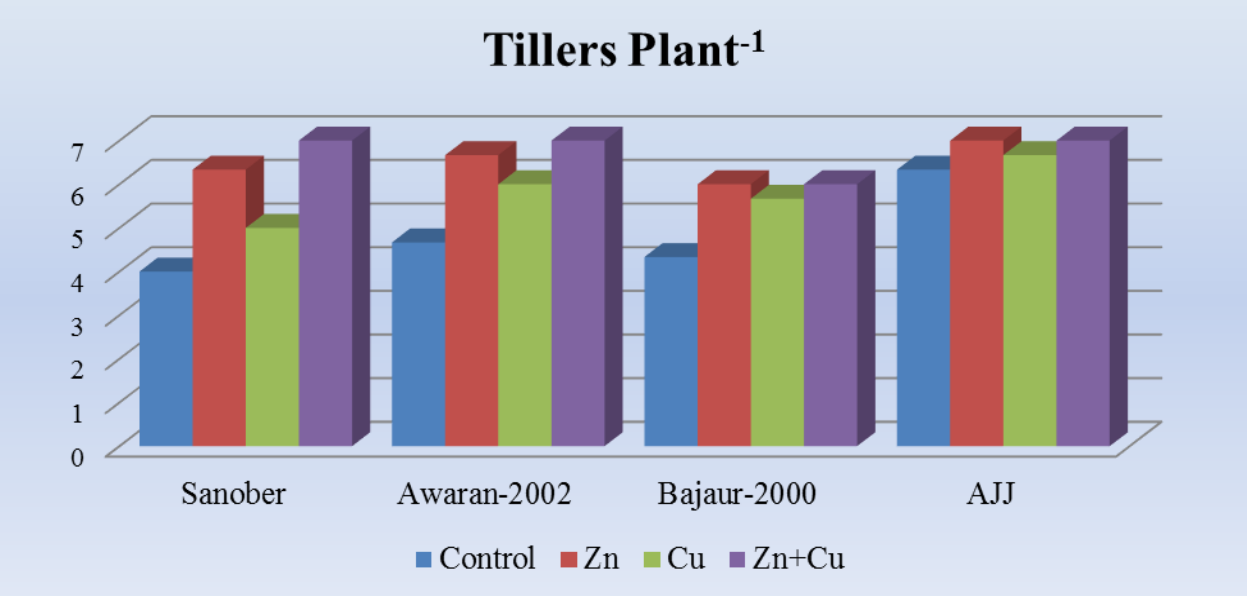

Figure 1. Tillers plant^{-1} of barley varieties as affected by micronutrients

Spike length (cm)

Table 2 showed data of barley varieties and micro nutrients. It was confirm from the statistical investigation of the data that spike length significantly varied by varieties, micro nutrients and MN x V. Variety AJJ produced maximum length (9 cm) as compare to others varieties, while Bajaur-2000 recorded minimum (7 cm). The difference in spike length among barley varieties might be due to the genetic variability. These results are agreed with the findings of **[33]** who reported that spike characters varied significantly due to varietal effect. Use of zinc+Cu in combination achieved maximum spikes L (9 cm) as compared to Zn or Cu which give (8 and 7cm length) respectively, however, shorter length of spikes were noted in control plots. The impact may be the reason for zinc impact on digestion and other bio-exercises and invigorating impact of copper on protein exercises which enhance growth of plant **[34]**. These finding are agreed with **[35]**. Among interaction between MN x V, spike length was enhanced significantly, between varieties, variety AJJ with combine application of Zinc and Copper give positive result (Figure 2).

Thousand grains weight (g)

Thousand grains weight data are presented in (Table 2). Statistical analysis of the data revealed that foliar application of micro nutrients, and varieties significantly affect thousand grains weight, while the interaction MN x V found non-significant. Weight per thousand grains was highest in variety AJJ as compare to others varieties. Among the remaining varieties, variety Sanober produced heaviest (40 g) grains weight as compare to Awaran-2002 and Bajaur-2000 which produced (39, 37 g respectively). Difference found in 1000-G weight might be the effect of environment on and the genetic variation between the varieties. Similar finding were reported by **[29, 36]** who reported significant variability in varieties for yield & yield related components. Foliar application of Zn and Cu significantly enhanced thousand grains weights, the combine application of Zn+Cu produced maximum (42 g) as compare to control (37 g), while Zn and Cu produced (39, 38 gram, respectively). Similar result was found by **[15]**. Regarding interaction MN x V found non-significant.

Grain yield (kg ha^{-1})

Grain yield is the target and final goal of any crop experiment. Barley varieties showed significant distinction for grain yield in (Table 2). Maximum (3912 kg ha^{-1}) grain yield was produced by variety AJJ as compared to other varieties, & minimum (3556 kg ha^{-1}) were maintained by variety Bajaur-2000. The distinction in grain yield among wheat assortments may be because of genotypic contrast and imposition of decapitation stress and other ecological factors **[29]**. Our results are also in accordance with the investigations of **[36]** who found significant variation in grain yields of wheat cultivars. Grain yield significantly increased by foliar application of Zn and Cu, maximum grain yield (4000 kg ha^{-1}) were maintained with the sole application of Zn+Cu, while minimum (3471 kg ha^{-1}) was observed in control treatment. Zinc play a vital role in increasing grain yield of wheat because zinc take place in many physiological process of plant such as chlorophyll formation, stomata regulation, starch utilization which enhance grain yield of wheat The finding is accordance with the result of **[37]**. Interaction among MN x V were non-significant.

Table 2. Spike length (cm), thousand grains weight (g) and grain yield (kg ha^{-1}) of barley varieties as affected by micro nutrients

Treatments	Spike length (cm)	Thousand grains weight (g)	Grains yield (kg ha^{-1})
Barley Varieties			
Sanober	8c	40d	3746b
Awaran-2002	8b	39b	3661bc
Bajaur-2000	7d	37c	3556c
Ajj	9a	41a	3912a
LSD Value	**0.31**	**0.75**	**120.59**
Micro Nutrients			
Control	7d	37b	3471d
Zn	8b	39c	3775b
Cu	7c	38d	3628c
Zn+Cu	9a	42a	4000a
LSD Value	**0.31**	**0.75**	**120.59**
LSD Value for interaction	**0.63**		
MN x V	*	**ns**	**ns**

Means esteems with various letters differ significantly according to LSD test (P<0.05) while non-significant difference and * at P < 0.05 level, respectively

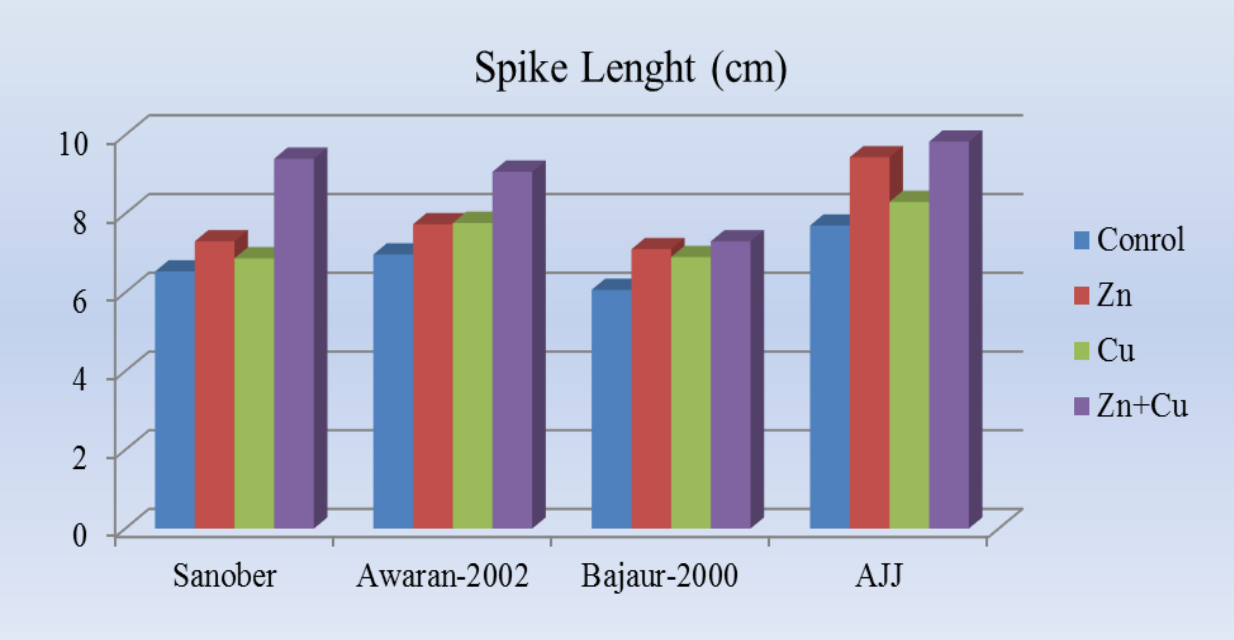

Figure 2. Spike Length (cm) of barley varieties as affected by micronutrients

Conclusion and recommendations

It has been finished up from the above outcomes that foliar utilization of micronutrients (Zn & Cu) in combination produced higher, grain yield in barley varieties, barley variety AJJ performed better in terms of grain yield than others barley varieties. Therefore AJJ barley variety and

the combine application of Zn+Cu are recommended for higher production of barley.

Authors' contributions

Conceived and designed the experiments: M Ishaq & M Ahmad, Performed the experiments: W A Shah, S Din, M Jawad, A Khan & SN Khan, Data collection and field inspections: M Ishaq, Zahid Hussain, W A Shah, R Amin & M Ahmad, Statistical Analysis of the data: M Ishaq & M Ahmad, Contributed reagents/ materials/ analysis tools: Z Hussain & R Amin, Wrote the paper: M Ishaq & M Ahmad.

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