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INFLUENCE OF FOLIAR NUTRIENTS APPLICATION ON GROWTH AND YIELD OF ONION GROWN IN NUTRIENT DEFICIENT SOIL

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Abstract

Commercially available foliar spray labeled as 'Planto-fuel' increased significantly ($p \leq 0.05$) most of the growth traits *viz*., leaf length, bulb diameter (7.6 cm), bulb length (5.9 cm), leaves fresh weight/plant, neck fresh weight/plant, bulb fresh weight/plant (166.6 g) and plant fresh weight. It also produced the maximum yield (14.2 tons/ha) while the basal application of DAP significantly increased the number of leaves/plant and 2nd best results in yield whereas the lowest yield was observed through water spray. It is observed that the foliar application of micronutrients mixture in combination with nitrogen is the most suitable method to increase the onion production.

Introduction

Onion (*Allium cepa* L.) the "Queen of the Kitchen" is among the most commercially important vegetables belonging to Alliaceae. It grows best in well drained, loose and high fertile soil with pH between 6.2 and 6.8 and plenty of organic matter (Raemaekers 2001). Irrigation also plays a vital role in production of onion. From 15 to 30 cm moisture content must be kept up for maximum yield. The best climatic condition for onion growth is the dry season (Norman 1992).

Seventeen elements are required by plants for normal growth. C, H and O are taken from water and air. Other nutrients are obtained from soil (Tahir 1980). The presence of nutrients like nitrogen, phosphorus, potassium, sulfur and magnesium are essential in balanced form for major processes of development of plants and production of yield (Randhawa and Arora 2000). Plants also require the trace elements (B, Cu, Mn, Zn and Mo) for their normal growth and development (Kanwar and Randhawa 1967). In agriculture practices fertilizer is an important source to increase crop yields. Among fertilizer application methods, one of the most important methods of application is foliar nutrition because foliar nutrients facilitate easy and quick consumption of nutrients by penetrating the stomata or leaf cuticle and enters the cells (Latha and Nadanassababady 2003). The nutrients have one of the chief importance in improving quality and productivity of vegetables which require mineral nutrients in large amount. Due to continuous inorganic fertilizers consumption results in micronutrients deficiency, disproportion in physiochemical properties of soil and low production of crops. For that reason these minerals are applied as affliction foliar form (Jeyathilake *et al.* 2006). Foliar application of nutrients at proper growth phases is essential for their consumption and improved crop performance (Anadhakrishnaveni *et al.* 2004). The mineral nutrients assimilation rate by plants aerial parts is

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not only different among plant species but also among many different varieties of the same plant species (Wojcik 2004). It was found that during crop growth supplementary foliar fertilization increased plants mineral status and improved crop yields (Rahman *et al.* 2014a).

The present study was planned to conduct an experiment in farmer's field, Marghazar, Mansehra to investigate appropriate dose of foliar mineral nutrients application on growth and yield of onion (*Allium cepa* L.).

Materials and Methods

Field experiment was carried out in farmer's field, Marghazar, Mansehra in randomized complete block design RCBD with four treatments replicated three times during winter season of 2012/2013.

Soil samples were taken before sowing randomly from the experimental field from 0 to 15 cm and 15 to 30 cm in depth for physico-chemical analysis. Air dried soil (50 g) and 50 ml distilled water were added into a glass beaker. Mixture was made and allowed to stand for 1 hrs. Then, soil pH was measured by pH meter (McLean 1982). A representative random sample was analyzed for physical and chemical analysis at Land Resources Research Institute, NARC. The nitrogen was analyzed through Macro-Kjeldahl method (Paul and Berry 1921). Ammonium bicarbonate-diethylen triamin penta acetic acid (AB-DTPA) method was used to analyze both phosphorus and potassium (Soltanpour and Woekman 1979).

Table 1. Chemical analysis of soil sample pre-sowing of onion in farmer's field Marghazar showing the amount of NPK in mg/Kg in soil.

S.No	Sample Id (cm)	pH	NO_3-N	P	K	EC (dSm^{-1})
1.	0 - 15	6.6	5.5	0.87	112	0.37
2.	15 - 30	7.0	3.2	0.7	124	0.18

Table 2. Standard values of different nutrients in soil (mg/Kg).

S. No.	Elements	Low	Medium	High
1	N	≤ 10.00	11 - 20	21 - 30
2	P	≤ 03.00	04 - 07	08 - 11
3	K	≤ 60.00	61 - 120	121 - 181

In farmer's field Marghazar, the onion total number of plots was 15 and area of each plot was 1 m^2 and 1.5 ft path in between each plot was prepared. Onion plant to plant and row to row space was 15 cm. All the foliar applications were revised after 14 days of interval till maturity while basal placement of DAP was done single time. The applications were as follows: T_0; (H_2O spray), T_1; Planto-fuel (N + micronutrients) 6.177 liter + 1235.4 liter H_2O/ ha, T_2; DAP (Solid form) 123.5 kg /ha, T_3; Fozan (DAP foliar form and 2% N foliar form) DAP = 12.35 liter + 617.7 liter H_2O/ ha and N = 12.35 liter + 617.7 liter H_2O/ ha, T_4; K-sol (NPK 20 : 20 : 20) 6177.4 g + 1235.4 liter H_2O /ha.

Five plant samples of onion from each plot were collected after maturity to observe the following growth and yield attributes. Quantitative traits of onion were: plant height, number of leaves/plant, leaf length, neck length, bulb length, neck diameter, bulb diameter, leaves weight/plant, neck weight/plant, bulb weight/plant, plant weight and yield. All the data were statistically analyzed by computer program SPSS 16.0. The differences among the means were calculated using LSD test ($p \leq 0.05$). Means of competition indices were separated by standard error bars.

Results and Discussion

The results of soil analysis showed the pH, EC and nitrogen, phosphorus and potassium values. In soil samples, the N and P were found deficient while K was in normal quantity. Exact values of N, P and K in the soil samples of experimental field analyzed are given in Table 1. Soil nutrients standard value is given in Table 2 (Soltanpour 1985).

The analysis of variance of recorded data for height of onion plant trait at harvest showed non-significant differences in the applications except T_1 (Table 3). The mean square values of plant height of treated applications showed that T_1 attained maximum plant height (59.8 cm), followed by T_3 (58.6 cm). Applications T_2 and T_4 had an average of plant height (56.6 and 52.7 cm, respectively) while minimum plant height (49.4 cm) was noticed in T_0 application.

Analysis of variance for number of leaves/plant attribute in T_2 application showed highly significant differences (Table 3). The mean squares data of this trait of applied applications showed that T_2 had most number of leaves/plant (13.6) which was followed by T_1 (10.6) (Fig. 1). T_3 and T_4 applications showed results for number of leaves/plant (9.6) and (8.6) while minimum number of leaves/plant (7.6) was observed through T_0 application. These findings are in agreement with that of Habba (2003) who examined the foliage application of etherel on plant height, leaves number and leaves weight of onion.

Table 3. Effects of nutrient application on plant height, no. of leaves, leaf length, neck length, bulb length and neck diameter of onion.

Treatments	Plant height (cm)	No. of leaves	Leaf length (cm)	Neck length (cm)	Bulb length (cm)	Neck diameter (cm)
T_0	50.06 B	7.66 B	22.53 C	4.60 BC	4.20 C	11.83 B
T_1	59.86 A	10.66 AB	36.13 A	4.40 C	5.93 A	14.83 AB
T_2	56.60 AB	13.66 A	31.66 AB	5.60 A	5.20 AB	17.36 A
T_3	58.66 AB	9.66 B	32.46 AB	5.33AB	4.93 BC	15.66 AB
T_4	52.73 AB	8.66 B	29.80 B	4.73 BC	4.93 BC	16.50 A
LSD $_{(0.05)}$	3.7481	1.3166	2.2960	0.3540	0.3688	1.8779

Within each column, treatments carrying same superscript letter are not significantly different at 5% level.

Highly significant differences were observed in leaf length through T_1 application (Table 3). The mean square values of leaf length trait showed that T_1 had highest leaf length (36.1 cm), followed by T_3 (32.4 cm), whereas it was followed by T_2 and T_4 with a leaf length of 31.6 cm and 29.8 cm, respectively. The minimum leaf length (22.5 cm) was recorded in T_0. The present observations are in accordance with Singh and Chuare (1999) who reported that leaf length was significantly increased compared to that of control by nitrogen application (up to 150 Kg/ha). Contradictory results were also recorded by Tisdale *et al.* (1985) who concluded that the leaf length increased by the application of zinc which takes part in auxin metabolism and various other enzymatic reactions.

The analysis of variance for neck length of onion plant showed non-significant differences in the applications. The mean square values of neck length character of treated applications revealed that T_2 had highest neck length (5.6 cm) which was followed by T_3 (5.3 cm) whereas T_4 and T_0 were after it and had a neck length of 4.7 and 4.6 cm, respectively. The minimum neck length (4.4 cm) was noticed in T_1 (Table 3).

The mean squares values of bulb length trait among applied applications showed that T_1 had maximum bulb length (5.9 cm) and was followed by T_2 (5.2 cm), while T_3 and T_4 showed similar values for bulb length of (4.9 cm). The minimum observation for bulb length trait (4.2 cm) was noticed in T_0.

The mean square data of this attribute among treated applications showed that T_2 had maximum neck diameter (17.3 mm) and was followed by T_4 (16.5 mm) while T_3 and T_1 revealed the values for neck diameter of 15.6 and 14.8 mm, respectively. Minimum neck diameter value (11.8 mm) was recorded in T_0. El-Bassiony (2006) reported similar findings who stated that neck diameter, bulb diameter and total yield were significantly affected by the foliar treatment of K.

The analysis of variance showed that T_1 application had highly significant difference for onion bulb diameter trait (Table 4). The mean squares data of bulb diameter of applied applications showed that T_1 had highest bulb diameter (7.6 cm) followed by T_2 (6.9 cm) while T_4 and T_3 showed the data for bulb circumference of 6.4 and 6.2 cm, respectively. The minimum value for bulb diameter (4.9 cm) was noticed in T_0. The present findings are in agreement with Shafeek *et al.* (2013) who noticed that many bulb attributes like bulb length, bulb diameter, bulb weight, yield TSS and protein content was significantly improved by the treatment of etherel (200 ppm) (Table 3).

The mean square data of this trait among treated applications showed that T_1 had highest leaves weight/plant (37.3 g), followed by T_2 (36.6 g) while T_3 and T_4 showed results for leaves weight/plant (31 and 19 g) while minimum leaves weight/plant (15 g) was observed in T_0. These results are in contradiction with Abd El-Samad (2011) who reported that in second season of experiment the micronutrients application showed non-significant differences on the attributes such as number of leaves/plant, neck length and dry weight of leaves (Table 4).

The mean square data of this trait among applied applications showed that T_1 had a maximum neck weight/plant (7.2 g) and was followed by T_2 (7.1 g) while results for neck weight/plant trait in T_3 and T_4 observed were 5.5 and 3.7 g, respectively. Minimum observations were noticed in T_0 for neck weight/plant trait (2.9 g). The present results are in accordance with Abd El-Samad *et al.* (2011) who concluded significant differences were noted on neck fresh weight and whole plant in the first season while on plant height in the second season by the combined application of different N doses and foliar micronutrients (Table 4).

The mean square values among treated applications for bulb weight/plant showed that T_1 had a highest bulb weight/plant (166.6 g) which was followed by T_2 (135.6 g). T_3 and T_4 had an average bulb weight/plant (106.6 and 89 g, respectively) and the minimum bulb weight plant^{-1} (65.6 g) was noticed in T_0 application. Similar results were obtained by Satbir *et al.* (1989) who suggested that bulb fresh weight was significantly improved by zinc and boron application.

The mean square values of this quantitative character among applied applications showed that T_1 had maximum plant weight (212.3 g), followed by T_2 (181.3 g) while T_3 and T_4 are after it for plant weight of 140.6 and 123.3 g. The minimum recorded data for plant weight of onion (83.3 g) was scored by T_0 (Table 4). This result was supported by Kirkby and Romheld (2004) who reported that foliar spray of the micronutrients might increase plant growth attributes and act as components of cell wall and other membranes.

The mean square data of onion yield among applied applications revealed that T_1 had highest yield (19992.6 kg) and was followed by T_2 (19200.3 kg). Applications T_4 and T_3 had an average yield (16231.0 kg) and (16001.0 kg), respectively. Whereas minimum yield of onion (13001.0 kg) was recorded through T_0 application (Table 4). Foliar application of macro and micronutrients play an important role in the production of good crop and higher yield (Rahman *et al.* 2015). These findings are in agreement with Balemi *et al.* (2007); Biesiada and Kołota, (2009) who described that bulb yield of onion significantly increased by rate of nitrogen fertilization. Similarly, Sliman *et al.* (1999) and Alam *et al.* (2010) showed that foliage treatment of zinc and then iron mostly increased the bulb yield of onion. Similar findings were found by other researchers in common bean and for cauliflower (Rahman *et al.* 2014b, c and Rahman *et al.* 2014d).

Table 4. Effects of nutrient affliction of response of neck weight, onion bulb weight, plant weight and bulb yield of onion.

Treatments	Bulb diameter (cm)	Leaves weight (g)	Neck weight (g)	Bulb weight (g)	Plant weight (g)	Bulb yield (kg/ha)
T_0	4.98 D	15.00 B	2.93 A	65.67 E	83.33 D	13001.00 D
T_1	7.65 A	37.33 A	7.20 A	166.67 A	212.33 A	19992.67 A
T_2	6.95 B	36.66 A	7.10 A	135.67 B	181.33 B	19200.33 B
T_3	6.29 BC	31.06 A	5.53 A	106.67 C	140.67 C	16001.00 C
T_4	6.17 C	19.0B	3.70 AB	89.00 D	123.33 C	16231.00 C
LSD $_{(0.05)}$	0.2940	3.7291	0.8600	5.8376	9.1948	26.734

Within each column, treatments carrying same superscript letter are not significantly different at 5% level.

Fig. 1. Effects of different nutrients application on growth of onion.

Foliar spray with 'Planto-fuel' containing (N+ Zn, Fe, Mg, Cu, B and Mn mixture) showed highest significant results in the growth and yield attributes, leaf length, bulb diameter (7.6 cm), bulb length (5.9 cm), leaves weight/plant, neck weight/plant, bulb weight/plant (166.6 g), yield (14.2 t/ha). The basal application of DAP + urea significantly increased the number of leaves /plant.

From the present investigations it may be concluded and recommended that the foliar application of micronutrients mixture in combination with nitrogen is the most suitable method to improve the growth and yield of onion.

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