Australian Journal of Basic and Applied Sciences, 5(5): 96-103, 2011
ISSN 1991-8178

Influence of Urea Fertilization and Foliar Application of Some Micronutrients on Growth, Yield and Bulb Quality of Onion

[1]Abd El-Samad, E.H., [2]R.Kh.M. Khalifa, [3]Z.A. Lashine and [1]M.R. Shafeek

[1]Vegetables Crop Research Dept. National Research Centre, Dokki, Cairo, Egypt.
[2]Fertilization Technology Dept., National Research Centre, Dokki, Cairo, Egypt.
[3]Horticulture Dept., Fac. Agric. Ain Shams Univ., Shoubra El-Kheima, Cairo, Egypt.

Abstract: Field experiments were conducted during 2008/2009 and 2009/2010 seasons in newly sandy reclaimed soil to investigate the effect of different nitrogen fertilization rates 60, 90 and 120 unit N/fed. as urea fertilizer and foliar spraying of micronutrients Fe, Zn or Mn with a dose of 2 ml/l for three times in 30 days interval on plant growth, bulb yield and quality as well as mineral contents of onion plants (*Allium cepa* L. cv. Giza 20). The obtained results clearly indicated that using the highest rate of nitrogen fertilization significantly increased plant vegetative growth characters, total yield, TSS and mineral contents in bulb tissues compared to the lowest rate in both seasons. Also, obtained results revealed that foliar spraying of micronutrients had a positively significant effect on plant growth, yield, quality and mineral contents of onion plants. Foliar spraying of Zn gave the superiority of all measured parameters than other treatments. Concerning the interaction effect between nitrogen fertilization rates and foliar spraying of micronutrients, no significant differences were recorded on all measured parameters in both seasons, except for fresh weight of neck, whole plant, bulb length, diameter, TSS, Fe content in the first season and plant length, bulb length in the second season. The results suggested that the best results were obtained when onion plants fertilized with nitrogen at rate of 120 unit N/fed. plus foliar spraying with Zn under newly sandy reclaimed soil conditions.

Key words: Onion, Urea, Foliar spraying, Fe, Zn, Mn, Bulb yield and quality, Mineral contents.

INTRODUCTION

Onion (*Allium cepa* L.), belonging to the family *Alliaceae,* is one of the most important vegetable crops grown in Egypt. It is considered as the third crop after tomato and potato. The word “onion” is derived from Latin and means “large pearl”. The onion was compared to a pearl not only for its shape but also for its highly valuable nutritional and medicinal quality. Egypt, is considered as one of the main producer countries for dry onion bulbs, since it ranked as the seventh country. The total production area amounted by about 53000 hectares, yielded about 1.74 million tons with an average of 33 tons/hectare according to FAOSTAT (2008).

Nitrogen is an essential element in all living systems and a major component of protein and chlorophyll. Under many agricultural settings, nitrogen is the limiting nutrient for high plant growth and yield (Marschner, 1995). It is required by plants in much greater amounts than all the other soil supplied nutrients (Tisdale *et al.,* 1985).

Although nitrogen nutrient is an essential to increase bulb size and yield, onion growers believed that excessive nitrogen prevented proper ripening and resulted in bulbs with poor storage quality (Sheikh *et al.,* 1987). Supplying vegetable crops with an optimum nitrogen level was proved to be very essential for plant growth and production of high yield as well as improving the quality of onion bulbs (Abu-Rayyan and Al-Hadidi, 2005; Balemi *et al.,* 2007; Biesiada and Kołota, 2009 and Shaheen *et al.,* 2010). In addition, Al-Moshileh (2002) concluded that using 200 kg N/ha gave the highest onion yield and an excess application of nitrogen over 200 kg N/ha will not be economically feasible for higher crop production.

Even though, micronutrients are needed by the plants in a minor quantities and present in plant tissue in quantities measured in parts per million but it is involved in a wide variety of metabolic processes and cellular functions within the plants. Also, they work as a co-enzyme for a large number of enzymes. In addition, they play an essential role in improving yield and quality, and highly required for better plant growth and yield of

Corresponding Author: Abd El-Samad, E.H., Vegetables Crop Research Dept. National Research Centre, Dokki, Cairo, Egypt
E-mail: emadhassanein@hotmail.com.

many crops (Barker and Pilbeam, 2007 and Hänsch and Mendel, 2009).

Producing of good quality onion bulbs is an important target by onion growers whom have an inadequate knowledge about beneficial role of micronutrients in increasing yield and quality of onion for local and foreign markets. Hence, its cultivation has been expanded in the newly reclaimed areas which characterized with low fertility, high pH value and low organic matter content, consequently low available of micronutrients in the soil. These problems are well known in newly reclaimed areas in Egypt where sandy and calcareous soils are exist (El-Gamal and Abdel Nasser, 1996). Meanwhile, deficiencies of micronutrients in such areas have been shown as yield limiting factor (El-Fouly, 1983). Foliar application of micronutrients during crop growth was successfully used for correcting their deficits and improving the mineral status of plants as well as increasing the crop yield and quality (Kolota and Osinska, 2001).

The foliar application of micronutrients had a significant effect on plant growth, yield and quality (Sliman *et al.,* 1999; El-Gamelli, 2000; El-Shafie and El-Gamaily, 2002; El-Tohamy *et al.,* 2009 and Alam *et al.,* 2010). In the same respect, spraying onion plants cv. Pusa Red with Fe or Zn at 60 and 70 days after transplanting date led to significant increase of plant vegetative growth (Singh and Tiwari, 1995) as well as bulb yield and quality (Singh and Tiwari, 1996).

The main purpose of this study was to examine the effect of using different rates of nitrogen fertilization and foliar application of some micronutrients on vegetative growth, bulb yield and quality as well as mineral contents of onion plants grown in newly sandy reclaimed soil.

MATERIALS AND METHODS

Two field experiments were conducted under sandy soil conditions in newly reclaimed area at Research and Production Station of National Research Centre, El-Nubaria, El-Behera Governorate, Egypt, during two successive growing seasons of 2008/2009 and 2009/2010 to investigate the effect of different rates of nitrogen fertilization 60, 90 and 120 unit N/fed. used as urea (46% N) and foliar application of micronutrients Fe, Zn or Mn with a dose of 2 ml/l on vegetative growth, yield, quality and some chemical properties of onion plants.

Uniform onion seedlings cv. Giza 20 with 4 to 5 green true leaves were transplanted into the open field on the second week of December in both seasons. Seedlings were planted on drip irrigated ridges of 70 cm width, 6.0 m length and 10 cm apart on both sides of ridge. Each experimental plot included 6 ridges with a net area of 25.2 m^2. The commonly agricultural managements for onion production in the growing area were carried out as recommended by Ministry of Agriculture.

Collected soil samples (0-15 cm) were air dried, ground and sieved through 2 mm sieve and analyzed to classify soil texture as well as determined other soil parameters. Soil analysis was done following standard procedures of Tandon (2000). The physical and chemical properties of the experimental soil are given in Table (1).

Table 1: Physical and chemical properties of the experimental soil.

Properties		Value	
Sand%		90.80	
Silt%		5.20	
Clay%		4.0	
Texture		Sandy	
pH (1 : 2.5 soil : water)		8.50	
EC (1 : 2.5 soil : water) dS/m		0.14	
$CaCO_3$%		5.20	
Organic matter%		0.26	
Exchangeable macronutrients (mg/100g soil)		Available micronutrients (mg/kg soil)	
P	0.23	Fe	6.15
K	12.5	Mn	4.12
Mg	12.6	Zn	0.13
Ca	92.8	Cu	0.20
Na	11.92		

Full dose of phosphorus as calcium super phosphate (300 kg/fed. 15.5% P_2O_5) was applied to all treatments during the final preparation of land and thoroughly mixed with soil. While potassium sulphate (200 kg/fed. 48% K_2O) was applied as soil top dressing in two equal doses at 80 and 120 days after transplanting date. Urea fertilizer was used in three equal splits and added beside the plants during the growing period at 30, 60 and 90 days after transplanting date. In the same regard, onion plants were foliar sprayed with an aqueous solution of micronutrients Fe, Zn or Mn with a dose of 2 ml/l for three times in 30 days interval starting at 30 days after transplanting date. Distilled water was served as control treatment. Aqueous solutions of micronutrients Fe, Zn or Mn were freshly prepared using a chelating form known under the commercial name of Agro-Fe 8.5%, Agro-Zn 8.5% and Agro-Mn 7%. In addition, few drops of STICKY® as a wetting and sticky agent were added to spraying solution. All sprays were done in the morning using a hand pressure sprayer and covering the plant foliage with spraying solution. All agricultural chemicals used for foliar application treatments were obtained from AGRICO International Co., Egypt, (www.agricointernational.com).

Experimental Design and Statistical Analysis:

The experiment was laid out in a split plot design with three replicates, where the three nitrogen rates were arranged within the main plots, while the foliar application treatments were randomly distributed in the sub-plots. The obtained data were statistically analyzed and mean separation was done using the least significant differences (LSD) test at 5% level as described by Gomez and Gomez (1984).

The Following Data Were Recorded:

Plant Growth Parameters:

Ten onion from each sub-plot randomly taken after 100 days from transplanting date and transferred to the laboratories of the above mention institute to record the following parameters:

1- Plant length (cm);
2- Number of leaves/plant;
3- Bulb length and diameter (cm);
4- Neck length and diameter (cm);
5- Fresh and dry weights of leaves, neck and bulb as well as whole plant (g/plant).

Bulb Yield and its Physical Properties:

At harvesting time, 50 bulbs from each sub-plot were randomly chosen to determine the following parameters:

1- Bulb length and diameter (cm);
2- The average weight of bulb (g);
3- Average yield of bulb (ton/fed);
4- TSS (%).

Macro and Micronutrient Contents:

At harvesting time, onion bulb samples from each sub-plot were randomly selected for elemental analysis. Bulb tissues were oven aired at 70ºC for 72 hours, then fine grinded and used to determine ion contents on a dry weight basis. Bulb dried samples were wet digested as described by Wolf (1982). Total nitrogen, phosphorus and potassium as macronutrients and Fe, Zn, Mn and Cu as micronutrients were determined in acid digested solution of dried bulb samples. Total nitrogen and phosphorus were determined using the modified micro Kjeldah method and colorimetric method using spectrophotometer (SPECTRONIC 20D, Milton Roy Co. Ltd., USA), respectively, according to the procedure described by Cottenie *et al*. (1982). Potassium content was measured using flame photometer method (JENWAY, PFP-7, ELE Instrument Co. Ltd., UK) as described by Chapman and Pratt (1982). In addition, Fe, Zn, Mn and Cu were determined using Atomic-absorption (Analyst 200, Perkin Elmer, Inc., MA, USA), as described by Chapman and Pratt (1982).

RESULTS AND DISCUSSION

Vegetative Growth Parameters:

Effect of N Applications:

Data presented in Tables (2&3) clearly showed that increasing nitrogen fertilization rate from 60 to 120 unit N/fed. caused an increase in vegetative growth parameters of onion plant in both seasons. No significant differences were detected on the number of leaves/plant and bulb diameter in both seasons. Hence, the highest values of vegetative growth parameters were recorded by using the highest rate of nitrogen fertilization in both seasons except for leaves dry weight in the second season only where it recorded by using the medium rate of nitrogen fertilization. On the contrary, the lowest values of plant growth parameters were recorded with those plants received the lowest rate of nitrogen fertilization in both seasons except for bulb diameter in the first season only where it recorded by using the medium rate of nitrogen fertilization. In addition, it was realized that no significant differences were detected between the highest and the medium rates of nitrogen

Table 2: Effect of using different rates of nitrogen fertilization as urea and foliar spraying of micronutrients on vegetative growth parameters of onion plants during the first season of 2008/2009.

Treatments		Plant length	No. of leaves/	Bulb (cm)		Neck (cm)		Fresh weight (g)				Dry weight (g)			
Nitrogen	Micronutrients	(cm)	plant	Length	Diameter	Length	Diameter	Leaves	Neck	Bulb	Whole	Leaves	Neck	Bulb	Whole
60 unit N/fed.	Control	39.48	9.48	1.4	3.17	9.17	1.4	16.98	12.14	81.59	110.71	2.49	2.92	7.96	13.37
	Fe	56.04	9.76	1.93	5.67	10.67	1.7	26.13	15.45	103.54	145.12	3.9	3.05	15.77	22.72
	Zn	60	12.17	2.1	5.7	12.7	2.1	39.37	18.31	134.32	192	4.78	4.11	15.97	24.8
	Mn	47.16	11.33	1.83	4.83	10.83	1.83	24.05	16.96	88.23	129.24	2.83	3.09	13.95	19.87
	Mean	50.67	10.66	1.82	4.84	10.84	1.76	26.63	15.72	101.92	144.27	3.5	3.29	13.41	20.2
90 unit N/fed.	Control	44.3	10	1.87	3.1	9.31	1.87	31.95	15.82	86.46	134.23	2.97	3.19	12.78	18.94
	Fe	58.04	12	2.03	4.43	11.53	2.23	37.95	19.19	122	179.14	3.83	5.43	20.26	29.52
	Zn	63.33	11.67	2.57	6.36	12.63	2.17	37.81	22.51	126.85	187.17	4.92	5.74	24.55	35.21
	Mn	57.38	11.17	1.94	4.49	11.19	1.87	29.35	17.11	116.84	163.3	4.51	4.27	16.11	24.89
	Mean	55.76	11.21	2.1	4.6	11.17	2.04	34.27	18.66	113.04	165.96	4.06	4.66	18.43	27.14
120 unit N/fed.	Control	48.33	10.47	1.7	4.77	9.77	1.82	32.82	19.17	83.5	135.49	2.51	3.56	17.55	23.62
	Fe	62.99	12.33	2.63	4.98	12.83	2.55	60.47	28.78	153.68	242.93	5.64	5.86	21.16	32.66
	Zn	66.63	13	3.17	5.2	12.95	2.83	63.41	31.49	185.99	280.89	5.74	6.59	29.19	41.52
	Mn	63.04	11.12	2.04	4.95	11.2	2.41	57.11	23.31	117.61	198.03	4.34	5.53	18.87	28.74
	Mean	60.25	11.73	2.39	4.98	11.69	2.4	53.45	25.69	135.2	214.34	4.56	5.39	21.69	31.64
Average	Control	44.04	9.98	1.66	3.68	9.42	1.7	27.25	15.71	83.85	126.81	2.66	3.22	12.76	18.64
	Fe	59.02	11.36	2.2	5.03	11.68	2.16	41.52	21.14	126.41	189.06	4.46	4.78	19.06	28.3
	Zn	63.32	12.28	2.61	5.75	12.76	2.37	46.86	24.1	149.05	220.02	5.15	5.48	23.24	33.87
	Mn	55.86	11.21	1.94	4.76	11.07	2.04	36.84	19.13	107.56	163.52	3.89	4.3	16.31	24.5
LSD at 5%	Nitrogen	4.36	NS	0.31	NS	0.38	0.3	6.88	4.5	10.4	20.16	0.41	1.07	3.42	4.78
	Micronutrients	7.1	NS	0.45	0.98	1.08	0.41	10.31	3.89	20.18	25.95	1.03	0.87	7.16	7.44
	Interaction	NS	NS	NS	NS	NS	NS	NS	7.18	NS	33.9	NS	NS	NS	NS

Table 3: Effect of using different rates of nitrogen fertilization as urea and foliar spraying of micronutrients on vegetative growth parameters of onion plants during the second season of 2009/2010.

Treatments		Plant length	No. of leaves/	Bulb (cm)		Neck (cm)		Fresh weight (g)				Dry weight (g)			
Nitrogen	Micronutrients	(cm)	plant	Length	Diameter	Length	Diameter	Leaves	Neck	Bulb	Whole	Leaves	Neck	Bulb	Whole
60 unit N/fed.	Control	31	7.13	1.27	3.33	9.33	1.27	13.35	9.45	49.42	72.22	1.56	1.16	7.76	10.48
	Fe	37.17	8.94	1.53	4.4	10.42	1.53	18.17	13.6	69.3	101.07	3.3	1.58	10.51	15.39
	Zn	40.02	10	2.4	5.6	11.2	1.5	23.19	14.49	86.41	124.09	4.02	1.92	15.36	21.3
	Mn	34.33	8.37	1.5	5.21	10	1.4	16.5	11.15	65.78	93.43	2.63	0.99	13.89	17.51
	Mean	35.63	8.61	1.68	4.64	10.24	1.43	17.8	12.17	67.73	97.7	2.61	1.41	11.88	16.17
90 unit N/fed.	Control	33.02	7.33	1.37	3.67	9.67	1.37	16.85	11.15	61.36	89.36	2.2	1.47	11.58	15.25
	Fe	42.3	9	1.93	5.33	11.53	1.5	25.45	16.63	79.55	121.63	3.85	1.89	15.92	21.66
	Zn	49.87	11.33	2.3	5.33	12.31	1.77	21.71	19.07	85.25	126.03	4.17	1.96	19.99	26.12
	Mn	37.07	9.35	1.87	5.23	10.81	1.63	19.24	14.71	77.59	111.54	3.8	1.87	19.05	24.72
	Mean	40.57	9.25	1.87	4.89	11.08	1.57	20.81	15.39	75.94	112.14	3.51	1.8	16.64	21.95
120 unit N/fed.	Control	33.67	8.67	1.57	4.17	10.17	1.23	16.15	13.93	69.41	99.49	1.85	1.07	15.73	18.65
	Fe	50.43	9.38	2.13	4.93	12.33	1.65	22.95	19.25	79.4	121.6	3.26	0.96	18.59	22.81
	Zn	53.67	10.74	2.33	6.13	12.93	2.13	33.77	28.56	96.59	158.92	2.92	3.51	22.95	29.38
	Mn	42.33	10.2	1.63	4.67	11.51	1.57	28.42	16.69	85.23	130.34	2.4	2.12	20.81	25.33
	Mean	45.03	9.75	1.92	4.98	11.74	1.65	25.32	19.61	82.66	127.59	2.88	1.92	19.52	24.05
Average	Control	32.56	7.71	1.4	3.72	9.72	1.29	15.45	11.51	60.06	87.02	1.87	1.23	11.69	14.79
	Fe	43.3	9.11	1.86	4.89	11.43	1.56	22.19	16.49	76.08	114.77	3.47	1.48	15.01	19.95
	Zn	47.85	10.6	2.34	5.69	12.15	1.8	26.22	20.71	89.42	136.35	3.7	2.46	19.43	25.6
	Mn	37.91	9.31	1.67	5.04	10.77	1.53	21.39	14.18	76.2	111.77	2.94	1.66	17.92	22.52
LSDat 5%	Nitrogen	4.54	NS	0.18	NS	1.01	0.12	2.21	2.42	6.68	10.83	0.81	0.43	2.56	2.91
	Micronutrients	4.19	1.83	0.22	0.35	1.71	0.2	2.35	1.92	11.29	15.78	1.14	0.37	3.24	4.15
	Interaction	5.19	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

fertilization in most parameters of onion plant growth i.e. bulb length and dry weights of neck, bulb and whole plant in the first season and plant length, bulb length, neck length and diameter and dry weights of leaves, neck and whole plant in the second season.

The obtained results were in good accordance with those of Balemi *et al.* (2007) and Shaheen *et al.* (2010). It is of interest to note that nitrogen is an indispensable elementary constituent of numerous organic compounds of general importance (amino acids, protein, nucleic acids and chlorophyll). It is formation of protoplasm and new cells, encouragement for elongation and it is considered as a limiting nutrient for high plant growth (Marschner, 1995).

The increment of vegetative growth parameters of onion plant by using the highest rate of nitrogen fertilization was probably due to that nitrogen plays an important role in plant photosynthesis by improving leaf area index and chlorophyll contents thus resulting in higher photosynthetic rate and higher plant vegetative growth (Murata, 1969).

Effect of Micronutrients Foliar Application:

Data presented in Tables (2&3) strongly showed that there was a significant effect of foliar spraying of micronutrients on vegetative growth parameters of onion plants in both seasons. Foliar application of onion plants with Zn resulted in the highest values of vegetative growth parameters in both seasons, followed by foliar application of Fe in the first season and by Mn in the second season for parameters of number of leaves/plant, bulb diameter, bulb fresh weight and dry weights of neck, bulb and whole plant. No significant differences were detected among micronutrients on number of leaves/plant, neck diameter, leaves fresh weight and bulb dry weight in the first season and on number of leaves/plant, neck length and leaves dry weight in the second season.

The favorable effect of micronutrients on plant growth might be due to its role in many physiological processes and cellular functions within the plants. In addition, they play an essential role in improving plant growth, through the biosynthesis of endogenous hormones which responsible for promoting of plant growth (Battal, 2004 and Hänsch and Mendel, 2009).

The same trends were also recorded by many authors on onion plants (Sliman *et al.,* 1999; El-Gamelli, 2000; El-Shafie and El-Gamaily, 2002; El-Tohamy *et al.,* 2009 and Alam *et al.,* 2010). They reported that growth parameters of onion plant were positively affected by application of micronutrients. Moreover, Singh and Tiwari (1995) found that plant height and bulb fresh weight, bulb diameters of onion plants were recorded the highest values with spraying of Zn.

Interaction Effect of N Fertilization Rates and Foliar Spraying of Micronutrients:

Data presented in Tables (2&3) showed that the interaction effect between different nitrogen rates and foliar application of micronutrients were recorded significant differences on fresh weight of neck and whole plant in the first season and on plant length in the second season. While the other parameters recorded no significant differences in both seasons. Generally, it could be stated that using 120 unit N/fed. plus foliar spraying of Zn gave the best values of all measured parameters followed by using 90 unit N/fed. plus foliar spraying of Zn but with no significant difference between them.

Total Bulb Yield and Quality:

Effect of N Applications:

Expected total yield of onion bulb as ton/fed. significantly increased with increasing nitrogen fertilization rate from 06 to 120 unit N/fed. in both seasons. The highest and lowest values of total yield (18.970, 15.418 and 17.506, 12.057 ton/fed.) were recorded by application of nitrogen fertilization at rate of 120 and 60 units N/fed. in the first and second seasons, respectively, as shown in Table (4). In addition, the average bulb weight, bulb dimensions (length and diameter) and TSS parameters significantly recorded the highest values when nitrogen fertilization was used at the highest rate followed by medium rate with no significant difference between them except for bulb diameter in the second season only.

It could be concluded that the highest yield and the best values of physical properties for onion bulb may be attributed to the reflection of vigorous of vegetative growth of onion plant which received the highest rate of nitrogen fertilization as previously described and shown in Tables (2&3).

The results of this study were in good accordance with the findings of Abu-Rayyan and Al-Hadidi (2005); Balemi *et al.* (2007); Biesiada and Kołota (2009) and Shaheen *et al.* (2010). All of them reported that increasing nitrogen fertilization rate led significantly to increase onion bulb yield as well as quality. In contrast Al-Moshileh (2002) stated that the highest onion yield was obtained by using nitrogen application at rate of 200 kg N/ha and an excess application of nitrogen over 200 kg N/ha will not be economically feasible for higher crop production.

Effect of Micronutrients Foliar Application:

Table (4) clearly revealed that total bulb yield as well as bulb quality parameters of onion plants were significantly influenced by foliar spraying of micronutrients in both seasons. Onion plants sprayed with Zn gave the highest values of all measured parameters in both seasons, followed by foliar spraying of Fe in the first season for all measured parameters except average weight of bulb and by Mn in the second season for parameters of bulb diameter, average weight of bulb and total yield. However, no significant differences were detected among foliar sprayed micronutrients on bulb diameter, average weight of bulb and total yield in the first season and on average weight of bulb in the second season.

This effect might be due to that micronutrients play a pivotal role in strengthening plant cell walls and translocation of carbohydrates from leaves to other plant parts, this means that a possibility of increasing dry matter percentage as well as yield. Also it is highly required for better yield of many crops since it could serve as counter ion (Barker and Pilbeam, 2007 and Hänsch and Mendel, 2009). In addition a high yield is a reflection of vigorous vegetative growth and healthy plants (Singh and Tiwari, 1996).

Similar results were obtained by Sliman *et al.* (1999); El-Gamelli (2000); El-Shafie and El-Gamaily (2002) and Alam *et al.* (2010). They stated that bulb yield and quality of onion was mostly enhanced by foliar spraying of Zn followed by Fe. In the same respect, El-Tohamy *et al.* (2009) revealed that yield of onion plants cv. Giza 6 significantly increased by the application of Fe or Zn compared to control plants.

Table 4: Effect of using different rates of nitrogen fertilization as urea and foliar spraying of micronutrients on total yield and quality parameters of onion bulbs during seasons of 2008/2009 and 2009/2010.

Treatments		Bulb (cm)		Average weight of bulb	Total yield (ton/fed.)	TSS%	Bulb (cm)		Average weight of bulb	Total yield (ton/fed.)	TSS%
Nitrogen	Micronutrients	Length	Diameter				Length	Diameter			
		2008/2009 season					2009/2010 season				
60 unite N/fed.	Control	5.15	5.21	86.64	12.583	10.71	4.68	5.11	74.9	10.603	10.3
	Fe	6.69	7.27	116.53	15.983	12.03	5.03	6.04	99.71	12.737	12.2
	Zn	7.35	7.51	123.92	17.197	12.47	6.34	6.34	112.86	13.103	11.26
	Mn	5.71	5.84	106.83	15.91	11.5	5.28	5.66	103.69	11.783	11.11
	Mean	6.23	6.46	108.48	15.418	11.68	5.33	5.79	97.79	12.057	11.22
90 unite N/fed.	Control	5.29	6.1	94.32	14.433	10.93	5.22	4.98	84.15	12.553	11.13
	Fe	7.81	8.27	129.8	19.18	12.2	7.05	6.51	123.57	13.8	12.3
	Zn	6.65	6.78	146.38	19.963	13.9	6.23	7.6	130.06	18.87	13.2
	Mn	6.44	7.17	132.37	16.86	11.77	5.69	7.07	112.16	15.113	11.53
	Mean	6.55	7.08	125.72	17.609	12.2	6.05	6.54	112.49	15.084	12.04
120 unite N/fed.	Control	5.56	7.55	103.17	15.738	11.27	5.8	6.14	92.68	14.677	11.58
	Fe	7.59	7.92	143.33	19.827	12.86	6.6	8.15	125.08	16.82	12.69
	Zn	7.92	9.71	166.1	20.343	13.53	7.27	9.05	149.32	20.409	13.35
	Mn	6.94	8.58	153.05	19.965	12.4	6.2	8.48	138.01	18.117	12.93
	Mean	7	8.44	141.41	18.97	12.52	6.47	7.96	126.27	17.506	12.64
Average	Control	5.33	6.29	94.71	14.251	10.97	5.23	5.41	83.91	12.611	11
	Fe	7.05	7.44	129.89	18.33	12.36	6.23	6.9	116.12	14.452	12.4
	Zn	7.31	8	145.47	19.168	13.3	6.61	7.66	130.75	17.461	12.6
	Mn	6.36	7.2	130.75	17.578	11.89	5.72	7.07	117.95	15.004	11.86
LSD at 5%	Nitrogen	NS	NS	16.61	1.318	0.48	0.55	0.85	14.07	2.156	0.66
	Micronutrients	0.16	0.91	28.55	2.481	0.71	0.84	0.49	19.45	2.642	0.63
	Interaction	0.92	1.93	NS	NS	1.21	1.01	NS	NS	NS	NS

Interaction Effect of N Fertilization Rates and Foliar Spraying of Micronutrients:

The interaction effect recorded significant differences effect on bulb length in both seasons, as well as bulb diameter and TSS in the first season as shown in Table (4). In spite of no significant effects were detected on the rest of yield and quality characters a general trend was noticed toward increasing onion bulb yield and quality with increasing nitrogen fertilization rate up to 120 unit N/fed. plus foliar spraying treatment by Zn. These findings were completely similar in both seasons.

Macro and Micronutrient Contents:

Effect of N Applications:

Data shown in Tables (5&6) strongly indicated that increasing the application rate of nitrogen fertilization from 60 to 120 unit N/fed. significantly increased N, P, K, Fe, Zn, Mn and Cu in onion bulb tissues in both seasons except for Cu in the second season only. The highest values of macro and micronutrient contents in bulb tissues were recorded with the highest rate of nitrogen fertilization in both seasons except for Fe content in the first season only, where it recorded by medium rate. However, the statistical analysis of the obtained data showed that no significant differences were detected between nitrogen fertilization rates of 90 and 120 units N/fed. on P, K, Zn, Mn, Cu and P, K, Fe, Zn, Cu in bulb tissues in the first and second seasons, respectively.

A general improvement in nutrient uptake of onion plants might be due to that a good supply of nitrogen stimulates root growth and development, as well as the uptake of nutrients.

These results were in line with the findings of Abu-Rayyan and Al-Hadidi (2005); Balemi *et al.* (2007) and Shaheen *et al.* (2010).

Effect of Micronutrients Foliar Application:

Data presented in Tables (5&6) indicated that foliar spraying of micronutrients caused a significant increase in macro and micronutrient contents of bulb tissues in seasons of 2008/2009 and 2009/2010. Foliar spraying of onion plants with Zn gave the highest values of macro and micronutrient contents in bulb tissues except for Fe, Mn and Cu contents. The obtained results were completely similar in both seasons.

It is of interest to note that no significant differences were noticed among foliar spraying treatments on Mn content in the first season. In addition between Zn and Fe treatments on Cu content in both seasons as well as on K, Fe and Zn contents in the first season. In the same regard between Zn and Mn treatments on N content in the second season. The obtained results were in agreement with those obtained by Sliman *et al.* (1999) and El-Shafie and El-Gamaily (2002). In addition foliar application of micronutrients was successfully used for improving the mineral status of plants (Kolota and Osinska, 2001).

Interaction Effect of N Fertilization Rates and Foliar Spraying of Micronutrients:

The interaction effect between nitrogen fertilization rates and foliar spraying of micronutrients had no significant differences on macro and micronutrient contents of bulb tissues in both seasons except for Fe content in the first season as shown in Tables (5&6). It could be declared that onion plants which received

Table 5: Effect of using different rates of nitrogen fertilization as urea and foliar spraying of micronutrients on macro and micronutrient contents in onion bulb tissues during the first season of 2008/2009.

Treatments		Percentage (%)			ppm			
Nitrogen	Micronutrients	N	P	K	Fe	Zn	Mn	Cu
60 unit N/fed.	Control	1.25	0.16	0.42	235.67	28	19.67	7.33
	Fe	1.42	0.32	0.52	278.67	35	23.67	9.67
	Zn	1.46	0.4	0.61	260	39.67	23.06	6.97
	Mn	1.36	0.35	0.49	271.67	31.06	28	7.67
	Mean	1.37	0.31	0.51	261.5	33.43	23.6	7.91
90 unit N/fed.	Control	1.35	0.21	0.51	250	31	21	7.63
	Fe	1.49	0.38	0.57	312.67	38	30.67	10
	Zn	1.63	0.49	0.66	311.67	42.33	29.1	11.67
	Mn	1.55	0.44	0.6	288.33	37.33	33.33	8.33
	Mean	1.51	0.38	0.59	290.67	37.17	28.53	9.41
120 unit N/fed.	Control	1.52	0.31	0.59	254	32	23	8.26
	Fe	1.66	0.38	0.67	282.67	41.2	31.33	10.62
	Zn	1.68	0.5	0.71	291.67	42.67	32	11.61
	Mn	1.63	0.44	0.63	267.33	40.33	34.67	9.35
	Mean	1.62	0.41	0.65	273.92	39.05	30.25	9.96
Average	Control	1.37	0.23	0.51	246.56	30.33	21.22	7.74
	Fe	1.52	0.36	0.59	291.34	38.07	28.56	10.1
	Zn	1.59	0.46	0.66	287.78	41.56	28.05	10.08
	Mn	1.51	0.41	0.57	275.78	36.24	32	8.45
LSD at 5%	Nitrogen	0.09	0.05	0.06	11.83	3.01	3.06	1.36
	Micronutrients	0.06	0.02	0.07	12.13	3.79	4.12	1.08
	Interaction	NS	NS	NS	21.01	NS	NS	NS

Table 6: Effect of using different rates of nitrogen fertilization as urea and foliar spraying of micronutrients on macro and micronutrient contents in onion bulb tissues during the second season of 2009/2010.

Treatments		Percentage (%)			ppm			
Nitrogen	Micronutrients	N	P	K	Fe	Zn	Mn	Cu
60 unit N/fed.	Control	0.82	0.18	0.31	209.33	19.67	11.67	7.2
	Fe	1.03	0.24	0.46	259	16.33	19	10.67
	Zn	1.24	0.33	0.44	217.33	27.67	15.33	8.03
	Mn	1.41	0.3	0.36	223	21	21.03	6.42
	Mean	1.13	0.26	0.39	227.17	21.17	16.76	8.08
90 unit N/fed.	Control	1.22	0.28	0.47	222.67	21.67	15	8.67
	Fe	1.26	0.36	0.51	283	18	23	9.67
	Zn	1.61	0.42	0.69	215.67	30.67	19.67	10.33
	Mn	1.38	0.32	0.62	246	28.67	26.67	8.41
	Mean	1.37	0.35	0.57	241.84	24.75	21.09	9.27
120 unit N/fed.	Control	1.3	0.31	0.51	227.33	21	18.33	10.33
	Fe	1.55	0.46	0.58	279.67	24.27	26.67	11.1
	Zn	1.68	0.48	0.72	224.33	32	22.33	9.36
	Mn	1.57	0.42	0.61	259.33	29.13	32	9.33
	Mean	1.53	0.42	0.61	247.67	26.6	24.83	10.03
Average	Control	1.11	0.26	0.43	219.78	20.78	15	8.73
	Fe	1.28	0.35	0.52	273.89	19.53	22.89	10.48
	Zn	1.51	0.41	0.62	219.11	30.11	19.11	9.24
	Mn	1.45	0.35	0.53	242.78	26.27	26.57	8.05
LSD at 5%	Nitrogen	0.12	0.08	0.05	10.8	2.32	3.48	NS
	Micronutrients	0.07	0.04	0.08	13.32	2.27	2.35	1.35
	Interaction	NS	NS	NS	NS	NS	NS	NS

nitrogen fertilization at rate of 120 unit N/fed. plus foliar spraying of Zn gave the highest values of macro and micronutrient contents in bulb tissues, while the lowest values were obtained by using the lowest rate of nitrogen fertilization plus control treatment. These findings were completely similar in both seasons.

Conclusions:

From the above mentioned results it could be concluded that the combination of nitrogen fertilization as urea at rate ranged from 90 to 120 unit N/fed. with foliar spraying of Zn and/or Fe could be gave the best results of onion plant growth parameters, yield and quality of onion bulbs as well as macro and micronutrient contents in bulb tissues under newly sandy reclaimed soil conditions.

REFERENCES

Abu-Rayyan, A.M. and N.A. Al-Hadidi, 2005. Onion production and nitrogen uptake in response to different doses of urea fertilizer at two different plant populations. Journal of King Saud University Agricultural Sciences, 18(1): 19-34.

Alam, M.N., M.J. Abedin and M.A.K. Azad, 2010. Effect of micronutrients on growth and yield of onion under calcareous soil environment. International Research Journal of Plant Science, 1(3): 56-61.

Al-Moshileh, A.M., 2002. Effect of rate and time of nitrogen application on onion production in the central region of Saudi Arabia. Journal of King Saud University Agricultural Sciences, 14(1): 33-41.

Balemi, T., N. Pal and A.K. Saxena, 2007. Response of onion (*Allium cepa* L.) to combined application of biological and chemical nitrogenous fertilizers. Acta Agriculturae Slovenica, 89(1): 107-114.

Barker, A.V. and D.J. Pilbeam, 2007. Handbook of plant nutrition. CRC Press, London, New York.

Battal, P., 2004. Effects of some mineral nutrients on gibbrellic acid levels in maize plants. Economic Botany, 58(2): 195-203.

Biesiada, A. and E. Kolota, 2009. The effect of nitrogen fertilization on yield and nutritional value of onion grown from sets for early cropping. Vegetable Crops Research Bulletin, 70: 145-151.

Chapman, H.D. and P.F. Pratt, 1982. Methods of Plant Analysis, I. Methods of Anaylsis for Soil, Plant and Water. Chapman Publishers, Riverside, California, USA.

Cottenie, A., M. Verloo, L. Kickens, G. Velghe and R. Camerlynck, 1982. Chemical analysis of plants and soils. Laboratory of Analytical and Agrochemistry. State University, Ghent Belgium, pp: 63.

El-Fouly, M.M., 1983. Micronutrients in arid and semiarid areas: levels in soils and plants and the need for fertilizer with reference to Egypt. Proceeding 17th Coll. International Postash, Bern., pp: 163-173.

El-Gamal, A.M. and G. Abdel Nasser, 1996. Response of sweet potato crop to phosphorus and potassium fertilization rates. The fourth Arabic Conference for Horticultural Crops, 25-28 March, Minia University, Egypt. Part I, Vegetable Crops, pp: 471-488.

El-Gamelli, Hanna El-Hadi, 2000. The effect of some foliar fertilizers application on growth, bulb yield, quality and storage ability of Giza 20 onion cultivar (*Allium capa* L). Annals of Agricultural Science, Moshtohor, 38(3): 1727-1737.

El-Shafie, Fatma S. and Eida E. El-Gamaily, 2002. Effect of organic manure, sulphur and micro-elements on growth, bulb yield, storability and chemical composition of onion plants. Minufiya Journal of Agricultural Research, 27(2): 407-424.

El-Tohamy, W.A., A.Kh. Khalid, H.M. El-Abagy and S.D. Abou-Hussein, 2009. Essential oil, growth and yield of onion (*Allium cepa* L.) in response to foliar application of some micronutrients. Australian Journal of Basic and Applied Sciences, 3(1): 201-205.

FAOSTAT, 2008. http://faostat.fao.org/.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agriculture Research. 2nd ed. Willey Inter Science Publisher, pp: 323-357.

Hänsch, R. and R.R. Mendel, 2009. Physiological functions of mineral micronutrients (Cu, Zn, Mn, Fe, Ni, Mo, B, Cl). Current Opinion in Plant Biology, 12: 259-266.

Kolota, E. and M. Osinska, 2001. Efficiency of foliar nutrition of field vegetables grown at different nitrogen rates. Acta Horticulturae, 563: 87-91.

Marschner, H., 1995. Mineral nutrition of higher plants. 2nd ed., Academic Press, London, New York.

Murata, H.J., 1969. Physiological response to nitrogen in plants". In: Physiological Aspects of Crop Yields. Eastin, J.D., F.A. Haskins, C.Y. Sullivan and C.H.M. Van Bavel, (Eds.). American Society of Agronomy, Crop Society of America, Madison, USA, pp: 253-259.

Shaheen, A.M., Fatma A. Rizk, Hoda A.M. Habib and M.M.H. Abd El-Baky, 2010. Nitrogen soil dressing and foliar spraying by sugar and amino acids as affected the growth, yield and its quality of onion plant. Journal of American Science, 6(8): 420-427.

Sheikh, M.A., A.H. Ansari, S.M. Qayyum, M.B. Qayyum and S.A. Hussain, 1987. Technical report on effect of nitrogen doses on the growth and crop yield of onion. Pakistan Agriculture, 9: 35-40.

Singh, D.P. and R.S. Tiwari, 1995. Effect of micronutrients on growth and yield of onion (*Allium cepa* L.) variety Pusa Red. Recent-Horticulture, 2(2): 70-77.

Singh, D.P. and R.S. Tiwari, 1996. Effect of micronutrients on yield and quality of onion (*Allium cepa* L.) variety Pusa Red. Recent-Horticulture, 3(1): 111-117.

Sliman, Z.T., M.A. Abdelhakim and A.A. Omran, 1999. Response of onion to foliar application of some micronutrients. Egyptian Journal of Agricultural Research, 77(3): 983-993.

Tandon, H.L.S., 2000. Methods of analysis of soils, plants. In: Water and Fertilizers, Fertilizer Development and Consultation Organization (FDCO), New Delhi, India.

Tisdale, S.L., W.L. Nelson and J.D. Beaton, 1985. Soil and fertilizer potassium. In: Soil Fertility and Fertilizers 4th ed., S.L. Tisdale, W.L. Nelson and J.D. Beaton (eds.), MacMillan Publ. Co., New York, USA, pp: 249-291.

Wolf, B., 1982. A comprehensive system of leaf analysis and its use for diagnosing crop nutrients status. Communication of Soil Science and Plant Analysis, 13: 1035-1059.