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Response of Onion to Foliar Spraying with some Nutrients under Different Rates of Npk Fertilizers

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ABSTRACT

This study was conducted in seasons of 2014/2015 and 2015/2016 at Shandaweel Agriculture Research Station, Sohag, Egypt. The experimental design was randomized complete block design (RCBD) with three replications. The treatments were (1) Non-fertilization, (2). Control treatment (120, 45, 25 kg/fed NPK), (3). Humic acid+ 100% NPK, (4). Potassin +100% NPK, (5) Calfruit + 100% NPK, (6) Humic acid+ Potassin +100% NPK, (7) Humic acid+ Calfruit + 100% NPK, (8) Potassin + Calfruit + 100% NPK, (9) Humic acid+ Potassin + Calfruit, (10). Humic acid+ Potassin + Calfruit + 25% NPK, (11) Humic acid+ Potassin + Calfruit + 50% NPK (12) Humic acid+ Potassin + Calfruit + 75% NPK. Application of Pot.+Cal.+HA+75%NPK, produced the highest values of plant height at 90 and 120 DAT in both seasons and plant dry weight, bulb dry weight at 120 DAT in both seasons. While, Non-fertilization treatment gave the lowest values of plant height, bulb diameter, fresh plant weight, leaves fresh weight, bulb fresh weight, plant dry weight, leaves dry weigh, bulb dry weigh at 90 and 120 DAT and number of days to maturity in the two seasons. Generally, treatment of Pot.+Cal.+HA+75% NPK attained the highest values of total bulbs yield, bulb diameter, TSS%, D.M% in both seasons.

INTRODUCTION

Onion (*Allium cepa*, L.), an important vegetable crop in Egypt and the world, is used for exportation, local consumption and processing. In addition, it is an important source for hard currency, due to the early availability of the Egyptian onion for foreign markets as well as its higher quality compared to onion produced in other countries. In Egypt the total cultivated area of onion in 2016 season was 162,833 feddan producing 2,317,707 tons with an average of 14.43 ton/fed (the Yearly Book of Economics and Statistics of the Ministry of Agriculture and Land Reclamation, Egypt, 2017).

The NPK fertilizers applied in the required amounts are essential for producing high yields with a good storage quality. Nitrogen is correlated with chlorophyll content and is an essential for synthesis of amino acids, proteins and enzymes. Phosphorus and potassium are important in multiple physiological processes such photosynthesis, plant metabolism, and enhancing the translocation of photo assimilates Marschner (1995), El-Desuki *et al.* (2006 a & b). Because onion has shallow roots with high nutrients demand, and long growing season, it is sensitive to nutritional imbalance Yaso *et al.* (2007).

Calcium is a major plant nutrient. It is required for the cell wall and membranes integrity and maintenance. Calcium is a counter-cation for inorganic and organic anions White and Broadley (2003). Fertilization with $CaCl_2$ has been shown to improve onion storability through the firmness of the scales Coolong and Randle (2008). Foliar spraying of potassium nitrate and calcium nitrate plus potassium chloride results in the highest vegetative growth and significant reduction of the flaking rate during storage and increases the exportable bulbs percentage.

The objective of this investigation is to study the effect of foliar spraying with some commercial fertilizers products rich in humic acid, calcium and potassium under different rates of NPK fertilization on plant growth, yield and quality of onion crop.

MATERIALS AND METHODS

This investigation was conducted at Shandaweel Research Station, Agricultural Research Center (ARC) during winter seasons of 2014/2015 to 2015/2016. The site soil class was clay. The area specified for the experiment was left uncultivated in the previous summer in the two seasons. The physical and chemical analyses of the experimental sites soil are presented in Table (1).

The plot size was 3.5 m in length and 3 m in width including five ridges with 60 cm a part with total area of 10.5 m^2. Ridging direction was north-south (NS). Transplants were placed on both sides of the ridge at 7 cm between plants. The soil received the full doses of Super-phosphate (15.5% P_2O_5) and potassium sulphate (50% K_2O) during the soil preparation, while ammonium nitrate (33.5% N), was applied at two equal additions. One addition was after one month and the second addition was after two months from planting date.

Table 1. The mechanical and chemical analysis of the experimental sites soil in both seasons.

Determination		Season	
		2014/2015	2015/2016
Physical analysis	**Textural class**	**Clay loam**	**Clay loam**
Chemical analysis	Ph	7.8	7.7
	EC (m.mhos/cm.)	0.84	0.73
	Organic matter %	1.53	1.60
	Available N ppm	18.20	20.00
	Available P ppm	9.6	9.00
	Available K ppm	273	257
Cations (meq/100g)	Ca	7.00	6.59
	Mg	2.9	2.38
	Na	1.50	1.58
	K	0.24	0.33
Anion (meq/100g)	CO_3	0.00	0.00
	HCO_3	2.8	2.5
	SO_4	5.5	5.3
	Cl	3.3	3.08
Available nutrients (ppm)	Fe	10	9.4
	Cu	0.47	0.45
	Zn	1.77	1.56
	Mn	1.00	1.01

The onion seeds were sown in the nursery on 25 August and 1st September in the first and second seasons respectively. Nursery bed was prepared and planted with onion seeds (cv. Shandaweel 1) and transplanting took place on 8th November in both seasons. The experimental design was randomized complete blocks design (RCBD) with three replications; the treatments were factorial combination between the NPK chemical fertilizers applied to soil and the foliar application of Humic acid, Potassin and Calfruit. Potassin and Humic acid (General Organization for Agricultural Equalization Fund, Ministry of Agriculture and Land Reclamation, Egypt). Calfruit is produced by Dakahlia group company. Foliar spraying was applied three times after 45, 60 and 75 days from transplanting.

Table 2. The chemical composition and rates of sprayed fertilizers.

Compounds	Composition	Spraying rate
Humic acid	5 % K2O and 5 % Ca	1.5 cm / liter
Potassin	30 % K_2O and 5 % NO_3	1 L / Fadden
Calfruit	15 % Ca, 9 % N, 6 % K2O and 31 % Legno slophonat	2.25 cm/ liter

The treatments can be illustrated as follows:

T1. Non-fertilization.

T 2. Control (100% of 120, 45, 24 kg/fed NPK).

T 3. Humic acid +100% NPK.

T 4. Potasin + 100% NPK.

T 5. Cal fruit + 100% NPK

T 6. Humic acid + Potasin + 100% NPK.

T 7. Humic acid+ Cal fruit + 100% NPK.

T 8. Potasin + Cal fruit + 100% NPK.

T 9. Humic acid + Potasin. + Cal fruit

T 10. Humic acid + Potasin +Cal fruit + 25% NPK.

T 11. Humic acid + Potasin + Cal fruit + 50% NPK.

T 12. Humic acid + Potasin + Cal fruit + 75% NPK.

Characters studied:

A- Vegetative characters: Ten random plants were selected from each plot to measure plant height (cm), number of leaves per plant, plant fresh weight (gm) and plant dry weight (gm) at 90 and 120 days after transplanting (DAT).

B. Number of days to maturity: Maturity was determined based on both softening of bulb neck and 50% top-down of bulb leaves of plot plants. It was estimated as the days taken from transplanting to the harvest stage.

C. Bulbs yield and its components:

The following yield parameters were recorded at harvest:

1. Total bulbs yield (t/fed.)
2. Exportable bulbs yield (t/fed.), was determined as the weight of single bulbs with diameter from 4 to 7 cm per feddan.
3. Culls bulbs yield (t/fed.), was estimated according to the following equation $= \frac{weight\ of\ bolters\ and\ doubles}{Total\ weight\ of\ bulbs} X100$

D. Bulbs quality: The following measurements were taken on 10 random plants from each plot.

1- **Bulb diameter (cm):** was measured by a caliper at widest part of the bulb.

2- **Total soluble solids percentage (T.S.S%),** it was determined immediately after harvest by a hand refractometer according to A.O.A.C. (1975).

3- **Dry matter percentage (D.M.%):** It was determined by drying plants for four hours at 105°C and then at 70°C in a drying oven with ventilator, until the weight reaches to a constant value, according to the following formula:

$$\textbf{D.M.\%} = \frac{\text{Sample dry weight}}{\text{Sample fresh weight}} x100$$

Statistical analysis:

Statistical analysis was done as described by Snedecor and Cochran (1973). To compare between means, L.S.D. at 0.05 level of significance was used according to Walter and Duncan (1969).

RESULTS AND DISCUSSION

A. Vegetative growth characteristics:

Vegetative growth of onion plant expressed as plant height, number of leaves/plant, plant fresh weight and plant dry weight were significantly affected by the fertilization treatments at growth stages of 90 and 120 DAT, in both seasons, except for plant dry weigh at 90 DAT in the second season. (Table 3).

Application of Pot.+Cal.+ HA+75% NPK gave the highest values of plant height at 90 and 120 DAT in both seasons; plant fresh weight at 90 DAT in the first season and at 120 DAT in both seasons; number of leaves/plant at 120 DAT in the first season; plant fresh weight at 90 DAT in the first season and at 120 days in both seasons; and plant dry weight at 120 DAT in both seasons This treatment surpassed all the other fertilization treatments, which had the different combinations between NPK doses and foliar spraying with humic, potassium and calcium. The treatments of 100% NPK and Pot. + Cal. +100% NPK produced the highest plant dry weight at 90 DAT in the first and second season, respectively, while applying the treatment of Cal +100% NPK produced the highest plant dry weight at 120 DAT in the first season.

Table 3. Response of vegetative growth characteristics of onion to foliar spraying with some nutrients under different rates of NPK fertilizers at 90 and 120 DAT in 2014/2015.

Treatments	90 DAT				120 DAT			
	Plant Height (cm)	No. of Leaves /plant	Plant fresh weight (g)	Plant dry weight (g)	Plant Height (cm)	No. of leaves /plant	Plant fresh weight (g)	Plant dry weight (g)
Non-fertilization	68.67	5.97	65.56	4.09	68.33	7.33	111.11	10.33
100 % NPK (Control)	81.20	7.50	69.41	6.59	84.30	7.83	169.44	15.71
HA+100 % NPK	80.93	7.73	106.67	5.08	84.20	8.53	152.78	14.08
Po+100 % NPK	79.10	6.87	95.56	6.20	80.10	8.13	161.11	14.08
Cal+100 % NPK	80.10	7.40	96.44	6.31	81.77	8.30	157.22	15.77
HA+Po+100 % NPK	81.33	7.97	98.33	6.48	85.67	8.07	151.67	14.49
HA+Cal+100 % NPK	79.53	7.73	91.67	5.56	82.70	7.93	155.00	13.89
Po+Cal +100 % NPK	78.20	7.40	66.67	5.96	84.07	8.07	160.00	15.32
HA+Po+Cal	82.77	6.73	91.67	5.69	78.87	7.87	147.78	13.98
HA+Po+Cal+25 % NPK	81.20	6.73	96.11	6.28	83.00	7.50	155.56	14.52
HA+Po+Cal+50 % NPK	83.83	7.87	108.33	4.98	84.83	8.07	172.78	15.48
HA+Po+Cal+75 % NPK	84.43	7.40	111.11	6.53	87.30	8.63	180.11	15.08
LSD 5%	5.65	1.03	17.11	1.11	5.99	1.05	14.00	1.63

The results of plant growth characters reflect the role of both humic , potassium and calcium in encouraging onion plants growth and in reducing the needs of plants for NPK fertilization. These results may be due to that humic acid contains nutrients that improve the soil fertility and increase the availability of other nutrients and consequently increase plant growth and yield. It particularly used to reduce the negative effect of salt stress. These results are in line with those reported by Hafez (2003), AbdEl-Al *et al.* (2005), Sheng-li *et al.* (2010), and Kandil *et al.* (2013-b). Similar results were obtained by El-Desuki (2004), Sangetha and Singara (2007), Haleema *et al.* (2012) and Kandil *et al.* (2013-b) who found that combined application of recommended dose of inorganic fertilizers and lignite humic acid significantly increased the plant growth characters.

Table 4. Response of vegetative growth characteristics of onion to foliar spraying with some nutrients under different rates of NPK fertilizers at 90 and 120 DAT in 2015/2016.

Treat.	90 DAT				120 DAT			
	Plant Height (cm)	No. of leaves /plant	Plant fresh weight (g)	Plant dry weight (g)	Plant Height (cm)	No. of leaves/plant	Plant fresh weight (g)	Plant dry weight (g)
Non-fertilization	66.87	7.33	81.11	8.39	72.93	7.40	115.56	11.71
100 % NPK (Control)	78.87	8.00	111.11	9.54	93.67	8.27	174.44	15.33
HA+100 % NPK	76.23	8.53	125.56	11.28	94.20	9.13	169.44	16.78
Po+100 % NPK	80.87	8.55	121.67	10.48	91.87	8.73	160.11	15.89
Cal+100 % NPK	74.57	8.40	96.67	7.34	77.20	8.70	149.11	17.01
HA+Po+100 % NPK	78.20	8.77	107.22	9.87	94.63	8.27	172.78	16.60
HA+Cal+100 % NPK	80.33	8.43	97.78	9.71	82.97	8.50	162.89	15.29
Po+Cal +100 % NPK	80.53	8.19	103.33	12.78	80.97	8.57	162.89	14.67
HA+Po+Cal	76.33	8.43	96.11	9.79	87.00	8.47	155.11	14.36
HA+Po+Cal+25 % NPK	78.33	8.50	105.56	9.92	81.77	8.97	161.33	16.02
HA+Po+Cal+50 % NPK	81.07	8.40	103.33	10.24	88.27	8.77	177.22	15.80
HA+Po+Cal+75 % NPK	84.77	8.56	108.33	10.04	95.33	8.83	187.78	17.77
LSD 5%	5.73	0.89	13.05	NS	4.57	0.97	10.70	1.89

The treatments that contained NPK plus potassium and calcium showed higher values in most plant growth characters as compared to NPK alone. Similar results were reported by El-Bassiony (2006), Ghoname *et al.* (2007) Nabi *et al.* (2010) and Shaheen *et al.* (2013) who found that application of calcium and potassium as individually and/or mixing together resulted enhancing plant growth.

Data also revealed that treatment of 100% NPK (control) exhibit the superiority to the non-fertilization treatment for all growth traits at the two growth stages, in both seasons. These results are attributed to the role of the nitrogen in plant growth characters, as it enhances number of leaves by its simulative effect on cell division and cell enlargement. As a consequence, the number of leaves and leaf dimensions may increase. Similar observations were reported by Jayathilake *et al.* (2003), Mondal *et al.* (2004), Singh and Singh (2004), Nasreen *et al.* (2007). These results, also, can be explained by the role of phosphorus and potassium in multiple physiological processes such as photosynthesis, carbohydrate metabolism, and enhancing the translocation of assimilates and protein synthesis (Marschner, 1995, El-Desuki *et al*., 2006 a & b).

Data also exhibited that non- fertilization treatment showed the lowest values of all growth characters at both growth stages in both seasons, except for plant dry weight at 90 DAT in the second season.

B. Number of days to maturity:

Data in Table (5) point out that number of days to maturity was significantly affected by used fertilization treatments in both seasons. The shortest time for plants to mature (127.33 and 124.33day) were resulted from non-fertilization treatment in the first and second seasons respectively, while The longest time to mature (141.00 and 139.33 day) were resulted from the treatment of Pot.+Cal.+HA+75% NPK in the first season and second seasons respectively,

Data reveal that foliar spraying with calcium and potassium compounds individually and/or mixing together decreased the number of days to maturity as compared to 100% NPK alone, except for the treatment of Pot. + Cal. + HA + 75% NPK. These results were true in both seasons. Similar results were reported by Khalil *et al*. (2002), Mohamed and Hemida (2004).

C. Total bulbs yield and its components:

Data in Table (5) show that the used fertilization treatments exerted a significant effect on total bulbs yield /fed. in both seasons; and on exportable bulbs yield and culls bulbs yield in the second seasons only. Fertilizing onion plants with Pot. + Cal. +HA+75% NPK produced the highest total bulbs yield/fed (15.84 and 16.69 t/fed.), while non-fertilization treatment produced the lowest yield/fed (11.19 and 6.50 t/fed.), in the first and second seasons respectively. Data also reveal that using the treatment of HA+Po+ Cal.+75% NPK significantly increased total bulbs yield as compared to the treatment of HA +Po +Cal. alone in both seasons. Such favorable effect of mineral nitrogen on total bulbs yield might be resulted from quickly providing nitrogen uptake in roots zone which resulted in more vegetative growth. These results are in accordance with that found by Islam *et al.* (2007), Miah *et al.* (2005), Mohanty and Das (2001), Morsy *et al.* (2012) and Kandil *et al*. (2013-a). Plants that received the treatment of Pot. +Cal.+HA+75% NPK produced the highest values of exportable bulbs yield/fed (13.62 and 14.28 t/fed.) as compared to all other treatments, while the non-fertilization treatment gave the lowest values of exportable bulb yield (9.88 and 5.28 t/fed.), in the first and second seasons respectively. Similar results were obtained by El-beheidi *et al.* (2004), Mohamed and Hemida (2004), El-Tantawy and El-Beik (2009), Soleymani and Shahrajabian (2012) and Esawy *et al.* (2015).

The above results reveal to the importance of spraying with humic, potassium and calcium on yield and yield components. For the effect of spraying fertilizers with humic acid, it was found that humic acid could be resulted in an increase in plant photosynthates accumulation and plant photosynthesis rates which led to an enhancement in plant growth. This effect can be attained by improving the soil fertility and increasing the availability of nutrients in soil organic matter, consequently, it increases plant growth and yield. These data are in harmony with those observed by Sangetha and Singara (2007), Haleema *et al.* (2012) and Bettoni *et al.* (2016). Concerning calcium role, calcium is an important constituents of plant tissues and has a vital role in maintaining and modulating various cell functions (Gerasopoulos and Drogoudi, 2005; Hepler, 2005 and Ghoname *et al.*, 2007). Several factors controlling Potassium uptake by plants from the soil solution including soil texture, moisture conditions, pH, aeration and temperature (Mengel and kirkby, 1980). It was found that potassium supply in the soil is seldom adequate to achieve the important processes like as sugar transport from leaves to bulbs, enzyme activation, protein synthesis and cell extension, which finally determine bulbs yield and quality during growth development (Williams and Kafkafi, 1998; Lester and Jifon, 2007; El-Bassiony, 2006; El-Desuki *et al.*, 2006; Shaheen *et al.*, 2011 and Shaheen *et al.* 2013).

Table 5. Response of days to maturity, bulb yield and yield components of onion to foliar spraying with some nutrients under different rates of NPK fertilizers in 2014/2015 and 2015/2016 seasons.

Treatments	2014 / 2015				2015 / 2016			
	Days to matur.	Total bulbs yield t/fed	Expo. bulbs yield t/fed	Culls bulb weig. t/fed	Days to matur.	Total bulbs Yield t/fed	Exp. bulbs yield t/fed	Culls bulb weig. t/fed
Non-fertilization	127.33	11.09	9.88	1.21	124.33	6.50	5.28	1.22
100 % NPK (Control)	140.67	12.57	12.24	1.32	138.67	11.79	10.14	1.65
HA+100 % NPK	140.67	12.91	12.28	1.54	134.33	10.00	8.24	1.76
Po+100 % NPK	140.00	14.20	12.72	1.47	130.33	9.21	7.95	1.26
Cal+100 % NPK	140.00	12.85	11.52	1.33	136.67	8.30	6.52	1.77
HA+Po+100 % NPK	136.00	14.47	12.78	1.69	135.67	13.21	11.71	1.50
HA+Cal+100 % NPK	140.33	12.05	11.17	1.88	132.00	10.08	8.13	1.96
Po+Cal +100 % NPK	139.00	14.22	12.41	1.81	136.33	10.14	8.53	1.61
HA+Po+Cal	139.33	12.25	11.55	1.79	134.67	10.05	8.45	1.60
HA+Po+Cal+25 % NPK	140.00	13.85	12.05	1.8	133.00	16.29	14.15	1.54
HA+Po+Cal+50 % NPK	139.67	14.98	13.00	1.79	134.67	16.58	14.17	1.67
HA+Po+Cal+75 % NPK	141.00	15.84	13.62	2.22	139.33	16.69	14.28	2.41
LSD 5%	3.87	2.18	NS	NS	5.48	4.95	4.38	1.20

Data also reveal that the lowest values of culls yield (1.21 and 1.22 t/fed.) were observed under non-fertilization treatment in the first and second seasons respectively. However, the highest values of culls yield/fed (2.22 and 2.41 t/fed.) were recorded from the treatment of Pot.+ Cal. +HA+75% NPK in the 1st and 2nd seasons, respectively (Table 5).

D. Bulb quality:

The result in Table (6) show that fertilization treatments affected significantly on bulb diameter and total soluble solids percentage (TSS%) in both seasons; and on dry matter% in the first season only.

The maximum bulb diameter (6.50 and 6.53 cm) were recorded with the treatment of HA + Po + Cal. +75% NPK, while the minimum diameters of bulbs (4.57 and 4.43 cm) were recorded under non-fertilization treatment, in the first and second seasons respectively. Application of HA +Po +Cal. plus 75% PK, significantly increased bulb diameter as compared with spraying with HA +Po +Cal. alone. This effect might be due to that the increase of nutrients elements in the soil stimulation effect of nitrogen on building up new cells and increasing the synthesized compounds which may increase bulb diameter. These findings are in accordance with those recorded by Mohanty and Das (2001), Jayathilake *et al.* (2003), Abdissa *et al.* (2011), Mozumder *et al.* (2007) and Soleymani and Shahrajabian (2012).

The average bulb diameter was increased by applying humic acid with reducing mineral fertilizers might be due to that applying humic acid increased microorganism in the soil, which transforms the ability of mobilizing unavailable forms of nutrients elements to available forms, which improves the plant growth. These results were in agreement with that found by El-Desuki (2004), Kandil *et al.* (2013-b), Bettoni *et al.* (2016) and Gala *et al.* (2016).

For the TSS% character, data clearly show that treatments of non-fertilization and HA + Po. + Cal. gave the highest T.S.S % (14.40 and 16.47%) , while treatments of HA +Po.+ Cal. +75% NPK, and HA + Po.+ 100 % NPK produced the lowest values (13.00 and14.00) in the first and second seasons respectively. Treatment of HA + Po.+ Cal. significantly gave higher values of T.S.S% as compared to HA +Po.+ Cal. +75% NPK treatment in the both seasons. These results were in partially agreement with that found by Al-Fraihat (2009), Nabil *et al.* (2010) and Diriba-Shiferaw *et al.* (2013) Shafeek *et al.* (2013). The decrease in T.S.S percentage in onion bulbs with the increase in nitrogen supply could be attributed to the increase in moisture contents of the plants. Similar results were obtained by Nabil *et al.* (2010), Abdissa *et al.* (2011) and Soleymani and Shahrajabian (2012).

The treatments which contained NPK plus humic acid exhibited higher values of T.S.S % as compared to NPK alone. Humic acid applications may led to a significant improvement in soil organic matter and improvement of the soil fertility and thus increasing nutrients availability. Hence, it improves T.S.S %. Similar results were reported by El-Desuki (2004) and Kandil *et al.* (2013-b). The treatments which contained NPK plus potassium and calcium exhibited higher values of T.S.S % as compared to NPK alone. Similar results were reported by Ghoname *et al.* (2007) and Shaheen *et al.* (2013).

Table 6. Response of bulb quality of onion to foliar spraying with some nutrients under different rates of NPK fertilizers in 2014/2015 and 2015 / 2016 seasons.

Treatments	2014/ 2015			2015 / 2016		
	Bulb Diam. (cm)	T.S.S %	D.M %	Bulb Diam. (cm)	T.S.S %	D.M. %
Non-fertilization	4.57	14.40	13.97	4.43	14.57	11.07
100 % NPK (Control)	6.17	13.23	13.00	6.20	14.87	13.28
HA+100 % NPK	6.30	13.97	13.22	6.03	16.13	13.71
Po+100 % NPK	6.20	14.03	14.05	6.33	15.97	13.15
Cal+100 % NPK	6.23	14.13	13.70	6.30	16.43	13.86
HA+Po+100 % NPK	6.07	14.30	12.56	6.40	14.00	9.58
HA+Cal+100 % NPK	6.10	14.10	13.13	6.00	15.50	12.06
Po+Cal +100 % NPK	6.23	13.40	12.22	6.20	14.03	13.65
HA+Po+Cal	6.07	14.10	12.57	6.07	16.47	12.29
HA+Po+Cal+25 % NPK	6.27	13.87	12.99	6.13	15.10	14.33
HA+Po+Cal+50 % NPK	6.17	13.23	13.15	6.27	15.37	13.63
HA+Po+Cal+75 % NPK	6.50	13.00	13.10	6.53	15.90	14.15
LSD 5%	0.21	0.49	1.00	0.41	1.50	NS

Data in Table (6) show that the highest values of dry matter% (14.05 and 14.33 %) were obtained from treatment of Po.+100 % NPK in the first season and from the treatment of Po.+ Cal.+HA+25 % NPK in the second season, respectively. While, the lowest values (12.22 and 9.58 %) were obtained by the treatment of Po. + Cal. + 100 % NPK in the first season and by treatment of HA.+ Po.+ 100 % NPK in the second season, respectively. Also, it was found that the treatment of Po. + 100% NPK in the first season and the treatment of Cal.+100% NPK in the second season increased dry matter % as compared to 100 %NPK alone. Also, the application of HA +Po+Cal. Plus 25% NPK increased dry matter% as compared to application of HA +Po +Cal. alone. These result may be due to the role of different nutrients on increasing production of assimilates and dry matte%. Jayathilake *et al.* (2003) Barakat *et al.* (2004), Geries *et al.* (2007), El-Desuki (2004) and Kandil *et al.* (2013-b) attained similar results.

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استجابة البصل للرش الورقي ببعض العناصر الغذائية تحت معدلات التسميد بالعناصر الكبري

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أقيمت هذه التجربة خلال موسمين متعاقبين 2014 / 2015 و 2015 / 2016. وقد كان التصميم المستخدم هو القطاعات كاملة العشوائية (RCBD) مع استخدام ثلاث مكررات وكانت معاملات التسميد هى كما يلى: 1- بدون تسميد. 2- معاملة الكنترول (التسميد بالمعدل الموصي به وهو 120، 45، 24 كجم/ فدان نيتروجين – فوسفور – بوتاسيوم). 3- الهيوميك + (100% نيتروجين – فوسفور – بوتاسيوم). 4- بوتاسين +(100% نيتروجين – فوسفور – بوتاسيوم). 5- كالفروت +(100% نيتروجين – فوسفور – بوتاسيوم). 6- هيوميك + بوتاسين + (100% نيتروجين – فوسفور – بوتاسيوم). 7- هيوميك + كالفروت + (100% نيتروجين – فوسفور – بوتاسيوم). 8- بوتاسين + كالفروت + (100% نيتروجين – فوسفور – بوتاسيوم). 9- هيوميك + بوتاسين + كالفروت. 10- هيوميك + بوتاسين + كالفروت + (25% نيتروجين – فوسفور – بوتاسيوم). 11- هيوميك + بوتاسين + كالفروت + (50% نيتروجين – فوسفور – بوتاسيوم). 12- هيوميك + بوتاسين + كالفروت + (75% نيتروجين – فوسفور – بوتاسيوم). وقد تم الحصول على النتائج التالية: *ادت معاملة كالفروت + بوتاسين + هيوميك + 75% نيتروجين – فوسفور – بوتاسيوم الي الحصول علي أعلي القيم من طول النبات في أعمار 90و120 يوم من الشتل في كلا الموسمين والى تحقيق أعلي القيم من الوزن الجاف للنبات والوزن الجاف للبصلة فى عمر 120 يوم من الشتل فى كلا الموسمين. فى حين أظهرت معاملة عدم التسميد أقل القيم من طول النبات ، وقطر البصلة والوزن الغض للنبات والأوراق والأبصال والوزن الجاف للنبات وللأوراق والأبصال في عمر 90و 120 يوم من الشتل واقل القيم من عدد الايام حتى الحصاد في الموسمين.* وعموما حققت معاملة كالفروت + بوتاسين + هيوميك + 75% نيتروجين – فوسفور – بوتاسيوم، أعلي القيم من المحصول الكلى للابصال، وقطر البصلة، والنسبة المئوية للمواد الصلبة الذائبة الكلية والنسبة المئوية للمادة الجافة فى الابصال, في كلا الموسمين.