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EFFECT OF POTASSIUM APPLICATION METHODS AND SOME MICRONUTRIENTS ON GROWTH, YIELD AND STORABILITY OF GARLIC

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ABSTRACT

Two field trials were conducted on garlic clone Sids-40, in the vegetable private farm at Kafr Meet Fars, Dakahlia Governorate, during 2000/2001 and 2001/2002 seasons to study the effect of application methods of K-fertilizer (soil application, foliar application and 50% soil application + foliar), either single and/or in combination with mixed of micronutrients (Fe, Ze and Mn) at 0, 150 and 300 ppm as a foliar application at 60, 90 days after planting on plant growth, yield and its components, as well as chemical constituents and storability of bulbs.

Almost all the parameters of the garlic plants received K-fertilizer as a 50% soil application + foliar application significantly increased as compared with other application methods. Besides, the most interesting observation was the increasing of the storability by application K_2O as 50% soil application + foliar application followed by soil application in both seasons. On the other hand, foliar application of micronutrient at 300 ppm caused significant increases in plant height, number of leaves, shoot dry weight and bulbing ratio as well as total yield and bulb weight and diameter. Moreover, this treatment significantly increased concentration of TSS, N, P, K and micronutrients (Fe, Zn and Mn) in cloves comparing with those of the plants of the other treatments. However, weight loss percent of bulbs was significantly reduced during the storage period at 90 and 120 days. The combined treatments of K_2O application methods and micronutrients levels were generally more effective than with single ones. The best results were obtained by using K_2O as 50% soil application + foliar application with foliar application of micronutrients at 300 ppm. Therefore, this treatment could be recommended for raising garlic yield and improving bulb quality during the storage period as well as lowering the productive cost under similar conditions to this work.

INTRODUCTION

Garlic (*Allium salivum* L.) is one of the most important bulb vegetable crops and is next to onion in importance. It is commonly used as a spice or in the medicinal purposes. In Egypt, it has been generally cultivated for both local consumption and export. Therefore, increasing garlic yield and improving bulb quality are essential aims for both growers and consumers, but it usually depends on many factors especially that influence the plant growth throughout the growth period. Potassium nutrition is one of major factors that affect growth, yield and quality of garlic. It plays a vital role for a normal cell division, translocation of carbohydrates, reduction of nitrates and particularly in meristems; on the other hand, potassium doesn't appear to represent a permanent structural component; but it has a metabolic role (Black, 1960).

There are some problems which prevents the garlic plants from using sufficient amounts of potassium to obtain high productivity, such as potassium ions are adsorbed by clay minerals in the clay soils

(Schouwenburg and Schuffelen, 1963) and/or interlayer fixation of minerals (Graham and Lopez, 1969). Such soil fertilization problems can only be solved by foliar fertilizer application (Alexander, 1986). On the other hand, foliar fertilization is more economical than root application due to the higher degree of applied nutrients utilization and the continuous increases in the costs of using chemical fertilizers, which makes the nutrients more efficient. It is a quick and efficient method of supplying micro elements in particular. It can, also be used to satisfy acute needs of macro nutrients (Franke, 1986).

Several investigators reported that garlic plants growth, yield and storability were generally markedly advanced by potassium fertilization (Das *et al.*, 1985; Setty *et al.*, 1989; Eid *et al.*, 1991 ; Wang *et al.*,1992; Salvaraj *et al.*, 1993 and Mohd *et al.*, 1994). Similar conclusions had been shown on other crops, i.e. soybeans yields increases by the foliar fertilization of N, P, K and Sulfur (Garcia and Hanway, 1976), K-foliar application significantly increased plant growth and yield of pea (El-Habbasha *et al.*, 1996 and Mohamed, 1998) and El-Sawy *et al.* (2000 a) found that K-foliar application increased potato growth and yield.

With regard to micronutrients, several investigators indicated that soaking cloves or spraying garlic plants enhanced plant growth, stimulated dry matter accumulation and increased bulb yield and quality (Hilman and Asandhi, 1987; Guadi *et al.*, 1988; Eid et al., 1991, Ibrahim et al., 1991, Saravanan and Nambisan, 1994, Phor *et al.*, 1995; Abdel-Hamied, 1997 and Abdel-Fattah et al., 2002).

Thus, this study was planned to determine the effects of application methods of K-fertilizer and some micronutrients (Fe + Zn + Mn), in addition to their interactions on garlic productivity and storability under the conditions of Dakahlia District.

MATERIALS AND METHODS

Two field experiments were carried out in vegetable private Farm at Kafr Meet Faris, Dakahlia Governorate, during two growing seasons of 2000/ 2001 and 2001/2002, to study the effects of application methods of potassium fertilizer and micronutrients (Fe, Zn and Mn) on garlic (Sids-40) growth, yield and its components, as well as chemical constituents in cloves and bulb storability. The soil of the experimental field was clay loam in texture with pH 7.9. Available N, P and K contents were 19.6 - 22.3, 2.6 - 2.9 and 290 - 310 ppm during the first and second seasons, respectively. Each experiment included 9 treatments which were 3 methods of K-application and 3 levels of micronutrients as follows:

a- Potassium application methods:

1- Soil application, full recommended rate of K-fertilizer (96 kg K_2O/fed as potassium sulphate 48% K_2O) was added in two equal doses 60 and 90 days after planting.

2- Foliar application of 2% K_2O solution (as potassium sulphate 48% K_2O), added in four times 60,75, 90 and 105 days after planting in the rate of 400 L/fed in each.

3- 50% soil application (48 Kg K_2O) + foliar application of 2% K_2O (as potassium sulphate 48% K_2O), in two times at 60 and 90 days after planting in the rate of 400 L/fed in each).

b- Micronutrients:

The mixture of Chelated micronutrients Fe, Zn and Mn (1:1:1) was supplied as a foliar application in three levels (0, 150 and 300 ppm) at 60 and 90 days after planting in the rate of 300 L/fed.

The treatments were laid out in split plot design with three replicates. Each experimental basic unit was 17.5m^2 which contained 5 rows, 5 m long and 0.7 m width. The application methods of potassium fertilizer were applied in the main plots.

Planting was carried out during the first week of October for both seasons. Uniform cloves were hand-planted on both sides of the ridges at 10 cm apart. All the plants were fertilized with 120 kg N/fed (ammonium sulphate, 20.5% N) and 72 kg P_2O_5/fed (superphosphate, 15.5% P_2O_5) after 30 and 60 days from planting. The other cultural practices for garlic commercial production were used according to the instructions laid down by the Ministry of Agriculture, Egypt. The harvesting was done 180 days after planting in both seasons.

Data recorded:

Growth parameters:

A random sample of ten plants was taken from each plot after 120 days from planting to estimate plant height, number of leaves/plant, shoot dry weight/plant and bulbing ratio.

Yield and its components:

At harvest time, marketable plants of each plot were cured, 15 days after harvest weighted in kg and converted to record as total yield (ton/fed). A random sample (10 bulbs) was taken from each treatment to determine bulb weight and diameter, as well as the number of cloves/bulb and clove weight.

Chemical analysis:

Samples of the dried cloves were ground, wet digested as described by Hesse (1971) and their nitrogen (N), phosphorus (P), potassium (K) iron (Fe), Zinc (Zn) and manganese (Mn) contents were determined according to the methods described by Pregl (1945), John (1970), Brown and Lilleland (1946) and Chapman and Pratt (1961), respectively. Total soluble solids (TSS) was determined according to A.O.A.C. (1970).

Storability:

After curing, random samples (10 kg of marketable yield from every plot) were taken, stored at the normal room conditions (Table 1) and total weight loss (%) was recorded monthly during five months of storage.

Data obtained during the two seasons of the study were statistically analyzed according to Gomez and Gomez (1984).

Table (1): Average (maxi. + min.) of air temperature and relative humidity in store room during 2001 and 2002 seasons.

Months	2001		2002	
	Temp. C°	Humidity %	Temp. C°	Humidity %
May	16.7	62	17.2	64
June	19.5	64	20.1	66
July	21.9	68	22.4	69
August	22.9	71	23.3	70
September	22.4	69	22.8	69

RESULTS AND DISCUSSION

1-Vegetative growth:

1.1- Effect of K-fertilizer application methods:

Data presented in Table (2) show that plant height, shoot dry weight/plant and bulbing ratio in both seasons and number of leaves in the second season only were significantly increased with supply 50% K-fertilizer as a soil application + foliar application in comparison with other treatments. These results may be due to the beneficial effect of the applied-K as a foliar beside the soil application during plant growth periods is available by plants. These results are in agreement with those of El-Habbasha *et al.* (1996) and Mohamed (1998) on pea and El-Sawy *et al.* (2000 b) on potato.

1.2- Effect of micronutrients:

The same data in Table (2) reveal that foliar application of micronutrients (Fe + Zn +Mn) exerted significant increases on all studied parameters of vegetative growth in both seasons of the study. In this connection, plants sprayed with micronutrients 300 ppm were generally stocky and healthy in appearance than other treatments. These results could be attributed to the effective role of such micronutrients in controlling various enzymes activities and photosynthetic pigments formation, consequently affecting plant growth. The obtained results are in harmony with those reported by Guadi *et al.* (1988), Eid *et al.* (1991), Abdel-Hamied (1997) and Abdel-Fattah *et al* (2002).

1.3- Effect of interaction between K-app. methods and micronutrients:

It is obvious from the same data in Table (2) that all vegetative growth characteristics are not affected by interaction, except the shoot dry weight in both seasons. In general, plants received 50% K-fertilizer (soil application) + K-foliar application with sprayed 300 ppm micro-nutrients gave the highest values of plant growth in both seasons followed by the soil application method with the same treatment of micronutrients. Similar results were reported by Eid *et al.* (1991).

2- Yield and its components:

2.1- Effect of K-fertilizer application methods:

Data illustrated in Table (3) show the effect of application methods of K-fertilizer on yield and its components of garlic. Such data indicate that the soil application of K-fertilizer with foliar-K significantly increased total yield, bulb weight and diameter as well as number of cloves and clove weight than the other methods in both seasons. The positive effect of this application method

of K may be due to the rapid absorption and utilization of foliar-K by garlic plants beside the available-K in the soil. The obtained results are in accordance with those of Das et al. (1985), Setty *et al.* (1989), Wang *et al.* (1992) and El-Sawy *et al.* (2000 b).

Table (2) : Vegetative growth characters of garlic plants as affected by potassium application methods and micronutrients levels on 2000/2001 (I) and 2001/2002 (II) seasons.

Characters / Treatments		Plant height (cm)		Number of leaves/ plant		Shoot dry weight/ plant (gm)		Bulbing ratio	
		I	II	I	II	I	II	I	II
Application methods:									
Soil application		93.96	90.77	11.29	10.89	16.71	15.35	0.31	0.32
Foliar application		91.07	88.96	11.44	10.85	14.13	13.86	0.33	0.34
Soil + foliar application		95.26	92.4	11.74	11.55	17.58	17.20	0.30	0.30
L.S.D at 5 %		02.29	02.29	N.S	00.47	00.80	01.98	0.001	0.02
Micronutrients:									
Control		90.96	88.66	11.22	10.78	15.18	14.57	0.33	0.32
150 ppm		93.40	90.74	11.51	11.00	15.86	15.12	0.32	0.33
300 ppm		95.92	92.74	11.74	11.51	17.38	16.72	0.30	0.31
L.S.D at 5 %		00.44	00.44	00.12	00.15	00.50	00.89	0.001	0.01
Interactions: App. methods / Micro.									
Soil application	Control	91.33	89.11	11.11	10.33	15.88	14.32	0.33	0.33
	150 ppm	93.44	90.89	11.11	10.77	16.86	15.32	0.31	0.33
	300 ppm	97.11	92.33	11.66	11.55	17.40	16.42	0.29	0.31
Foliar application	Control	88.33	87.33	11.00	10.66	12.97	12.92	0.34	0.35
	150 ppm	92.22	89.00	11.66	10.88	13.36	13.10	0.33	0.34
	300 ppm	92.66	90.55	11.66	11.22	16.10	15.56	0.32	0.33
Soil app. + Foliar app.	Control	93.22	89.55	11.55	11.33	16.70	16.47	0.32	0.31
	150 ppm	94.55	92.33	11.77	11.55	17.37	16.95	0.31	0.30
	300 ppm	98.00	95.33	11.89	11.77	18.66	18.18	0.28	0.30
L.S.D. at 5 %		N.S	N.S	N.S.	N.S	00.86	01.54	N.S	N.S

2.2- Effect of micronutrients:

Data in Table (3) indicate that total yield and its components, except of the number of cloves/bulb in the second season were better with spraying the plants with mixture of micronutrients (Fe + Zn + Mn). Moreover, application of micronutrients at 300 ppm was more effective than the other treatments. These increases might be ascribed to the favourable role of the used micronutrients in pigments formation, photosynthesis activation and carbohydrates assimilation diverted to the bulbs which represent the

economic part of plant (Hilman and Asandhi, 1987). Similar results were reported by Guadi *et al.*(1988), Eid *et al.*(1991)and Abdel-Fattah *et al.*(2002).

Table (3): Garlic yield and its components as affected by potassium application methods and micronutrients levels on 2000/2001 (I) and 2001/2002 (II) seasons.

Characters / Treatments		Total yield (ton/fed)		Bulb weight (gm)		Bulb diameter (cm)		Number of cloves/bulb		Clove weight (gm)	
		I	II	I	II	I	II	I	II	I	II
Application methods											
Soil application		7.000	6.832	61.25	59.79	6.23	5.77	21.4	19.7	2.81	3.05
Foliar application		6.423	6.256	58.32	54.77	5.56	5.49	20.2	20.3	2.76	2.69
Soil and foliar app.		7.601	7.486	66.62	64.40	6.39	6.07	22.3	21.1	2.98	3.11
L.S.D	at 5 %	0.290	0.352	02.34	02.53	0.22	0.13	01.4	00.7	0.20	0.16
Micronutrients											
Control		6.363	6.356	55.74	54.52	5.81	5.62	20.1	20.3	2.73	2.74
150 ppm		7.144	6.878	62.61	60.20	6.04	5.74	21.4	20.7	2.90	2.92
300 ppm		7.517	7.340	65.83	64.23	6.35	5.96	22.4	20.1	2.92	3.20
L.S.D	at 5 %	0.100	0.078	00.87	01.18	0.11	0.07	00.4	N.S	0.15	0.05
Interactions App. methods	Micro.										
Soil application	Control	6.563	6.609	57.42	57.87	6.15	5.61	20.3	20.0	2.75	2.90
	150 ppm	6.997	6.781	61.23	59.33	6.09	5.70	21.3	19.7	2.85	3.03
	300 ppm	7.440	7.105	65.10	62.17	6.46	6.01	22.7	19.3	2.83	2.23
Foliar application	Control	5.953	5.800	52.17	50.77	5.24	5.35	18.7	20.3	2.75	2.50
	150 ppm	6.570	6.254	57.75	54.77	5.65	5.51	20.7	20.3	2.77	2.69
	300 ppm	6.747	6.714	59.03	58.77	5.83	5.60	21.3	20.3	2.77	2.89
Soil app. + Foliar app.	Control	6.573	6.657	57.63	54.93	6.04	5.90	21.3	20.7	2.7	2.82
	150 ppm	7.867	7.600	68.85	68.50	6.38	6.03	22.3	22.0	3.08	3.03
	300 ppm	8.363	8.200	73.37	71.77	6.75	6.26	23.3	20.7	3.17	3.47
L.S.D.	at 5 %	0.180	0.136	01.50	2.063	0.19	0.12	N.S	N.S	N.S	N.S

2.3- Effect of Interaction between K-app. methods and micronutrients:

It is clear from data in Table (3) that there were significant interactions between application methods of K-fertilizer and micronutrients (Fe + Zn + Mn) on total yield, bulb weight and bulb diameter in both seasons. Number of cloves/bulb and clove weight were not significantly influenced in both seasons. In general, plants fed by 50% K-fertilizer as a soil application and sprayed with micronutrients at 300 ppm produced the highest values. These results coincide with those of Eid *et al.* (1991) and El-Sawy *et al* (2000 b).

3- Chemical constituents:

2.1- Effect of K-fertilizer application methods:

. Data in Table (4) evident show that application methods of K-fertilizer had a significant effect on TSS, N, P, K and micronutrients (Fe, Zn and Mn) in cloves. All elements concentrations in cloves were significantly increased with the soil application of 50% K-fertilizer + K-foliar sprayed followed by the soil application method in both seasons. These results are in agreement with those of Eid *et al.* (1991).

Table (4): Chemical constituents in cloves of garlic as affected by potassium application methods and micronutrients levels and their interactions (average two seasons).

Characters / Treatments		T.S.S (%)	Macro-elements (%)			Micro-elements (ppm)		
			N	P	K	Fe	Zn	Mn
k-application methods								
Soil application		5.81	2.36	0.55	2.33	171	123	57.78
Foliar application		5.38	2.26	0.53	2.22	162	116	52.56
Soil and foliar app.		6.17	2.51	0.58	2.41	182	128	62.44
L.S.D at 5 %		0.34	0.15	0.03	0.11	5.97	2.76	2.60
micronutrients-levels								
Control		5.56	2.16	0.53	2.26	163	117	52.76
150 ppm		5.71	2.29	0.55	2.30	171	123	57.67
300 ppm		6.09	2.67	0.58	2.40	181	127	62.33
L.S.D at 5 %		0.25	0.17	0.03	0.05	4.14	2.39	2.69
Interactions: App. methods	Micro.							
Soil application	Control	5.46	2.15	0.52	2.27	164	117	52.67
	150 ppm	5.82	2.29	0.56	2.31	170	123	57.67
	300 ppm	6.16	2.63	0.57	2.42	180	129	63.00
Foliar application	Control	5.22	2.08	0.51	2.18	154	112	47.00
	150 ppm	5.19	2.21	0.52	2.21	162	116	53.00
	300 ppm	5.73	2.50	0.55	2.30	169	121	57.67
Soil application + Foliar app.	Control	6.00	2.26	0.55	2.35	171	123	58.67
	150 ppm	6.12	2.38	0.57	2.38	181	129	62.00
	300 ppm	6.39	2.88	0.61	2.48	195	134	66.33
L.S.D. at 5 %		0.43	0.29	0.05	0.09	7.17	4.15	4.67

3.2- Effect of micronutrients:

Data in Table (4) show that TSS % and all concentrations of elements in cloves were significantly increased due to spraying the plants with mixture of micronutrients (Fe + Zn + Mn) at 300 ppm comparing with the untreated plants. These results agree with those reported by Eid *et al.* (1991) and Abdel-Fattah *et al.* (2002).

3.3- Effect of interaction between K-app. methods and micronutrients:

It is obvious from data in Table (4) that the interaction between application methods of K-fertilizer and micronutrients (Fe + Zn + Mn) levels had significant effects on all chemical constituents in cloves. The highest values of TSS% and all elements were shown when garlic plants supplied

50% of K-fertilizer as a soil application and sprayed with 300 ppm micronutrients. Similar results were obtained by Eid *et al.* (1991).

4- Storability:

4.1- Effect of K-fertilizer application methods:

Data in Table (5) reveal that the total weight loss percentage of bulbs was not significantly affected during storage period in both seasons. However, it increased by increasing the storage period and reached its maximum values at the fifth month. The lowest total weight loss percentage was obtained by applied-K at 50 % in the soil + K-foliar application comparing with other treatments. These results may be due to increase dry matter in plants (Table 2) and K-element in cloves (Table 4). Similar results were reported by Osman *et al.* (1991).

4.2- Effect of micronutrients:

Data in table (5) indicate that bulb storability of plants sprayed with micronutrients (Fe + Zn + Mn) was better than that of the untreated plants. Moreover, application of micronutrients at 300 ppm was more beneficial than the application once. These results are in harmony with those of Eid *et al* (1991), Abdel-Hamied (1997) and Abdel-Fattah *et al.* (2002).

Table (5): Weight loss percentage of garlic as affected by potassium application methods and micronutrients levels and their interactions (average two seasons).

Characters / Treatments		Weight loss (%) during the storage period				
		30 days	60 days	90 days	120 days	150 days
K-application methods						
Soil application		26.93	39.31	45.47	48.86	50.72
Foliar application		28.33	43.62	49.38	54.13	66.50
Soil and foliar application		24.93	36.40	42.74	46.46	47.92
L.S.D at 5 %		01.22	01.29	01.59	06.76	01.21
Micronutrients–levels.						
Control		28.86	43.57	49.62	54.91	55.42
150 ppm		26.35	39.14	45.49	48.94	51.22
300 ppm		24.48	36.61	42.48	45.61	48.49
L.S.D at 5 %		00.65	00.56	00.62	05.66	00.78
Interactions:						
App. Methods	**Micro.**					
Soil application	Control	28.98	43.58	49.95	52.62	53.83
	150 ppm	26.24	38.61	44.13	48.49	50.64
	300 ppm	24.57	35.73	42.34	45.47	47.70
Foliar application	Control	30.68	47.99	53.24	62.35	61.26
	150 ppm	27.17	43.47	49.65	51.97	55.93
	300 ppm	26.14	39.39	45.26	48.77	52.31
Soil app. + Foliar app.	Control	27.43	39.15	45.68	49.75	51.19
	150 ppm	24.62	35.33	42.69	46.36	47.08
	300 ppm	22.73	34.70	39.85	43.28	45.47
L.S.D. at 5 %		01.13	00.97	01.07	09.80	01.36

4.3- Effect of Interaction between K-app. methods and micronutrients:

It is clear from data in Table (5) that the positive interactions between application methods of K-fertilizer and micronutrients (Fe + Zn + Mn) levels often observed on storability of bulbs. Application of 50 % K-fertilizer in the soil + K-foliar with foliar spray of micronutrients at 300 ppm gave the lowest total weight loss percentage during storage period. These results agree with those of El-Sawy *et al.* (2000 a) on potato.

From the results of this study, it could be concluded that, application 50% of k-fertilizer + foliar-K with spraying the plants with mixture of micronutrients (Fe + Zn + Mn) at 300 ppm are the recommended treatments for increasing garlic yield, improving bulb quality of garlic and lowering cost production (as a result of saving one third of the added K-fertilizer approximately) under similar conditions to this work.

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تأثير طرق إضافة البوتاسيوم وبعض العناصر الصغرى على النمو والمحصول والقدرة التخزينية للثوم

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نفذت تجربتان حقليتان على محصول الثوم (سلالة سدس-٤٠) فى مزرعة خضر خاصة بكفر ميت فارس بمحافظة القليوبية خلال موسمى الزراعة ٢٠٠٠/٢٠٠١ و ٢٠٠١ / ٢٠٠٢ م لدراسة تأثير طرق إضافة السماد البوتاسى بمعدل ٩٦ كجم بو، أيضاً (إضافة أرضية ، إضافة بالرش (عند ٦٠، ٧٥، ٩٠ و١٠٥ يوم بعد الزراعة) و ٥٠% أرضى + رش (عند ٦٠ و ٩٠ يوم بعد الزراعة) كلٌ منها منفرداً أو مع خليط من عناصر الصغرى (حديد + زنك + منجنيز) عند مستويات صفر ، ١٥٠ و ٣٠٠ جزء فى المليون على نمو النباتات ومحصول الأبصال ومكوناته وكذلك أيضاً المحتويات الكيماوية فى الفصوص ونسبة التفقد فى وزن الأبصال خلال فترة التخزين . وقد وزعت المعاملات فى قطع منشقة مرة واحدة فى ثلاثة مكررات. ويمكن تلخيص النتائج المتحصل عليها فيما يلى :-

أدت اضافة البوتاسيوم بطريقة ٥٠ % أرضى + الرش بمحلول البوتاسيوم عن ٦٠ و ٩٠ يوم بعد الزراعة إلى حدوث زيادات ملموسة فى ارتفاع النبات، عدد الأوراق ، الوزن الجاف لعرش النبات ونسبة التبصيل، وكذلك المحصول الكلى ومتوسط وزن وقطر البصلة وبجانب ذلك زادت معنوياً تركيزات المواد الصلبة الكلية والنيتروجين والفوسفور والبوتاسيوم والعناصر الصغرى (حديد – زنك – منجنيز) فى الفصوص، وقد أدت أيضاً إلى حدوث انخفاض معنوى فى نسبة نقص وزن الأبصال خلال فترة التخزين متبوعة بطريقة الإضافة الأرضية فى كلا موسمى الدراسة.

ومن ناحية أخرى أدى رش النباتات بمعدل ٣٠٠ جزء فى المليون بخليط العناصر الصغرى إلى حدوث زيادات معنوية فى معظم صفات النمو الخضرى للنباتات وكذلك المحصول الكلى ومكوناته، كما أدى إلى زيادة تركيزات المواد الصلبة الكلية والنيتروجين والفوسفور والبوتاسيوم وكذلك العناصر الصغرى (حديد – زنك – منجنيز) فى الفصوص مقارنة مع معاملة الكنترول، وبجانب ذلك أدى إلى نقص نسبة انخفاض وزن الأبصال عند نهاية فترة التخزين معنوياً.

التفاعلات بين طرق إضافة البوتاسيوم والرش بالعناصر الصغرى لوحظت فى حالات كثيرة ، ولقد كانت أفضل النتائج هى بطريقة إضافة البوتاسيوم ٥٠ % أرضى + ٥٠ % رش مع الرش بمخلوط العناصر الصغرى بمعدل ٣٠٠ جزء فى المليون.

وبناءً على ماتقدم، يمكن التوصية باستخدام هذه المعاملة لرفع إنتاجية الثوم وتحسين جودة الأبصال وقابليتها للتخزين وكذا تقليل تكاليف الإنتاج تحت الظروف المشابهة لظروف هذا البحث.