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EFFECT OF SOME TREATMENTS ON GLOBE ARTICHOKE SEED PORODUCTION UNDER EGYPTIAN CONDITION A-FOLIAR SPRAY WITH BORON AND POTASSIUM ON HEAD AND SEED YIELD.

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ABSTRACT

Two field experiments were conducted at Baramoon Research Station, Mansoura, Dakahlia Governorate, Egypt during the two successive seasons of 2011/12 and 2012/13, to study the effect of foliar spray with boron (25 and 50 ppm) or potassium (1000 and 2000 ppm) and their combination on earliness, yield and quality, chemical composition as well as seed yield of globe artichoke (*Cynara scolymus* L.) c.v green globe.

The obtained results could be summarized as follows:-

- Early yield, total yield and head characters were significantly increased, in both seasons, in response to foliar spray with boron or potassium levels and there mixture.
- Foliar spray with 50 ppm B + 2000 ppm K significantly affect the concentration of N,P,K,total sugars and inulin of globe artichoke in both seasons of study**.**
- Number and weight of seeds /head as well as weight of100 seeds and germination percentage on different orders were positively and significantly responded to foliar spray with boron or potassium levels and their mixture in the two seasons. While, No significant difference was found between 50 ppm B + 2000 ppm K or 50 ppm B + 1000 ppm K.

In general, most studied characteristics of the plants received foliar spray with boron and potassium were better than those of control. Increasing the rate of foliar spray with boron and *I*or potassium significantly increased early yield total yield, head characters ,chemical components and head position characters including number and weight of seeds/ head as well as weight of100 seeds and germination percentage.

It could be stated that, foliar spray of globe artichoke with boron at 50 ppm and potassium at 1000 ppm is a promising practices for getting the highest seed yield and quality under local Egyptian conditions

INTRODUCTION

Egypt is ranked the fifth world producer of globe artichoke with the highest productivity per unit area in the world (F.A.O., 2010), Globe artichoke was cultivated on 21450 fed. in 2011,which produced 191117 ton of bud yield with an average of 8.910 ton fed^{-1} (the year book of Agric. Statistics and Economic Agric. Dept., Ministry of Agric., Egypt). it is grown in El-Behira, Alexandria and Giza governorates and newly reclaimed land. Nowadays, more attention is given to promote artichoke production in order to satisfy the increased demands of the local consumption as well as for exportation purposes. The demands for export to European markets were increased during the period from November to February. Thus, factors affecting the early production during this period are of major importance for promoting globe artichoke exportation to European markets since the peak of production

occurs usually during March to May. potassium (K), is a mineral nutrient required in a large amount to plants. It is an essential mineral element for plants as it involved in many biochemical and physiological processes vital to plant growth, yield, quality and stress (Aown *et.el*, 2012). It is also involved in stomatal regulation of transpiration and photosynthesis, photophosphorylation, transportation of photo assimilates from source tissues via the phloem to sink tissues, enzyme activation, and maintenance of tissue water relation and stress tolerance (Marschner, 2013).

Another important factor that did not investigate intensively on globe artichoke, but found to have a remarkable effect on the growth, yield and quality of many other vegetable crops, is boron (Panigrahi *et al*. 1990, on cauliflower; Eid *et al*. 1991, on garlic; Singh and Riwari 1996, on onion; Patil, 2001, on okra; Rai *et al*., 2002, on tomato).

Boron is important for metabolism and growth of higher plants in cell elongation and cell division,protein metabolisms, tissue differentiation, membrane permeability, pollen germination and pollen tube growth (Marschner, 2013).

A significant relationship has been found between potassium and boron fertilizers (Hill and Morrill 1975). Also, Woodruff et al. (1987) showed that boron may need to be applied to prevent a reduction in plant yield, if the crop is given heavy applications of potassium and other intensive production practices. Shorrocks (1990) reported that effects of B on membrane permeability could lead to association between B and K. The stimulation of K accumulation by the ATPase proton pump which may account for positive correlations between K and B.

Globe artichoke is an allogamous species that is mainly propagated vegetatively by offshoots, stumps or dried offshoots (‘ovoli’) ,nowadays propagation by seeds is an important goal to overcome the problems linked to vegetative propagated.,also,it has many advantages i.e., reduction in the cost of planting ,the spread pathogens, fertilizer use ,irrigation requirement and transformation globe artichoke from a perennial to annual crop(Sergio and Ezio 2010).

The present study aims at investigating the effects of boron and potassium on earliness,
yield and quality as well as improving seed yield of globe artichoke.

MATERIALS AND METHODS

Two field experiments were conducted at the Baramoon Research Station, Mansoura, Dakahlia Governorate, Egypt (+ 7m altitude, 30^{o} 11^{-} latitude and 28^{o} 26^{-} longitude), during seasons of 2011/12 and 2012/13, to study the effect of foliar spray with boron and potassium on productivity, chemical composition and seed yield of globe artichoke (*Cynara scolymus* L.).The sowing dates were 5^{th} and 2^{th} of August in the 1^{st} and 2^{nd} seasons, respectively. The old grown pieces (stumps) were treated pre-planting with fungicides for 30 minutes and hand planted at 1 m apart between plants on the ridge and 1 m between the ridges .

Some physical and chemical properties of the experimental soil at the depth of 0-30 cm were determined according to the standard procedures as described by Page (1982).

Table (1): The physical and chemical analysis of the experimental soils.

Seasons	Physical properties (%)				Chemical properties					
	Clay	Silt	Fine sand	Coarse sand	O.M (%)	E.C. (ds/m^{-1} at 25^{o} C)	Total N (%)	Avail P (ppm)	Exch. K (ppm)	pH (1:2.5 w/v)
2011	41.42	32.11	25,21	1,26	1.73	1.20	0.21	12.79	304	8.1
2012	41.16	30.87	26,50	1.47	1.95	1.17	0.16	11.93	278	7.9

A complete randomized blocks design with three replicates was used; field experimental area was divided into plots (28 m^2). Each plot contained four rows each one was 7 m length X1m width. Each row included 7 plants.The experiment included 9 treatments, which were as follows:

1.foliar application with tap water (control)
2. foliar spray with 25 ppm B
3. foliar spray with 50 ppm B
4. foliar spray with 1000 ppm k
5. foliar spray with 2000 ppm k
6. foliar spray with 25 ppm B + foliar spray with 1000 ppm k
7. foliar spray with 25 ppm B + foliar spray with 2000 ppm k
8. foliar spray with 50 ppm B + foliar spray with 1000 ppm k
9. foliar spray with 50 ppm B + foliar spray with 2000 ppm k

- Boron and potassium were applied to plants as foliar spray four times at 45, 60, 75 and90 days after planting.
- Boric acid (17% B) is a source of boron and potassium sulfate (50% k_2o) is a source of potassium .

Each plot received 4 liter aqueous solution and the control plants (check) were sprayed with distilled water and spreading agent only. Other agricultural practices were conducted according to recommendations.

Recorded data:

The following data were recorded:-

1-Yield and its components:- i.e., early yield(all flower heads were harvested, calculated in ton /fed., from the beginning of harvest until the end of February) and total yield (all flower heads were harvested from the beginning of harvest until the end of season). Head characters (A random sample of 10 flower heads was taken from each plot to measure average weight and length of flower heads).

2- Chemical composition.

The dry matter of receptacle, 120 days after planting, were finely ground and wet digested for N, P and K determination.

- Total nitrogen, phosphorus and potassium were determined according to the methods described by (A.O. A. C. 1990)
- Total sugars were determined according to Forsec, (1938).

- Inulin was determined according to Winton and Winton (1958).

3-Head position characters:- when plants started blooming, primary heads were cut away to favor the development of the remaining heads from 5 plants for each plot **,** At the end of the harvest, the secondary ,tertiary and quaternary order were collected separately to measure average number and weight of seeds / head as well as weight of100 seeds and germination percentage

4-Statistical analysis:

The data of both experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980) and Comparisons among means of treatments were tested using Duncan multiple range test.

RESULTS AND DISCUSSION

1. Yield and its components:

Data presented in Table (2) show that early yield, total yield and head characters i.e. weight, length and diameter were significantly increased, in both seasons, in response to foliar spray of boron and potassium, compared with the control, results also indicated that plants treated with foliar of 50 ppm B + 2000 ppm K gave the highest values, while the untreated plants followed by plants received only 25ppmB yielded the lowest values in both seasons, respectively. Also, no significant effects were found between foliar spray with 50 ppm B + 2000 ppm K or 50 ppm B + ppm 1000 K in both seasons on length and weight of flower as well as early yield in the first season only.

Table 2: Yield and head characters of globe artichoke as affected by foliar spray with Boron and Potassium, during 2011 / 2012 and 2012 / 2013 seasons.

Treatments	Early yield ton\fed		Total yield ton\fed		head characters					
					Length(cm)		Weight(gm)		Diameter(cm)	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Cont	1.451g	1.488g	7.425i	7.592i	9.8f	10.4f	157.6f	178.9f	7.95g	8.02g
25 ppm B	1.496f	1.521f	7.629h	7.712h	10.2ef	11.1ef	167.2f	187.5ef	8.14fg	8.33f
50 ppm B	1.510f	1.561e	7.921g	7.802g	10.7e	11.5e	188.4e	196.9e	8.29f	8.75e
1000 ppm K	1.550e	1.594d	8.201f	8.105f	12.6d	13.2d	204.3d	210.8d	8.62e	8.96d
2000 ppm K	1.581d	1.619d	8.420e	8.411e	13.1cd	13.8cd	211.5cd	217.7cd	8.90d	9.15cd
25ppmB+ ppm 1000 K	1.619c	1.675c	8.609d	8.701d	13.6bc	14.0cd	218.3bc	225.3bc	9.02cd	9.29c
50ppm B+ppm 1000 K	1.689a	1.748b	8.909b	9.285b	14.2ab	15.2ab	233.3a	249.9a	9.59b	9.80b
25ppm B+2000 ppm K	1.660b	1.698c	8.719c	٨.٩٩٥c	13.8bc	14.4bc	222.9b	229.8b	9.15c	9.33c
50ppm B+2000 ppm K	1.702a	1.889a	9.183a	٩.٤٩٣a	14.8a	15.7a	238.7a	259.5a	9.85a	10.01a

S_1 = the first season. **S_2 = the second season.**

The positive effect of boron and potassium might be due to their essential roles in many important metabolic functions such as transport of carbohydrates and translocation of sugars in plant (Marschner, 2013). Such functions would directly or indirectly contribute to increase yield and its components of globe artichoke. The obtained results are in harmony with those of El-Gridly (1994) on globe artichoke, Abou El- Yazeid *et.al* (2007) on Squash, Abdur and Ihsan(2012) on tomato, they showed that early and total

fruits as well as early and total yield were significantly increased in response to foliar spray with boron.

2- Chemical composition.

Data in Table (3) clearly illustrate that foliar spray of boron and potassium significantly affect the concentration on N,P,K, total sugars and inulin of globe artichoke**.** The highest values of chemical composition produced from the foliar spray with 50 ppm B + 2000 ppm K in both seasons of study**.** No significant effects were found in both seasons in concentrations of P and inulin% on globe artichoke plants as a result of foliar spray with 50 ppm B + 2000 ppm K or 50 ppm B + ppm1000 K.while, K in the second season only.

The positive effect of boron and potassium might be due to their essential roles in many important metabolic functions such as regulation of meristematic activity, photosynthesis, respiration, energy production and protein metabolism (Dale and Lukaszewski;1998 and Bidari and Hebsur; 2011.). Such functions would directly or indirectly contribute to increase chemical composition of globe artichoke. The obtained results are in harmony with those of El-Bassiouny and Hassan (*2003*),Abd El-Dayem and Ismaeil(2007),Khayyat *et.al* (2007) and Negro *et.al* (2012).

Table 3: Chemical composition of globe artichoke as affected by foliar spray with boron and potassium, during 2011 / 2012and 2012 / 2013 seasons.

Treatments	N%		P%		K%		Total Sugars		Inulin%	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Cont	1.85h	2.02g	0.25e	0.26g	2.75f	2.92f	3.01h	3.11i	1.10e	1.19e
25 ppm B	1.96g	2.11f	0.25de	0.26fg	2.80f	3.02ef	3.07h	3.32h	1.16ef	1.25e
50 ppm B	2.00fg	2.15f	0.26cd	0.27ef	2.89e	3.07e	3.19g	3.36g	1.18e	1.29de
1000 ppm K	2.04ef	2.23e	0.27c	0.28de	3.00d	3.12de	3.30f	3.50f	1.22e	1.36cd
2000 ppmK	2.09de	2.30d	0.28b	0.29cd	3.06d	3.19d	3.43e	3.63e	1.31d	1.44c
25ppmB+1000ppmK	2.12d	2.37c	0.28b	0.30c	3.15c	3.30c	3.52d	3.77d	1.40c	1.57b
50ppmB+1000ppmK	2.27b	2.52b	0.30a	0.33ab	3.24b	3.44ab	3.74b	4.02b	1.66a	1.81a
25ppmB+2000ppmK	2.19c	2.41c	0.29b	0.316b	3.17bc	3.37bc	3.65c	3.92c	1.55b	1.64b
50ppmB+2000ppmK	2.38a	2.65a	0.31a	0.339a	3.55a	3.52a	3.89a	4.19a	1.70a	1.88a

S_1 = the first season. **S_2 = the second season.**

3- -Head position characters

Data presented in Tables (4 and 5) reveal that all studied characters i.e. number and weight of seeds*/* head as well as weight of100 seeds and germination percentage on secondary , tertiary and quaternary order were generally greater with boron and potassium treatments than the control. The highest values were obtained from 50 ppm B + 2000 ppm K treatment on both seasons of study. In general, no significant effects were found between 50ppmB+2000ppmK or 50 ppm B + ppm 1000 K on different order on both seasons. Tertiary order gave the highest values compared with secondary or quaternary order. The positive effect of boron and potassium might be due to their essential roles such as increase flower production, pollen tube elongation and germination as well as seed development (Lang 1965; Dale. and Lukaszewski 1998).

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The obtained results are in harmony with those of Agway et.al 1994; on onion, Elia *et.al* (1994), Hanafy *et al* (1995), Mauromicale and Lerna. (2000) and Ortiga 2002; on globe artichoke, Nayanmoni and Gogoi(2007)on tomato, Abdullah *et al* (2012) on strawberry and Gaetano *et al* (2012) on globe artichoke.

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تأثير بعض المعاملات على إنتاج بذور الخرشوف تحت الظروف المصرية

أ- تأثير الرش الورقى بالبورون والبوتاسيوم على محصول الرؤوس والمحصول البذرى .

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أجرى هذا البحث بالمزرعة البحثية بالبرامون التابعة لمعهد بحوث البساتين خلال موسمى الزراعة الشتوى ٢٠١٢/٢٠١١ و٢٠١٣/٢٠١٢ لدراسة تأثير الرش بمستويات مختلفة من البورون والبوتاسيوم ومخلوط منهما علي الانتاج المبكر والمحصول الكلى والجودة وانتاج البذرة فى الخرشوف صنف جرين جلوب.

أظهرت النتائج أن الرش بمختلف التركيزات من البورون والبوتاسيوم أدى إلى زيادة معنوية فى صفات المحصول الكلى والمحصول المبكروصفات الرأس ،طول و وزن وقطر، وذلك بالمقارنة بالكنترول، ولوحظ أن الزيادة فى الصفات المذكورة كان متزامنا مع زيادة مستويات البورون والبوتاسيوم كل على حده أو خليطا من كل منهما.

-استجاب محتوى التخت من النتروجين والفوسفور والبوتاسيوم والانيولين والسكريات الكلية معنويا لمعاملات الرش المذكورة خلال موسمى البحث .

-أدت المعاملات السابقة إلي تحسين فى معظم صفات رؤوس الخرشوف مثل(عدد ومحصول البذور فى الرأس بالاضافة إلى وزن ١٠٠ بذرة وكذلك نسبة إنبات البذره)، بينما لم تصل الزيادة إلى المعنوية بين الرش ب٥٠جزء فى المليون بورن +٢٠٠٠جزء فى المليون بوتاسيوم و ب٥٠جزء فى المليون بورن +١٠٠٠جزء فى المليون بوتاسيوم خلال موسمى التجربة.

- وعموما معظم الصفات تحت الدراسه زادت معنويا بالرش بالبورون والبوتاسيوم مقارنه بالكنترول . وزياده المعدلات منهما المنفرده أو المخلوطه حققت أفضل النتائج فى الحصول على أعلى محصول كلى ومبكر ذو جودة مرتفعه وكذلك المحتويات الكيماويه بالإضافه إلى عدد ومحصول البذور فى الرأس وكذلك وزن ١٠٠بذرة ونسبة الإنبات على مختلف الرتب .

- وبصفه عامه يمكن التوصيه برش نباتات الخرشوف بمحلول من البورون بتركيز ٥٠ جزء فى المليون مخلوطا مع البوتاسيوم بتركيز ١٠٠٠ جزء فى المليون وذلك للحصول على أعلى محصول بذرى ذو جودة عاليه تحت الظروف المصريه .

Table 4: Head position characters of globe artichoke as affected by foliar spray with Boron and Potassium, during 2011 / 2012 season.

Treatments	No. of Seeds/ head			Seeds weight / head			100 seeds weight			Germination percentage		
	S	T	Q	S	T	Q	S	T	Q	S	T	Q
Control	70.2e	80.6g	62.0f	3.94g	4.55h	4.73f	4.21g	4.60g	4.30f	45.5e	49.75e	40.12g
25 ppm B	74.3e	85.7g	66.3ef	4.22f	4.96g	4.92ef	4.50f	4.93f	4.69e	46.7e	51.85d	43.19fg
50 ppm B	80.6de	89.3fg	69.9def	4.81e	5.56f	5.11e	4.72e	5.03ef	4.85de	47.8de	53.15d	44.72ef
1000 ppm K	88.3cd	95.1ef	74.3cde	5.01e	6.02e	5.46d	4.92d	5.20de	4.96d	51.3cd	54.72c	46.82de
2000 ppm K	96.6c	103.8de	78.6cd	5.42d	6.44d	5.73c	5.03d	5.41d	5.04cd	52.2bc	55.09c	49.12cd
25 ppm B + 1000 ppm K	108.3b	111.2cd	85.3bc	6.40c	7.04c	5.98bc	5.20c	5.70c	5.19bc	54.8abc	55.82bc	51.05bc
50 ppm B + 1000 ppm K	120.9a	125.1ab	104.7a	7.33a	7.69ab	6.52a	5.71a	6.09ab	5.59a	56.9a	59.74a	53.82ab
25 ppm B + 2000 ppm K	115.6ab	119.3bc	90.8b	6.81b	7.42b	6.14b	5.43b	5.89bc	5.31b	55.1ab	57.02b	52.17abc
50 ppm B + 2000 ppm K	125.7a	129.3a	109.6a	7.40a	7.80a	6.60a	5.91a	6.12a	5.68a	57.9a	61.2a	54.75a

S- Secondary order T- tertiary order Q- quaternary order

Table 5: Head position characters of globe artichoke as affected by foliar spray with Boron and Potassium, during 2012 / 2013 season.

Treatments	No. of Seeds/ head			Seeds weight / head			100 seeds weight			Germination percentage		
	S	T	Q	S	T	Q	S	T	Q	S	T	Q
Control	79.8e	88.3f	65.1f	4.30f	4.99h	4.88e	4.41g	4.73c	4.46g	47.5e	51.50i	42.55d
25 ppm B	81.3e	92.3f	67.3ef	4.61f	5.31g	5.05e	4.70f	4.98c	4.78f	48.7de	53.19h	44.21cd
50 ppm B	84.6de	101.7e	70.6ef	5.12e	5.88f	5.3d	4.81ef	5.11c	5.01e	49.9de	54.74g	45.88c
1000 ppm K	92.3cd	108.3de	76.3de	5.20e	6.29e	5.87c	5.02e	5.37c	5.13de	50.2de	55.96f	48.90b
2000 ppm K	101.9c	115.4cd	83.8cd	5.81d	6.85d	6.01b	5.13d	5.7b	5.22cd	52.2cd	57.72e	50.15b
25 ppm B + 1000 ppm K	114.3b	119.8bc	90.3bc	6.73c	7.26c	6.42a	5.62c	5.91ab	5.34bc	55.8bc	59.29d	52.75a
50 ppm B + 1000 ppm K	122.2ab	132.1a	109.0a	7.50a	7.92a	6.93a	6.00a	6.22a	5.70a	58.6ab	63.89b	54.71a
25 ppm B + 2000 ppm K	119.7ab	124.3b	95.3b	7.22b	7.62b	6.70b	5.71b	6.01ab	5.49b	57.2ab	60.19c	53.65a
50 ppm B + 2000 ppm K	127.6a	139.3a	115.6a	7.70a	8.06a	7.06a	6.02a	6.29a	5.76a	60.5a	65.15a	55.11a

S- Secondary order T- tertiary order Q- quaternary order