

## **EFFECT OF ANNUAL AND PERENNIAL PRODUCTION METHODS ON SOME DIFFERENT GLOBE ARTICHOKE (*Cynara scolymus*, L.) VARIETIES**

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### **ABSTRACT**

This study was carried out at Kaha Horticulture Research Farm during the two successive seasons of 2005/2006 and 2006/2007 to study the effect of perennial and annual methods of production on growth and yield of some globe artichoke varieties.

The treatments included two different production methods; i.e., annual planting and perennial planting in addition to six varieties; i.e., Balady and Hyrious (local varieties), Green Globe, Kiss of Burgundy, Purple of Romagna and Violet Star (new varieties which were introduced in Egypt). A split system in randomized blocks design with three replicates was used in this study.

#### **The obtained results can be summarized as follow:**

- 1- The perennial production method surpassed significantly annual production method in number of offshoots /plant, plant height and leaves number/plant.
- 2- Also, perennial production method led to increasing early and total yield of the local varieties i.e. Balady and Hyrious as well as total yield of the introduced varieties i.e. Green Globe, Kiss of Burgundy, Purple of Romagna and Violet Star. In addition, it improved the tested head quality, i.e., head weight, head diameter and receptacle weight, besides increasing significantly nitrogen and protein percentage in the receptacle.
- 3- Balady and Hyrious varieties have the highest number of offshoots per plant, leaves number/plant and early yield, while Balady var. is characterized by the highest potassium percentage in its receptacle, but Hyrious var. contained the highest nitrogen and protein percentage in its receptacle.
- 4- Green Globe and Kiss of Burgundy varieties produced the highest plant height, total yield, head weight, head diameter and receptacle weight, but concerning chemical composition, receptacle of Green Globe variety contains the highest phosphorus percentage.
- 5- Using perennial method of production with Hyrious var. produced the highest number of offshoots, early yield, and nitrogen and protein percentage. Balady var. followed Hyrious var. in these traits.
- 6- Kiss of Burgundy and Green Globe varieties produced the highest head weight and head diameter when perennial method of production was used, while Green Globe was superior in head weight, but Kiss of Burgundy was superior in head length.

### **INTRODUCTION**

Globe artichoke is an important vegetable crop grown in Egypt; the government is encouraging to increase the cultivated area and yield of high quality artichoke heads to face high demand for local consumption and exportation.

Egypt has the potential to develop an excellent export industry of artichokes. The productions around Alexandria have the required climatic conditions to grow excellent quality artichokes for export. There are 3 artichoke cultivars that have been grown in Egypt for decades: Violetto di

provenza (*Violetto frances, Hyerious*) introduced to Egypt from France in the 1960, Catanase, from Italy, and Balady, the landrace cultivar. The selected Balady, and French varieties proved to be the best as regard to yielding ability during the period from December to March, El-Baz *et al.*, (1971).

Violet de Provenç'e and Romanesco were the best propagators. The number of heads per plant is relatively stable in the different strains of each the tested cultivars Foury (1979). On the other hand "Green Globe" and Salanquet F1 were the highest yields based on number of buds per plant (20.2 and 20, respectively) Pandita *et al.*, (1988). Green Globe is the most common variety with a green globular choke. Purple of Romagna- a large-headed purple choke thought to be more tender than Green Globe. Another possibility is Kiss of Burgundy, semi- thorn less variety, bred to deal with climate extremes (though more oriented to hot summers than cold winters). Recently, six new seed varieties were introduced in Egypt by Agricultural Technology Utilization and Transfer Project (A.T.U.T project) including Green Globe, Kiss of Burgundy, Purple of Romagana, Violet star, Imperial star and Emerald, including artichoke fields ranging in size from one half to (fedan). *Although* artichokes are perennial plants, they are grown as annual crops in Egypt by vegetative propagation. The disadvantages of this practice are poor stand, spread of diseases and insects as a result of poor off shoots selection.

Globe artichoke is considered one of the most curious plants you will ever encounter. It is actually a perennial herb from the thistle group scientifically it belongs to the *Astearaceae* family that includes all asters. Plants are grown as perennials and usually propagated from root divisions or off shoots (Sims *et al.*, 1977). Also plants grown from seed generally lack uniformity (Welbaum and Warfield 1992). Artichokes can not be grown reliably as perennials without winter protection where temperatures are consistently below -1° (welbaum 1994). Globe artichoke is vegetatively propagated, but the major problem of production by this method is the poor stand. This requires numerous replant causing a great variation in growth and development. Attempts have been made to grow the globe artichoke as annual from seed in Michigan (Harwood and Markarian 1968), Connecticut (Hill and Maynard, 1989). Seeds or immature plants may be placed in cold storage to increase the percentage of plants that flower during the first season, but this practice is not adapted easily to large-scale because of high commercial production cost, and is labor-intensive (Hill and Maynard, 1989). Perennial planting artichokes grown as perennials are propagated by division of crown. Rooted sections of crowns (stumps) are planted by hand. Growers generally replant, field every 5 to 10 years because after years of regrowth, the rooting area becomes crowded and the plants tend to lose vigor. The cropping cycle for annual artichokes is begun when plants are cut back from mid-April to mid-June for fall, winter, and spring harvest in late August or September for summer harvest. The plants are cut 2 to 3 inches below the soil surface to stimulate new shoot development (Schrader *et al.*, 1992). The aim of this study was to introduce perennial method in globe artichoke production to solve some problems which face the traditional method i.e. pieces of the basal rooted stems such as poor stand, high variations in plants growth as well as high cost of replanting in addition to late yield.

## MATERIALS AND METHODS

This investigation was carried out during 2005/2006 and 2006/2007 seasons at Kaha vegetables Research Farm, Horticulture Research Institute, Agricultural Research Center, to study the effect of variety and production method i.e. leaving the mother plants in the same land to produce the new yield (perennial method) and the traditional method, i.e., replanting the mother plants by pieces of the basal stem with its roots, on vegetative growth yield and yield components.

In 2001/2002 season, six new varieties were introduced in Egypt by Agricultural Technology utilization and Transfer project (A.T.U.T. project), including Green Globe, Kiss of Burgundy, Purple of Romagna and Violet Star. Imperial Star and Emerald. The seedlings of these varieties were planted at Kaha vegetables Res. Farm during 2001/2002 season to select superior individual plants within the seed grown varieties and propagated with the goal of improving productivity and quality.

In 2004/2005 season, six globe artichoke varieties i.e. Balady, Hyrious, Green Globe, Kiss of Burgandy, Purple of Romagna and Violet Star Fig (A) were planted through vegetative propagation in plots (plot area 15m<sup>2</sup>) in three replicates. At the end of May 2004, irrigation was stopped and plants are cut back 5 to 7.6cm below the surface of the soil to simulate new shoot development. on August, 15, 2005 these varieties were planted randomly in three replicates, and in the same date these varieties which were planted in the previous season were irrigated. At the end of May, 2006, irrigation was stopped, the tops of the plants which were planted on August, 15, 2005 season were removed.

In August, 2006, these varieties were planted as annual method of production and in the same date the plants of these varieties which were perennial in 2006 season were irrigated. The experimental plot area was 15 m<sup>2</sup> (consists of 3 rows one meter apart and 5m. long) and the within row spacing between plants was one meter. The experimental design was split plot system in randomized blocks with three replicates, where the main plots were assigned to production method (annual planting and perennial planting) while varieties (Balady, Hyrious, Green Globe, Kiss of Burgundy, Purple of Romagna and Violet Star) were distributed in the sub-plots. The normal cultural procedures of globe artichoke production in addition the diseases and other pests control programs were followed according to Ministry of Agriculture recommendations.

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**The following data were recorded:**

**I. Vegetative growth:**

Five plants were taken from each sub plot at the beginning of flowering stage and the following data were recorded:

**I.1. Number of off shoots per plant.**

**I.2. Plant height (cm).**

**I.3. Leaves number per plant.**

**II. Early and total yield based on number of heads per plant and per feddan (expressed as 1000 flower heads per fed.) were recorded. Early yield expressed as the number of heads produced during December till the end of February, while total yield expressed as the number of all heads produced throughout the entire growing season.**

**III. Head characteristics.**

**III.1. Head physical characteristics:**

A sample of ten heads of the first heads was taken from each sub plot to determine the following:

**III.1.a. Head weight (g.).**

**III.1.b. Head length (cm.).**

**III.1.c. Head diameter (cm.).**

**III.1.d. Receptacle weight (g.).**

**III.2. Chemical composition of the receptacle:**

A sample of ten heads of primary heads was taken from each sub plot and dried to estimate nitrogen, phosphorus, and potassium and protein percentage. Nitrogen was determined according to Koch and Mc Meekin, (1924), phosphorus was determined according to method of King, (1951), potassium was estimated according to Brown and Lilliland, (1946), while protein was determined by multiplying nitrogen values by 6.25 as described by Stewart, (1989).

All data were subjected to the proper analysis according to (S.A.S. 1996) and the means were compared using the least significant differences test (L.S.D.) at 5% (Snedecor and Cochran, 1980).

## **RESULTS AND DISCUSSION**

**I. Vegetative growth:**

**I.1. Number of offshoots per plant:**

Data in Table (1) indicate the effect of production method on No. of offshoots per plant. It is clear from these data that there were significant differences in both seasons of study and the perennial method surpassed significantly the annual method in both seasons.

Concerning the effect of variety on No. of offshoots per plant, data in the same Table showed clearly that there were significant differences in both seasons. Hyrious var. produced the highest No. of offshoots in both seasons of study followed by Balady var., but there were no significant differences among them, while they surpassed significantly all other tested varieties in this trait.

With regard to the interaction effect of production method and varieties, it is clear from data in the same Table, that there were significant differences in both seasons. Perennial method with Hyrious variety produced the highest No. of off shoots per plant in both seasons, while, the lowest No. of off shoot per plant was produced by Purple of Romanga and Violet Star varieties when the annual method was used. Number of off shoots per plant affects the yield i.e. increasing off shoots number led to an increasing in both early and total yield as well as it is important as a source of propagation material which could be used in the next season especially when nurseries are used as planting method to increase the early yield. The differences among the varieties in number offshoots per plant agree with those obtained by Ibrahim, (1980).

**Table (1): Effect of production method on vegetative growth of some different artichoke varieties during 2005/2006 and 2006/2007 seasons.**

Treatments	No. of off shoots/plant		Plant height (cm)		No. of leaves/plant		
	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	
<b>Production method (A):</b>							
Annual planting	0.95	1.52	61.28	63.02	29.57	35.83	
Perennial planting	3.61	5.50	80.02	82.65	41.34	54.02	
<b>L.S.D. at 0.05%</b>	<b>0.43</b>	<b>1.26</b>	<b>10.36</b>	<b>7.98</b>	<b>7.30</b>	<b>1.32</b>	
<b>Varieties (B):</b>							
Balady	4.05	5.55	53.61	49.94	40.22	51.75	
Hyrious	4.12	5.72	64.00	52.78	37.83	48.22	
Green Globe	1.98	3.95	83.8	85.00	42.12	49.95	
Kiss of Burgundy	1.52	2.83	90.32	95.00	33.75	45.92	
Purple of Romagna	0.95	1.33	62.79	72.77	27.83	32.03	
Violet Star	1.05	1.67	69.39	81.50	31.00	41.67	
<b>L.S.D. at 0.05%</b>	<b>0.45</b>	<b>0.48</b>	<b>3.26</b>	<b>4.74</b>	<b>4.48</b>	<b>4.36</b>	
<b>A x B:</b>							
<b>Annual planting</b>	Balady	2.78	2.67	45.55	40.33	33.11	37.17
	Hyrious	2.08	2.21	48.50	41.00	29.00	30.33
	Green Globe	0.66	2.57	74.17	75.00	35.00	44.90
	Kiss of Burgundy	0.17	1.00	78.33	83.33	28.33	40.50
	Purple of Romagna	0.00	0.33	57.67	65.43	24.67	27.06
	Violet Star	0.00	0.33	63.44	73.00	27.33	35.00
<b>Perennial planting</b>	Balady	5.33	8.44	61.67	59.55	47.33	66.33
	Hyrious	6.17	9.22	79.50	64.55	46.67	66.11
	Green Globe	3.29	5.33	93.43	95.00	49.23	55.00
	Kiss of Burgundy	2.87	4.67	102.30	106.67	39.17	51.33
	Purple of Romagna	1.90	2.33	67.91	80.10	31.00	37.00
	Violet Star	2.10	3.00	75.33	90.00	34.67	48.33
<b>L.S.D. at 0.05%</b>	<b>0.63</b>	<b>0.67</b>	<b>4.61</b>	<b>6.70</b>	<b>6.04</b>	<b>6.17</b>	

**I.2. Plant height (cm):**

Data in Table (1) indicate that there were significant effects of the production method on plant height in both seasons. Perennial method surpassed significantly annual method in this trait.

Concerning the effect of varieties on plant height, it is clear from data in the same Table that there were significant differences in both seasons. The highest plant height was obtained by Kiss of burgundy var. which surpassed significantly all other tested varieties in both seasons of study, while the lowest plant height value was obtained by Balady var. with significant differences in comparison with the other tested varieties. These results are in

harmony with those obtained by Ibrahim (1980), on different artichoke cultivars and seed grown plants. With regard to the interaction effect between production method and variety, it is clear that there were significant differences as shown in Table (1). Perennial method with Kiss of burgundy variety produced the highest plant height in both seasons, while the lowest plant height value was obtained by using annual production method with Balady var. in both seasons

### **I.3. leaves number per plant:**

Concerning the effect of production method on leaves number per plant, it is clear from data in Table (1), that there were significant differences. Perennial method surpassed significantly annual method in this trait during both seasons.

As for the effect of variety on leaves number per plant, it is clear also from data in the same Table that varieties affected significantly the leaves number per plant in both seasons. The highest leaves number per plant was obtained by green globe var. followed Balady var. in the first season and by Balady var. followed by green globe in the second season, while purple of Romanga produced the lowest leaves number per plant in both seasons. These results are in agreement with those obtained by Ibrahim (1980) and Kasim (1994), Kasim *et al.*, (2002) and Kasim (2008), who stated in their breeding studies on globe artichoke that the number of leaves per plant varied from clone to another.

With regard to the interaction effect between production method and variety, data in the same Table indicate clearly that there significant differences in both seasons of study. Green Globe var. with annual method produced the highest leaves number per plant. Also, Green Globe var. with perennial method produced the highest leaves number per plant in first season, while the same production method with Balady var. produced the highest leaves number per plant in the second season. It is also clear from these data that the lowest leaves number per plant was produced by annual method with purple of Romagna var. in both seasons.

## **II. Early and total yield:**

### **No. of heads per plant and per feddan:**

It is clear from data in Table (2) that there were significant differences between the two production methods on early production in both seasons. Perennial production produced early yield higher than that of annual production. The same trend was also observed with total yield.

Concerning the effect of varieties on early and total yield, there were no significant differences among Balady and Hyrious vars., but these two varieties surpassed all other tested vars. in this trait. The obtained results are in agreement with those obtained by El-Shal *et al.*, (1977) who indicated that the two varieties of globe artichoke namely, Balady, the local cultivar and Hyrious, a French variety did not differ to a great extent, from each other in most of their characteristics, while El-Baz *et al.*, (1979) stated that the selected Balady and French varieties proved to be the best as regard to yielding ability during the period from December to March.

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This phenomenon could be attributed to the fact that the selected Balady gave abundant number of heads during the time of production while other varieties gave minimal yield and poorest quality.

**Table (3): Effect of production method on heads physical characteristics of some different artichoke varieties during 2005/2006 and 2006/2007 seasons.**

Treatments	Head weight (g)		Head length (cm)		Head diameter (cm)		Receptacle weight (g)		
	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	
<b>Production method (A):</b>									
Annual planting	263.81	295.82	10.17	9.91	8.65	9.19	91.38	93.29	
Perennial planting	298.01	335.35	9.86	10.48	9.28	9.9	109.18	111.03	
<b>L.S.D. at 0.05%</b>	<b>N.S</b>	<b>4.72</b>	<b>N.S</b>	<b>N.S</b>	<b>0.61</b>	<b>N.S</b>	<b>7.12</b>	<b>5.33</b>	
<b>Varieties (B):</b>									
Balady	220.64	226.33	9.59	9.75	7.68	8.31	68.57	74.24	
Hyrrious	215.97	222.26	9.59	9.89	7.87	8.11	75.60	71.17	
Green Globe	341.92	426.67	9.96	10.09	10.08	11.08	136.25	133.17	
Kiss of Burgundy	359.35	384.58	11.55	11.24	9.85	10.66	122.43	103.06	
Purple of Romagna	292.33	342.42	10.43	10.31	9.63	10.11	105.17	122.17	
Violet Star	255.25	291.25	8.98	9.90	8.68	8.99	93.66	109.17	
<b>L.S.D. at 0.05%</b>	<b>18.01</b>	<b>12.84</b>	<b>0.82</b>	<b>N.S</b>	<b>0.42</b>	<b>0.52</b>	<b>7.99</b>	<b>7.74</b>	
<b>A x B:</b>									
<b>Annual planting</b>	Balady	210.16	219.33	9.09	9.18	7.44	8.30	65.79	72.80
	Hyrrious	208.53	212.42	9.54	9.85	7.73	7.95	69.96	63.33
	Green Globe	327.83	383.33	11.87	10.19	9.40	10.11	125.50	111.67
	Kiss of Burgundy	323.31	370.00	11.19	10.7	9.58	10.59	101.14	98.61
	Purple of Romagna	283.00	309.83	10.52	9.98	9.38	9.78	100.00	110.00
	Violet Star	230.00	280.00	8.83	9.58	8.35	8.40	85.89	103.33
<b>Perennial planting</b>	Balady	231.12	233.33	10.08	10.31	7.91	8.32	71.36	75.67
	Hyrrious	223.41	232.09	9.63	9.93	8.00	8.26	81.23	79.00
	Green Globe	356.00	470.00	8.05	10.00	10.75	12.05	147.00	154.67
	Kiss of Burgundy	395.39	399.17	11.91	11.78	10.12	10.73	143.72	107.5
	Purple of Romagna	301.67	375.00	10.33	10.63	9.87	10.43	110.33	134.33
	Violet Star	280.5	302.5	9.13	10.22	9.00	9.58	101.44	115.00
<b>L.S.D. at 0.05%</b>	<b>25.47</b>	<b>18.16</b>	<b>1.16</b>	<b>0.94</b>	<b>0.58</b>	<b>0.74</b>	<b>11.30</b>	<b>10.94</b>	

Kiss of Burgundy and Green Globe vars. surpassed all other tested vars. in total yield. The above results confirm those of Pandita *et al.*, (1988) about the highest yield of Green Globe.

Concerning the interaction effect among the production method and the tested varieties on early and total yield, it is clear from data in Table (2) that the differences were significant in both seasons. The highest early yield was produced by applying perennial method with hyrious vars. followed by applying the same method with Balady var. in both seasons. As for total yield, it is clear from data in the same Table that applying perennial method with Green Globe var. produced the highest total yield followed by applying the same method with Kiss of Burgundy in both seasons, while the lowest total yield was produced by applying annual production with purple of Romanga var. in both seasons. These results confirm those of Mc Erlich (1983), Segarra (1986), Pandite *et al.*, (1988), Kasim (1994) and Kasim *et al.*, (2002) and Miccolis *et al.*, (1990) who recorded significant differences in total yield among different artichoke genotypes.

### **III. Head characteristics:**

#### **III.1. Head physical characteristics:**

##### **III.1.a. Head weight (g.):**

Data in Table (3) indicate that, perennial method of production produced heaviest heads than annual method in both seasons of study, but the differences were significant in the second season only.

Concerning the effect of varieties on head weight, data in the same Table show that there were significant differences among the varieties on head weight. Kiss of Burgundy and Green Globe varieties surpassed significantly all other tested varieties in both seasons, but there were no significant differences between these two varieties in the first season. The lowest head weight was produced by Hyrious var. in both seasons of study. With respect to the interaction effect, data in the same Table indicate that, there were significant differences in both seasons. Kiss of Burgundy with perennial method surpassed significantly all other interactions in the first season followed by Green Globe var. while in the second season Green Globe var. surpassed Kiss of Burgundy and all other tested interactions. Annual method of production with Hyrious var. produced the lowest head weight. These data are in agreement with those of Mc Erlich (1983), Kasim (1994), Kasim *et al.*, (2002) and Kasim (2008) who found that, the average head weight was significantly different among artichoke different genotypes.

##### **III.1.b. Head length (cm.):**

Data in Table (3) indicate that there were no significant differences between the effects of the two tested production methods on head length in both seasons.

Concerning the variety effect, it is clear that there were significant effect in both seasons of study. Kiss of Burgundy var. surpassed significantly all other tested vars. in both seasons of study followed by Purple of Romagna var., while the lowest head length was produced by Violet Star var. in the first season and by Balady var. in the second season with no significant differences among them in both seasons.

With respect to interaction effect, data in the same Table indicate clearly that there were significant differences in both seasons. Kiss of Burgundy produced the highest head length in both seasons of study. The lowest head length was produced by Green Globe var. and using the perennial method of production in the first season and by Balady var. with annual method of production in the second season. Similar results were confirmed by those of Kasim, (1994) and (2008) who stated that the head length varied among the studied clones of artichoke.

#### **III.1.c. Head diameter (cm.):**

Data in Table (3) indicate that perennial method of production surpassed annual method in both seasons, but the differences were significant in the first season only.

Concerning the effect of varieties on head diameter, data in the same Table indicate that the differences were significant in both seasons. Green Globe var. produced the broadest heads in both seasons followed by Kiss of Burgundy var. but the differences between the values of this trait of these two varieties were not significant. On the other hand the lowest head diameter value was produced by Balady and Hyrious varieties in both seasons with significant differences between them and other tested varieties in this trait. With respect to the interaction effect between production method and variety, it is clear from data in the same Table that, there were significant differences between head diameter values in both seasons.

The highest head diameter was produced by Green Globe var. in both seasons, followed by Kiss of Burgundy var., while the lowest head diameter value was produced by Balady and Hyrious varieties in the first and second season, respectively with no significant differences among them. These data are in agreement with El-Shal *et al.*, (1977) who indicated that the two variety used in there studies (Balady and Hyrious cvs.) did not differ to a great extent, from each other.

#### **III.1.d. Receptacle weight (g.):**

It is clear from data in Table (3), that there were significant differences among the receptacle weight values which were produced by the two tested methods of production in both seasons. Perennial method surpassed significantly the annual method in this trait.

Concerning the effect of varieties on receptacle weight, data in the same Table indicate that there were significant in both seasons. Green Globe var. produced the highest receptacle weight followed by Kiss of Burgundy var. in the first season and Purple of Romagna var. in the second season, while the lowest value of receptacle weight was produced by Balady var. in the first season and Hyrious var. in the second season with no significant differences between these two varieties in this trait in both seasons.

As for the interaction effect between production method and variety, on receptacle weight data in the same Table indicate that there were significant differences in both seasons of study. The highest value was produced by Green globe var. in both seasons, while Balady var. produced the lowest receptacle weight in both season followed by Hyrious var. Similar results were found by Kasim, (1994) and Kasim *et al.*, (2002) who found that the edible part (receptacle) varied in weight between the tested clones and

cultivars. The receptacle is the most economic part for both fresh consumption and processing.

**III.2. Chemical composition of the receptacle (g. /100 mg.):**

Data represented in Table (4) show N%, P%, K% & protein % in the receptacle of the first heads of some different artichoke varieties as affected by production method during 2005/2006 and 2006/2007 seasons.

It is clear from data in Table (4) that nitrogen percentage significantly increased in the receptacle produced from perennial production compared with annual production during 2005/2006 and 2006/2007 seasons. This may be attributed to nutrients stored in the roots of old plants which resulted from perennial method.

Concerning the effect of variety on nitrogen percentage in the receptacle, data presented in the same Table reveal that Hyrious var. and Purple of Romagna var. have the highest percentage of nitrogen in the receptacle without any significant differences among them in the first season, but there were significant differences in the second season. They are followed by Kiss of Burgundy var. and Green Globe var. with significant difference in the second season. The lowest value of nitrogen percentage was produced by Violet Star var. in the first season and by Balady var. in the second season.

Regarding the interaction effects ,as shown in Table(4) ,data indicate that Hyrious var. with perennial planting gave a significant increase on nitrogen percentage in the receptacle and surpassed significantly all other tests varieties in both seasons followed by Purple of Romagna var. with perennial planting with no significant difference among them in the first season, but with a significant difference among them in the second season, while the lowest percentage of nitrogen was obtained with annual production of Balady var. followed by annual production of Violet Star in both seasons.

Concerning phosphorus percentage ,data in Table(4) reveal that phosphorus percentage increased in the receptacle produced from perennial production compared with annual production during 2005/2006 and 2006/2007 seasons with no significant differences .Concerning the variety effect ,results reveal that Green Globe followed by Hyrious var. showed the highest content of phosphorus percentage in the two seasons. On the contrary, Purple of Romagna var. and Balady var. had the lowest content in 2005/2006 and 2006/2007 seasons respectively.

Concerning the effect of interaction between the two production methods and varieties, it is clear from data in the same Table, that Green Globe and Hyrious varieties with perennial production had the highest phosphorus content percentage in the receptacle in the two seasons, while the lowest phosphorus content percentage was obtained by annual production of Purple of Romagna var.

As for potassium percentage, data in Table (4) reveals that annual production lead to produce receptacle possessed the highest content of potassium percentage compared with perennial production with significant differences in 2005/2006 season, while in the second season, perennial production increased potassium content percentage in the receptacle but the differences were not significant.

**Table (4): Effect of production method on chemical composition of the receptacle (g/100g. dry weight) of some different globe artichoke varieties of the first harvested heads during 2005/2006 and 2006/2007 seasons.**

Treatments		N %		P %		K %		Protein %	
		2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007
<b>Production method (A):</b>									
	Annual planting	1.892	1.997	0.183	0.205	4.498	4.460	11.824	12.479
	Perennial planting	2.019	2.140	0.220	0.246	4.472	4.477	12.623	13.376
<b>L.S.D. at 0.05%</b>		<b>0.096</b>	<b>0.018</b>	<b>N.S</b>	<b>N.S</b>	<b>0.012</b>	<b>N.S</b>	<b>0.598</b>	<b>0.108</b>
<b>Varieties (B):</b>									
	Balady	1.915	1.950	0.196	0.204	4.695	4.800	11.970	12.187
	Hyrious	2.04	2.185	0.213	0.241	4.377	4.580	12.750	13.657
	Green Globe	1.92	1.955	0.225	0.274	4.385	4.020	12.002	12.218
	Kiss of Burgundy	1.95	2.145	0.194	0.207	4.428	4.530	12.188	13.408
	Purple of Romagna	2.105	2.170	0.181	0.209	4.510	4.495	13.158	13.563
	Violet Star	1.803	2.005	0.199	0.222	4.515	4.385	11.273	12.532
<b>L.S.D. at 0.05%</b>		<b>0.069</b>	<b>0.014</b>	<b>N.S</b>	<b>N.S</b>	<b>0.062</b>	<b>0.066</b>	<b>0.429</b>	<b>0.090</b>
<b>A x B:</b>									
<b>Annual planting</b>	Balady	1.78	1.81	0.182	0.189	4.67	4.730	11.127	11.313
	Hyrious	1.95	2.12	0.190	0.210	4.30	4.370	12.187	13.250
	Green Globe	1.88	1.92	0.211	0.254	4.34	3.970	11.750	11.997
	Kiss of Burgundy	1.90	2.10	0.190	0.194	4.31	4.470	11.877	13.127
	Purple of Romagna	2.09	2.13	0.142	0.181	4.45	4.440	13.063	13.313
	Violet Star	1.75	1.90	0.180	0.203	4.92	4.780	10.994	11.877
<b>Perennial planting</b>	Balady	2.05	2.09	0.209	0.218	4.72	4.870	12.813	13.060
	Hyrious	2.130	2.25	0.235	0.271	4.45	4.790	13.313	14.063
	Green Globe	1.960	1.99	0.238	0.293	4.43	4.070	12.253	12.440
	Kiss of Burgundy	2.00	2.19	0.197	0.219	4.55	4.590	12.5	13.690
	Purple of Romagna	2.120	2.21	0.220	0.237	4.57	4.550	13.253	13.813
	Violet Star	1.857	2.11	0.218	0.240	4.11	3.990	11.607	13.187
<b>L.S.D. at 0.05%</b>		<b>0.097</b>	<b>0.020</b>	<b>N.S</b>	<b>N.S</b>	<b>0.088</b>	<b>0.092</b>	<b>0.607</b>	<b>0.127</b>

Concerning varieties, data presented in Table(4)in the season of 2005/2006 show that receptacle of Balady var. contains the highest K (%) content ,followed by varieties Violet Star, Purple of Romagna and Kiss of Burgundy, while that of varieties Hyrious and Green Globe contain the lowest values. In 2006/2007 season, data in the same Table show significant

differences in potassium percentage in the receptacle of the different varieties .The receptacle of Balady var. contains the highest (K %) content, followed by Hyrious var. They surpassed significantly varieties i.e Purple of Romagna, Violet Star and Green Globe .Potassium percentage in the receptacle of Kiss of Burgundy surpassed significantly the contents of varieties Violet and Green Globe.

Concerning the effect of interaction between the two production methods and varieties ,it is clear that from data in the same Table, that the receptacle of Balady var. resulting from perennial production contain high percentage of (K) content compared with receptacle resulting from annual production without any differences in the first season, but with significant differences in the second season .They surpassed all other varieties perennial and annual production except the receptacle resulting from annual production of Violet Star var. which surpassed all of them in the first season ,while perennial production of the same variety produced the lowest percentage of potassium content in both seasons. On contrary, potassium percentage in the receptacle resulting from perennial production of vars. Hyrious, Green Globe, Kiss of Burgundy and Purple of Romagna surpassed significantly potassium percentage in the receptacle resulting from annual production of the same varieties during two seasons.

In concern with protein percentage, results revealed that the protein content showed the same trend as nitrogen content. Data in Table(4) indicates that there were significant differences among the percentage of protein in the receptacle resulting from perennial production over that of annual production during the two seasons. Concerning varieties, data presented in the same Table indicate that Hyrious and Purple of Romagna varieties have the highest percentage of protein without any significant differences among them in the first season, but there were significant differences among them in the second season. They are followed by varieties Kiss of Burgandy and Green Globe with significant differences in the second season. The lowest protein percentage was produced by Violet var. in the first season and by Balady var. in the second season.

Regarding the interaction effects, as shown in Table (4),data reveal that Hyrious var. with perennial production gave a significant increase in protein percentage in the receptacle and surpassed significantly all other tested varieties in both seasons, followed by Purple of Romagne var. with perennial production , while the lowest percentage of protein was obtained by annual production of Balady var. followed by annual production of Violet Star var. in both seasons. The differences among the tested varieties confirm the results obtained by Pandita *et.al*, (1988), Kasim(1994) and Kasim *et al* .,2002.

## **CONCLUSION**

This study was conducted according to the wishes of the owners of some agricultural companies to know what is the responsibility of some globe artichoke varieties to the perennial method of production. This study indicated that perennial method surpassed annual method in most of studied

characters. Varieties Green Globe and Kiss of Burgundy vars. surpassed the other tested varieties in total yield, head weight, head diameter as well as high receptacle weight. So perennial method of production can be adopted in the artichoke cultivated area especially in the new land to increase early and total yield as well as save production cost.

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### **تأثير طرق الإنتاج بالزراعة الحولية و التعقير على بعض الأصناف المختلفة للخرشوف**

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**قسم بحوث البطاطس والخضر خضرية التكاثر - معهد بحوث البساتين- مركز البحوث الزراعية- الدقي- الجيزة- مصر**

أجريت هذه الدراسة بمزرعة بحوث الخضر بقها خلال موسمي ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ لدراسة تأثير طريقة التعقير و طريقة الزراعة الحولية فى الإنتاج على نمو و محصول بعض أصناف الخرشوف .

اشتملت المعاملات على طريقتي إنتاج مختلفتين (الزراعة الحولية-التعقير) بالإضافة إلى ستة أصناف هى بلدي و هريوس (أصناف محلية) , جرين جلوب , كس أف برجندى , بريل أوف روماجنا و فيوليت ستار (أصناف جديدة استوردت لمصر) , و كان التصميم الاحصائى المستخدم هو القطاعات المنشقة مرة واحدة فى ثلاث مكررات . ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

١- طريقة الإنتاج بالتعقير تفوقت معنويا على طريقة الإنتاج بالزراعة الحولية فى عدد الخلفات/ نبات , ارتفاع النبات , عدد الأوراق/ النبات .

٢- أيضا طريقة التعقير فى الإنتاج أدت إلى زيادة المحصول المبكر و الكلى فى الأصناف المحلية ( بلدي و هريوس) بالإضافة إلى المحصول الكلى فى الأصناف المستوردة (جرين جلوب, كس اوف برجندى , بريل أوف روماجنا و فيولت ستار).

بالإضافة إلى أنها حسنت جودة النورات المختبرة (وزن الرأس, قطر الرأس ووزن التخت) بجانب الزيادة المعنوية فى النسبة المئوية للنيتروجين والبروتين فى التخت.



- ٣- صنفى البلدى والهريوس يحتويان على أعلى عدد من الخلفات/ نبات, عدد الأوراق / نبات والمحصول المبكر بينما الصنف البلدى يمتاز بأعلى نسبة من البوتاسيوم في التخت ولكن الصنف هريوس يحتوى على أعلى نسبة من النيتروجين والبروتين في التخت.
- ٤- صنفى الجرين جلوب و الكس أوف برجندى أنتجوا أعلى ارتفاع للنبات, المحصول للكلى, وزن النورة, قطر النورة, وزن التخت ولكن فيما يختص بالتركيب الكيماوي فان تخت الصنف جرين جلوب يحتوى على أعلى نسبة مئوية للفوسفور.
- ٥- استخدام طريقة التعفير في الإنتاج مع الصنف هريوس أنتجت أعلى نسبة من الخلفات/نبات, المحصول المبكر والنسبة المئوية للنيتروجين والبروتين في التخت بينما كان الصنف البلدى يلي الصنف هريوس في هذه الصفات.
- ٦- الصنف كس أوف برجندى و الصنف جرين جلوب أنتجوا أعلى وزن للرأس وقطر الرأس عندما استخدمت طريقة التعفير في الإنتاج بينما الصنف جرين جلوب كان متفوقا في وزن الرأس ولكن الصنف كس أوف برجندى كان متفوقا في طول الرأس.



**Table (2):Effect of production method on early and total yield (expressed as number of heads/plant and fed.) on some different artichoke varieties during 2005/2006 and 2006/2007 seasons.**

Treatments	No. of Heads/plant				No. of Heads thousand/fed.				
	Early yield		Total yield		Early yield		Total yield		
	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	
<b>Production method (A):</b>									
Annual planting	0.54	0.45	11.61	13.13	2.14	1.79	46.43	52.51	
Perennial planting	1.19	0.77	16.26	18.08	4.78	3.07	65.02	72.3	
<b>L.S.D. at 0.05%</b>	<b>0.39</b>	<b>0.11</b>	<b>4.31</b>	<b>4.22</b>	<b>1.57</b>	<b>0.43</b>	<b>17.23</b>	<b>16.89</b>	
<b>Varieties (B):</b>									
Balady	2.73	1.89	14.29	15.81	10.90	7.54	57.17	63.23	
Hyrious	2.46	1.77	12.62	14.33	9.85	7.06	50.47	57.31	
Green Globe	-	-	17.25	21.97	-	-	69.00	87.89	
Kiss of Burgundy	-	-	16.48	17.65	-	-	65.92	70.60	
Purple of Romagna	-	-	11.08	11.95	-	-	44.33	47.81	
Violet Star	-	-	11.87	11.90	-	-	47.46	47.61	
<b>L.S.D. at 0.05%</b>	<b>0.27</b>	<b>0.17</b>	<b>1.97</b>	<b>2.37</b>	<b>1.09</b>	<b>0.69</b>	<b>7.89</b>	<b>9.49</b>	
<b>A x B:</b>									
<b>Annual planting</b>	Balady	1.95	1.66	11.45	13.62	7.80	6.64	45.8	54.47
	Hyrious	1.26	1.03	9.83	10.99	5.04	4.12	39.33	43.95
	Green Globe	-	-	14.50	18.67	-	-	58.00	74.67
	Kiss of Burgundy	-	-	13.63	14.00	-	-	54.51	55.99
	Purple of Romagna	-	-	9.50	10.83	-	-	38.00	43.33
	Violet Star	-	-	13.00	10.67	-	-	42.92	42.67
<b>Perennial planting</b>	Balady	3.5	2.11	17.13	18.00	14.00	8.44	68.53	72.00
	Hyrious	3.67	2.50	15.40	17.67	14.67	10.00	61.60	70.67
	Green Globe	-	-	20.00	25.28	-	-	80.00	101.11
	Kiss of Burgundy	-	-	19.33	21.30	-	-	77.33	85.21
	Purple of Romagna	-	-	12.66	13.07	-	-	50.65	52.28
	Violet Star	-	-	13.00	13.14	-	-	52.00	52.56
<b>L.S.D. at 0.05%</b>	<b>0.39</b>	<b>0.25</b>	<b>2.79</b>	<b>3.35</b>	<b>1.54</b>	<b>0.98</b>	<b>11.16</b>	<b>13.42</b>	