

NEW CLONES SELECTED FROM GLOBE ARTICHOKE *Cynara scolymus* L., FRENCH CULTIVAR (HERIOUS).

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ABSTRACT

This investigation was carried out during 2003/2004, 2004/2005, 2005/2006 and 2006/2007 seasons at Kaha vegetables Research Farm, Hort. Res. Inst.

In 2003/2004 season, 38 mother plants were planted. These plants were selected in the previous season (2002/2003) from a population of 1200 plants from a private Farm at Kome El-Berka village, Kafr El-Dawaar district, Behira Governorate according to their earliness, yield and its quality traits. Each of the 38 mother plants was considered a clone and planted as an observation trial. At the end of this season fifteen clones were selected according to the obtained data and planted in season 2004/2005. At the end of 2004/2005 season, ten clones were selected according to the obtained data of the studied traits and planted in 2005/2006 and 2006/2007 seasons.

The obtained results could be summarized as follow:

I. Vegetative traits:

- I.1.** Clone K.D₁₆ produced the highest number of offshoots per plant followed by clones K.D₂₀ and K.D₉ while the lowest number of offshoot per plant was produced by clone K.D₂₂.
- I.2.** The highest plant height was produced by clone K.D₇ and clone K.D₁₆, while the lowest plant height was produced by the control.
- I.3.** The highest leaves number per plant was produced by clone K.D₁₆ followed by clones K.D₉ and K.D₇, while the lowest leaves number per plant was produced by clone K.D₂₁ in 2005/2006 and clone K.D₂₃ in 2006/2007 season.

II.1. Early yield:

The highest early yield was produced by clone K.D₆ followed by clones K.D₁₆ and K.D₂₁ while the lowest early yield was produced by the control followed by clones K.D₂₀ and K.D₂₂.

II.2. Total yield:

The highest total yield was produced by clone K.D₆ followed by clones K.D₁₆, K.D₂₀ and K.D₁₉, while the lowest total yield was obtained from the control followed by clone K.D₂₃.

III. Head characters:

III.1. Head physical characters:

- a. The highest head weight was produced by clone K.D₁₆ followed by clones K.D₉, K.D₆ and K.D₂₁, while the lowest head weight was obtained from the control
- b. The highest head length was produced by clone K.D₁₆ followed by clone K.D₇, while the control produced the lowest head length.
- c. The highest head diameter was produced by clone K.D₆ followed by clones K.D₂₀ and K.D₁₆, while the lowest head diameter was obtained from the control.
- d. Clone K.D₁₆ produced the highest receptacle weight followed by clones K.D₂₁ and K.D₇, while the lowest receptacle weight was obtained from the control.

III.2. Head chemical characters:

- a. The highest nitrogen percentage was obtained from clone K.D₈ followed by clones K.D₆, K.D₁₆, K.D₇ and K.D₂₁ while the lowest nitrogen percentage was obtained from clone K.D₂₂.

- b. The highest phosphorus percentage was obtained from clone K.D₇ followed by clones K.D₁₆ and K.D₂₁, while the lowest phosphorus percentage was produced from the control but the differences were not significant.
- c. The highest potassium percentage was produced by clone K.D₇ followed by clone K.D₁₆ while the lowest potassium percentage was obtained from clone K.D₂₂.
- d. Clone K.D₈ produced the highest protein percentage followed by clones K.D₆, K.D₁₆, K.D₇ and K.D₂₁, while K.D₂₂ produced the lowest protein percentage.
- e. The lowest fibers percentage was found in clone K.D₆ followed by clones K.D₇, K.D₁₆ and K.D₂₁, while the highest fibers percentage was found in clone K.D₈.

INTRODUCTION

Globe artichoke *Cynara scolymus* L. is considered one of the most important vegetables grown in Egypt, Specially, in Behira, Alexandria and Giza governorates. The demands of the European markets on the globe artichoke produced in Egypt increased yearly during the period from December to February, but the production at this period is low.

The genotype is considered one of the most important factors affecting markedly earliness, yield and quality of globe artichoke, therefore, many investigators worked on improving globe artichoke. Bailey (1969), described 10-20 species of cynara, two of them are cultivated in a wide scale.

Also, breeding researches in the production area of several foreign countries has been conducted on the development of improved clones adapted to regional climatic, cultural and market conditions (Miller, 1975; Bozzini and Locheli 1976; Ibrahim *et al.*, 1976; Sarno, 1976 and Ibrahim, 1980). In this connection, Micoolis *et al.* (1989), mentioned that harvesting date, harvesting period and average yield varied from cultivar to another. Also, Foti and Mauromica (1994), mentioned that there were wide variations in earliness, yield capacity and head characteristics as well as morphological traits of studied artichoke varieties.

Mauromica and Copani (1989) reported that the possibility of selection based on few characteristics. Kasim (1994) mentioned that artichoke cultivars traditionally have been composed of clones or groups of related clones. Also, Kasim *et al.* (2002) found that different variations in earliness, yield and head quality among the selected clones.

The globe artichoke hyrious cv. was introduced from France in 1960 as a promising cultivar either for local or foreign markets, but after many years from introducing this cultivar, it deteriorated and became mixed of different ecotypes as a result of the traditional vegetative propagation methods as well as the wrong agricultural practices, therefore, it is very important to isolate the different ecotypes of the heterogeneous cultivar.

As a consequence of the increasing interest for producing early production with good quality globe artichoke, the main goal of this study was to select some new promising clones from hyrious cv., characterized by earliness, high yield with good quality.

MATERIALS AND METHODS

This investigation was carried out during 2003/2004, 2004/2005, 2005/2006 and 2006/2007 seasons at Kaha Vegetables Research Farm, Hort. Res. Inst.

In 2003/2004 season, 38 mother plants were planted. These 38 mother plants were selected in the previous season (2002/2003) from a population of 1200 plants from a private farm at Kome El-Berka village, Kafr El-Dawaar district, Behira Governorate according to their earliness, yield and quality traits. Each of these 38 selected mother plants was considered a clone and have been given serial numbers as follow: K.D₁, K.D₂....., K.D₃₈. The rooted basal stems of these clones were cut into four pieces and planted in one row at Kaha veg. Res. Farm on August, 10 in 2003/2004 season as an observation trial. Some preliminary data on yield and yield quality were recorded during 2003/2004 growing season. According to the data obtained at the end of 2003/2004 season, fifteen clones which had desirable traits were selected while that of undesirable characteristics were discarded.

The basal stems of the plants produced from each selected clone (15 clones), which were produced during 2003/2004 season, were divided into pieces, and cultivated on August, 8 in 2004/2005 season at Kaha vegetables Research Farm.

Each clone was cultivated in five rows. The data of vegetative growth, early yield, total yield and head quality were recorded. According to the data obtained during this season, ten clones of good characteristics were selected, while the other clones which have undesirable traits were discarded. The ten selected clones were cultivated in 2005/2006 and 2006/2007 seasons on 7, 8 August, 2005 and 2006 respectively, at Kaha vegetables Research Farm. The experimental design used for conducting the experiment in the seasons of 2005/2006 and 2006/2007 was randomized complete block design with three replicates. The plot area was 25m² (consisted of 5 rows and the dimensions of each row was 5 m long and 1m wide).

The cultural practices used for growing globe artichoke in this investigation were followed according to Ministry of Agriculture recommendations.

The following data were recorded in this study.

I. In the first season (2003/2004), the selected clones (38 clones), were planted as observational trial and the following data were recorded:

I.1. Early and total yield (expressed as No. of heads/plant):

Early yield was calculated as number of heads produced per plant through the period from the beginning of harvesting till the end of February.

Total yield was estimated by collecting all heads harvested per plant throughout the harvest season.

I.2. Head quality of the early yield:

A sample of 15 heads was taken from each clone to determine its physical characteristics i.e head weight (g.), head length (cm), head diameter (cm) and receptacle weight (g.).

II. In the second season (2004/2005), the following data were recorded:

II.1. Vegetative growth:

After four months from planting date, the following vegetative traits were recorded on a sample of 5 plants from each clone. These vegetative data were number of off shoots per plant, plant height (cm) and number of leaves per plant.

II.2. Early and total yield (expressed as No. of heads/plant):

Early yield was calculated as number of heads produced per plant through the period from the beginning of harvest season till the end of February.

Total yield was determined by collecting all heads produced per plant from the beginning till the end of harvest season.

II.3. Head quality:

Sample of 15 heads were taken from each clone to determine its physical characteristics i.e. head weight (g.), head length (cm), head diameter (cm) and receptacle weight (g.).

III. Third and fourth seasons (2005/2006 and 2006/2007), the following data were recorded:

III.1. Vegetative growth:

After four months from planting data, the following vegetative traits were recorded on a sample of 3 plants from each plot. These vegetative data were number of off shoots per plant, plant height (cm) and number of leaves per plant.

III.2. Early and total yield (expressed as No. of heads/plant):

Early yield was calculated as number of heads produced per plant through the period from the beginning of harvest season till the end of February.

Total yield was determined by collecting all heads produced per plant from the beginning till the end of harvest season.

III.3. Head characteristics:

III.3.1. Physical characteristics:

Sample of 10 heads were taken from each plot to determine its physical characteristics i.e. head weight (g.), head length (cm), head diameter (cm) and receptacle weight (g.).

III.3.2. Chemical characteristics of the receptacle:

Receptacle chemical characteristics were estimated in the early yield during 2005/2006 and 2006/2007 seasons for certain clones i.e K.D₆, K.D₇, K.D₈, K.D₁₆, K.D₂₁, K.D₂₂ and control.

Samples of ten heads receptacle of each plot were taken and the following data were recorded:

Nitrogen% was determined according to Koch and Mc Meckin (1924), phosphorus was determined according to Troug and Meyer (1939), potassium was estimated as described by Brown and Lilliland (1946), while protein was determined by multiplying nitrogen values by 6.25 as describe by Pregl (1945).

The crude fibers were determined according to A.O.A.C. (1970).

Statistical analysis. All data obtained during 2005/2006 and 2006/2007 seasons were statistically analyzed according to the methods described by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

I. First season (2003/2004):

Data in Table 1 indicate some traits which were studied in the preliminary study at the beginning selection during 2003/2004 season.

I.1. Early and total yield:

It was found from data in Table 1 that there were variations observed among the thirty eight selected clones in early and total yield. Clones that produced higher number of heads per plant in the early yield were K.D₁₆ (7 heads) and K.D₂₈ (5 heads). On the other hand clones that produced the lower number of heads per plant in the early yield were K.D₁, K.D₄, K.D₁₂, K.D₂₇ and K.D₃₅ which produced only one head per plant, while, the other selected clones were intermediate in this respect.

Concerning total yield, data in the same table indicate that the highest total yield was obtained from clone K.D₃₁ (18 heads) followed by clones K.D₂₀ (17 heads), K.D₅ and K.D₆ (14 heads), K.D₇ and K.D₁₆ (13 heads), K.D₉, K.D₂₉ and K.D₃₇ (12 heads), K.D₂, K.D₈ and K.D₁₀ (11 heads). On the other hand the lowest total yield was obtained from clone K.D₁₄ (3 heads) followed by clones K.D₁₅ and K.D₂₄ (4 heads), K.D₁₈, K.D₂₇ and K.D₃₄ (6 heads), K.D₁, K.D₃, K.D₁₂, K.D₁₃, K.D₁₇, K.D₃₀ and K.D₃₃ (7 heads), K.D₃₂ (8.16 heads), K.D₁₁, K.D₁₉, K.D₂₂, K.D₂₆, K.D₂₈, K.D₃₅ and K.D₃₆ (9 heads), K.D₂₃, K.D₂₅ and K.D₃₈ (10 heads), while K.D₂₁ produced (10.2 heads) per plant in total yield.

I.2. Head quality:

Head quality i.e head weight, head length, head diameter and receptacle weight of the selected clones in preliminary study in 2003/2004 season of the present investigation are shown in table (1). It is clear from the data that clones K.D₁₄ and K.D₂₈ produced the highest head weight (271g.) followed by clones K.D₂₉ (254.5g.), K.D₂₀ (237g.), clones K.D₄ and K.D₃₆ (230g.). On the other hand the lowest head weight was produced by clones K.D₁₇ and K.D₃₃ (144g.) followed by clones K.D₃₈ (155.5g.), K.D₁ (158.5g.), K.D₂ and K.D₂₆ (170g.) and K.D₁₈ (172.5g.), while the other selected clones were intermediate in this respect.

Concerning head length, it is clear from data in the same table; that clone K.D₁₄ produced the highest head length (11.8cm) followed by clones K.D₂₈ (11.5cm), K.D₇, K.D₁₆ (10.5cm) and K.D₅ (11.05cm). On the other hand, the lowest head length was produced by clone K.D₃₇ (8.5cm) followed by clones K.D₁₇ and K.D₃₃ (8.8cm), while the other selected clones were intermediate in this trait.

As regard to head diameter, data in the same table indicate clearly that the highest head diameter was obtained from clone K.D₁₄ (9cm) followed by clones K.D₂₈ (8.7cm), K.D₁₁ (8.6cm) and K.D₄, K.D₁₂, K.D₂₀ and K.D₃₆ (8.4cm). On the other hand the lowest head diameter (6.8cm) was produced by clones K.D₁₇, K.D₃₃ followed by clones K.D₂ (7.2cm), K.D₃₄ (7.3cm) and K.D₃₈ (7.4), while the other selected clones produced heads diameter with intermediate values.

Table 1: Yield (expressed as number of heads/plant) and heads physical characteristics of selected French globe artichoke clones of the early yield during 2003-2004 season.

Clone	Early yield	Total yield	Heads physical characteristics			
			Head weight (g)	Head length (cm)	Head diameter (cm)	Receptacle weight (g)
*K.D ₁	1.00	7.00	158.50	8.90	7.50	56.42
K.D ₂	3.00	11.00	170.00	8.70	7.20	47.70
K.D ₃	2.00	7.00	207.66	10.03	7.77	52.61
K.D ₄	1.00	8.00	230.00	10.30	8.40	70.00
K.D ₅	3.00	14.00	219.50	11.05	8.10	78.23
K.D ₆	3.33	14.00	182.50	9.40	7.50	65.68
K.D ₇	3.16	13.00	179.50	10.50	7.50	64.60
K.D ₈	4.00	11.00	193.00	9.25	7.55	69.00
K.D ₉	3.25	12.00	224.00	10.05	7.95	78.53
K.D ₁₀	4.00	11.00	181.50	9.35	7.70	55.50
K.D ₁₁	2.00	9.00	200.00	9.40	8.60	61.30
K.D ₁₂	1.00	7.00	205.00	9.70	8.40	82.50
K.D ₁₃	3.00	7.00	191.33	9.06	7.50	66.66
K.D ₁₄	3.00	3.00	271.00	11.80	9.00	95.00
K.D ₁₅	2.00	4.00	197.50	9.30	7.65	65.28
K.D ₁₆	7.00	13.00	190.00	10.50	7.70	65.00
K.D ₁₇	3.00	7.00	144.00	8.80	6.80	40.79
K.D ₁₈	2.00	6.00	172.50	9.36	7.26	63.50
K.D ₁₉	4.00	9.00	216.00	10.03	8.13	65.30
K.D ₂₀	4.00	17.00	237.00	10.10	8.40	67.00
K.D ₂₁	4.00	10.20	189.00	10.00	7.80	68.00
K.D ₂₂	2.00	9.00	190.00	9.20	7.80	50.70
K.D ₂₃	4.00	10.00	185.00	9.40	7.80	47.85
K.D ₂₄	2.00	4.00	214.00	9.95	8.00	70.50
K.D ₂₅	3.00	10.00	188.00	9.75	8.10	68.50
K.D ₂₆	4.00	9.00	170.00	8.90	7.70	73.00
K.D ₂₇	1.00	6.00	195.00	9.90	7.80	56.42
K.D ₂₈	5.00	9.00	271.00	11.50	8.70	78.00
K.D ₂₉	3.00	12.00	254.50	10.15	8.25	80.00
K.D ₃₀	2.00	7.00	220.00	10.80	7.50	62.00
K.D ₃₁	3.00	18.00	188.00	10.33	7.56	52.31
K.D ₃₂	1.33	8.16	223.00	10.10	8.21	64.50
K.D ₃₃	3.00	7.00	144.00	8.80	6.80	53.50
K.D ₃₄	2.00	6.00	175.00	9.30	7.30	60.00
K.D ₃₅	1.00	9.00	190.00	9.20	7.80	56.00
K.D ₃₆	-	9.00	230.00	10.30	8.40	70.00
K.D ₃₇	-	12.00	214.50	8.50	7.50	83.00
K.D ₃₈	-	10.00	155.50	8.70	7.40	45.37

* K.D: Kafr El-Dawar

Concerning the receptacle weight, data in the same table indicate that the highest receptacle weight was produced by clone K.D₁₄ (95g.) followed by clone K.D₃₇ (83g.), clone K.D₁₂ (82.5g.), K.D₂₉ (80g.) and K.D₉ (78.53g.). On the other hand the lowest receptacle weight was obtained from clone K.D₁₇ (40.79g.) followed by K.D₃₈ (45.37g.) and K.D₂ (47.7g.), while the other

selected clones produced receptacle weight ranged between the highest and lowest values of receptacle weight.

II. Second season (2004/2005):

Fifteen clones were selected from the previous season and planted in 2004/2005 season and the following data were recorded as shown in table (2).

II.1. Vegetative growth:

Data in table (2) indicate the vegetative growth of the selected clones. It is clear from these data that the highest number of offshoots per plant was obtained from clone K.D₁₁ (6) followed by clones K.D₁₆ (4.5), K.D₂₆ (4.0) and K.D₂₀ (3.66). On the other hand the lowest number of offshoots per plant (1.0 offshoot) was produced by clone K.D₁₃ followed by clones K.D₂₂ (1.08 offshoots) and K.D₇ (1.11 offshoot), while the other selected clones produced medium values of number of offshoots.

As regard to plant height, it is clear from data in table (2), that the highest plant height was obtained from clone K.D₁₁ (70cm) followed by clones K.D₇ (60cm), K.D₁₆ (57.5cm) and K.D₂₂ (57.34cm). On the other hand the lowest plant height was obtained from the control (43.75cm) followed by clones K.D₃₀ (47.5cm) and K.D₁₃ (48.33cm), while the other selected clones produced plant height values ranged between the aforementioned highest and lowest plant height values.

Concerning leaves number per plant, data in the same table indicate that the highest leaves number per plant was produced by clone K.D₁₁ (35 leaves/plant) followed by clones K.D₁₆ (32 leaves/plant) and K.D₉ (29 leaves/plant). On the other hand, the lowest leaves number per plant was obtained from clone K.D₂₂ (23.38 leaves/plant) followed by clones K.D₃₃ (25 leaves/plant) and K.D₁₃ (25.33 leaves/plant), while the other selected clones and control were intermediate in this trait.

II.2. Early and total yield:

Data in table (2) indicate early and total yield of the selected clones in 2004/2005 season.

Concerning early yield, it is clear from these data, that clone K.D₆ produced the highest early yield (3.66 heads/plant) followed by clones K.D₁₆ (3.22 heads/plant) and K.D₁₃, K.D₂₆ (3.16 heads/plant). On the other hand, the lowest early yield was produced by the control (1.66 heads/plant) followed by clones K.D₂₀ (1.89 heads/plant) and K.D₂₂ (1.9 heads/plant), while the other selected clones produced early yield ranged between the aforementioned highest and lowest early yield.

As regard to total yield, it is clear from data in the same table that clone K.D₃₃ produced the highest total yield (18 heads/plant) followed by clones K.D₂₀ (17 heads) and K.D₆ (16.11 heads). On the other hand clone K.D₁₃ produced the lowest total yield (7 heads/plant) followed by clone K.D₁₁ (8 heads) and the control (9.2 heads), while the other selected clones were intermediate in this trait.

Table 2: Vegetative growth of selected French globe artichoke clones during 2004-2005 season.

Clone	No. of shoots per plant	Plant height	No. of leaves per plant
*K.D ₆	1.55	53.30	28.33
K.D ₇	1.11	60.00	28.66
K.D ₈	2.00	49.12	27.50
K.D ₉	2.40	55.00	29.00
K.D ₁₁	6.00	70.00	35.00
K.D ₁₃	1.00	48.33	25.33
K.D ₁₆	4.50	57.50	32.00
K.D ₁₉	3.50	50.00	27.33
K.D ₂₀	3.66	49.22	28.61
K.D ₂₁	1.40	55.65	26.53
K.D ₂₂	1.08	57.34	23.38
K.D ₂₃	1.66	49.24	27.66
K.D ₂₆	4.00	55.00	26.00
K.D ₃₀	1.50	47.50	26.50
K.D ₃₃	2.50	53.33	25.00
**Cont.	1.50	43.75	25.46

* K.D: Kafr El-Dawar

**Cont.: The common used variety (hyrious)

II.3. Head quality:

Data in table (3) indicate the head quality of the clones which were selected from season 2003/2004 and planted in season 2004/2005.

Concerning head weight, it is clear from the data in table (3) that the highest head weight was obtained from clone K.D₁₆ (235.8g.) followed by clones K.D₃₀ (233g.) and K.D₉ (232.48g.) On the other hand, the lowest head weight was produced by the control (172.41g.) followed by clone K.D₁₃ (190g.), while the other selected clones were medium in head weight between the clones which produced the highest head weight and those which produced the lowest head weight.

As regard to head length, it is clear from data in the same table that the highest head length (10.58cm) was obtained from clone K.D₁₆ followed by clones K.D₈ (10.5cm) and K.D₇ (10.48cm). On the other hand, the lowest head length (9.4cm) was produced by the control followed by clones K.D₁₃ (9.5cm) and K.D₃₃ (9.73cm) while the other selected clones produced heads with values ranged between the aforementioned highest and lowest head length values.

As for head diameter, it is clear from data in table (3), that the highest head diameter (8.5cm) was produced by clone K.D₃₀ followed by clones K.D₆, K.D₁₁ (8.4cm) and clone K.D₂₀ (8.3cm). On the other hand, the control produced the lowest head diameter (7.6cm) followed by clones K.D₇, K.D₁₃ (7.7cm) and clone K.D₃₃ (7.73cm), while the other selected clones produced heads with diameter values ranged between the aforementioned highest and lowest head diameter values.

With respect to receptacle weight, the highest value of this trait was obtained from clone K.D₁₆ (76.61g) followed by clones K.D₂₁ (75g.) and K.D₇ (73g.). On the other hand clone K.D₃₃ produced the lowest receptacle weight

(52.31g.) followed by the control, while the receptacle weight values of the other selected clones were intermediate between the highest and lowest receptacle weight values of the aforementioned clones.

Table 3: Yield (expressed as number of heads/plant) and heads physical characteristics of selected French globe artichoke clones of the early yield during 2004-2005 season.

Clone	Early yield	Total yield	Heads physical characteristics			
			Head weight (g)	Head length (cm)	Head diameter (cm)	Receptacle weight (g)
*K.D ₆	3.66	16.11	226.50	10.20	8.40	59.00
K.D ₇	2.33	10.00	220.00	10.48	7.70	73.00
K.D ₈	2.52	11.66	213.00	10.50	8.20	58.70
K.D ₉	3.00	11.11	232.48	10.14	8.18	72.10
K.D ₁₁	3.00	8.00	226.00	10.20	8.40	60.50
K.D ₁₃	3.16	7.00	190.00	9.50	7.70	39.35
K.D ₁₆	3.22	13.00	235.80	10.58	8.25	76.61
K.D ₁₉	2.51	9.00	220.00	10.30	7.90	58.70
K.D ₂₀	1.89	17.00	225.80	10.30	8.30	65.00
K.D ₂₁	3.10	11.40	230.10	10.08	8.01	75.00
K.D ₂₂	1.90	11.10	210.20	10.30	7.80	56.10
K.D ₂₃	2.33	10.00	221.00	10.35	8.00	61.13
K.D ₂₆	3.16	14.00	226.00	10.30	8.00	60.50
K.D ₃₀	2.90	10.40	233.00	10.13	8.50	71.23
K.D ₃₃	2.00	18.00	206.33	9.73	7.73	52.31
**Cont.	1.66	9.20	172.41	9.40	7.60	53.46

* K.D: Kafr El-Dawar

**Cont.: The common used variety (hyrious)

III. Third and fourth seasons (2005/2006 and 2006/2007):

Ten clones were selected from the eighteen clones which were cultivated in the previous season (2004/2005) and cultivated in 2005/2006 and 2006/2007 seasons. These clones were selected according to their characters. The results were as follows:

III.1. Vegetative growth:

Concerning number of offshoots per plant, data in table (4) indicate that there were significant differences among the selected clones in this trait in both seasons of study. The highest value of offshoots number per plant was obtained by clone K.D₁₆ 3.83 and 4.11 offshoot/plant in 2005/2006 and 2006/2007 seasons respectively followed by clone K.D₂₀ 3.5 and 3.67 offshoots/plant in 2005/2006 and 2006/2007 seasons respectively, but the differences between these two selected clones were not significant, although they surpassed significantly most of the other selected clones and control in this trait. The lowest values of number of offshoots per plant were obtained from clones K.D₂₂ 1.11 and 1.0 offshoot/plant in 2005/2006 and 2006/2007 respectively followed by clone K.D₂₁ (1.34 offshoots) in 2005/2006 season and K.D₇ (1.33) in 2006/2007 season.

As regard to plant height, it is clear from data in the same table that there were significant differences among the selected clones in both seasons

of study. Clone K.D₇ produced the highest plant height (49.69 and 44.99 cm) followed by clone K.D₁₆ (49.24 and 44.59 cm) in 2005/2006 and 2006/2007 seasons respectively. On the other hand the lowest plant height was obtained from the control in the two seasons (33.67 and 34.87 cm) followed by K.D₈ (39 and 36 cm). While all the selected clones surpassed significantly the control in 2005/2006 season. Clones K.D₆, K.D₇, K.D₉, K.D₁₆, K.D₂₁, and K.D₂₂ surpassed significantly the control in this trait in 2006/2007 season.

As for leaves number per plant, data in Table 4 indicate clearly that there were significant differences among the values of leaves number per plant trait in both seasons of study. Clone K.D₁₆ produced the highest leaves number per plant followed by clones K.D₉ and K.D₇. Their values were 38.18, 34 and 31 for clone K.D₁₆, K.D₉ and K.D₇ respectively in 2005/2006 season and 37.22, 34.33 and 34.17 for these clones respectively in the 2006/2007 season. These clones (K.D₁₆, K.D₉ and K.D₇) surpassed significantly clones K.D₂₁ and K.D₂₃ in 2005/2006 and 2006/2007 seasons respectively. These variations in the studied vegetative growth traits may be attributed to differentiation in genotypes of these clones. These results are in agreement with those reported by Ibrahim (1980), Kasim (1994) and Kasim *et al.* (2002), recorded that there were differences among different globe artichoke genotypes in offshoots number per plant and plant height. Also Ibrahim (1980), Kasim (1994) and Kasim *et al.* (2002), reported that leaves number per plant varied from clone to another.

Table 4: Vegetative growth of selected French globe artichoke clones during 2005/2006 and 2006/2007 seasons.

Clone	No. of offshoots per plant		Plant height		No. of leaves per plant	
	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007
*K.D ₆	1.80	1.50	43.66	42.25	30.17	31.00
K.D ₇	1.50	1.33	49.69	44.99	31.00	34.17
K.D ₈	2.10	2.33	39.00	36.00	27.00	30.00
K.D ₉	2.33	2.50	47.00	42.65	34.00	34.33
K.D ₁₆	3.83	4.11	49.24	44.59	38.18	37.22
K.D ₁₉	1.67	1.35	43.00	40.08	30.00	28.50
K.D ₂₀	3.50	3.67	41.83	38.50	30.00	33.25
K.D ₂₁	1.34	1.69	47.66	44.22	24.00	28.94
K.D ₂₂	1.11	1.00	49.11	41.67	28.61	25.50
K.D ₂₃	2.00	2.17	42.50	40.00	28.67	25.00
**Cont.	2.01	2.19	33.67	34.87	28.94	29.89
L.S.D 0.05%	0.69	0.36	5.28	6.07	5.10	4.80

* K.D: Kafr El-Dawar

**Cont.: The common used variety (hyrious)

III.2. Early and total yield (expressed as number of heads per plant):

Concerning early yield, data in Table 5 indicated that there were significant differences in the early yield among the selected clones in both seasons of study. The highest early yield was obtained in both seasons from K.D₆, K.D₁₆ and K.D₂₁. They produced 3.58, 3.31 and 3.22 heads per plant respectively in 2005/2006 season and 3.5, 3.33 and 3.24 heads per plant respectively in 2006/2007 season. On the other hand the lowest number of

heads per plant was obtained from the control, clone K.D₂₀ and clone K.D₂₂ in both seasons of study. They produced 1.26, 1.53 and 1.88 heads/plant respectively in 2005/2006 season and 1.0, 1.85 and 2.0 heads/plant respectively in 2006/2007 season. There were significant differences among the values of early yield obtained from clones produced the highest early yield and those produced the lowest early yield in both seasons of study.

As for the total yield, data in the same table indicate that, there were significant differences among the selected clones in total yield in both seasons of study.

Clones K.D₆, K.D₁₆, K.D₂₀ and K.D₁₉ produced the highest total yield in both seasons of study. They produced 13.95, 13.67, 11.51 and 11.25 heads/plant respectively in 2005/2006 season, while they produced 15.83, 15.72, 14.5 and 14.33 heads/plant, respectively in 2006/2007 season. On the other hand the lowest total yield was obtained from the control and clone K.D₂₃ in the both seasons of study. They produced 8.83 and 10.1 heads/plant, respectively in 2005/2006 season, while they produced 10.55 and 12.33 heads/plant respectively in 2006/2007 season. The other clones were intermediate in this respect. The variations between the highest total yield and lowest total yield were significant in both seasons of study.

The obtained results are in harmony with those obtained by, Mc-Erlich (1983), Segarra (1986), Pandita *et al.* (1988), Micoolis *et al.* (1990), Kasim (1994) and Kasim *et al.* (2002). They found significant differences among the total yield of different globe artichoke genotypes.

Table 5: Early and total yield (expressed as number of heads/plant) of selected French globe artichoke clones during 2005/2006 and 2006/2007 seasons.

Clone	Early yield		Total yield	
	2005/2006	2006/2007	2005/2006	2006/2007
*K.D ₆	3.58	3.50	13.95	15.83
K.D ₇	2.50	2.80	10.90	13.81
K.D ₈	2.60	2.83	10.88	12.67
K.D ₉	2.65	2.92	10.56	13.81
K.D ₁₆	3.31	3.33	13.67	15.72
K.D ₁₉	2.17	2.67	11.25	14.33
K.D ₂₀	1.53	1.85	11.51	14.50
K.D ₂₁	3.22	3.24	10.83	13.42
K.D ₂₂	1.88	2.00	11.18	13.33
K.D ₂₃	2.04	2.50	10.10	12.33
**Cont.	1.26	1.00	8.83	10.55
L.S.D 0.05%	0.59	0.88	1.26	1.76

* K.D: Kafr El-Dawar

**Cont.: The common used variety (hyrious)

III.3. Head characteristics:

III.3.1. Physical characteristics:

Data in table (6) indicate the physical characteristics of the selected clones.

Concerning head weight, it is clear that there were significant differences in both seasons of study among heads weight of the selected

clones. The highest head weight was obtained from clones K.D₁₆ and K.D₉ in both seasons of study. They produced heads weight 239.42 and 238.15g., respectively in 2005/2006 season and 236.58 and 235.11g. respectively, in 2006/2007 season, while the lowest head weight was obtained by the control followed by clone K.D₂₃ in 2005/2006 season. They produced heads weight 184.83 and 210g., respectively, while the lowest head weight was produced in 2006/2007 season from control and clone K.D₂₂. They produced head weights 180 and 213g. respectively. The other selected clones were intermediate in this respect. The differences between head weight of the produced highest and lowest head weight were significant in both seasons of study.

As for head length, it is clear from data in the same table, that there were significant differences among the selected globe artichoke clones in both seasons of study. In 2005/2006 season the highest head length was obtained from clone K.D₁₆ followed by clones K.D₇ and K.D₆. They produced head length values 10.62, 10.55 and 10.43cm., respectively, while the lowest head length was produced by the control followed by clone K.D₁₉. Their head length values were 9.23 and 10.0cm, respectively. In 2006/2007 season, the highest head length was obtained from clone K.D₁₆ followed by clones K.D₇ and K.D₈. Their head length values were 10.64, 10.44 and 10.18cm respectively, while the lowest head length was obtained from the control followed by clone K.D₁₉. They produced head length values 8.74 and 9.3cm., respectively. There were significant differences among head length of clones which produced the highest values and those which produced the lowest values in both seasons of study.

As regard to head diameter, it is clear from data in table (6) that there were significant differences among head diameters of the selected clones in both seasons of study. Clones K.D₆, K.D₂₀ and K.D₁₆ produced the highest head diameter in both seasons of study. Their head diameter values were 8.39, 8.37 and 8.20cm in 2005/2006 season and 8.18, 8.03 and 8.01cm in 2006/2007 season, respectively, while the lowest head diameter was obtained from the control followed by clones K.D₂₁ and K.D₇ in 2005/2006 season and the control followed by clones K.D₂₁ and K.D₁₉ in 2006/2007 season. Their head diameter values were 7.20, 7.55 and 7.60cm in 2005/2006 season and 7.19, 7.55 and 7.66cm in the 2006/2007 season, respectively. It is clear also from these data that, there were significant differences between the highest head diameter values and lowest head diameter values in both seasons of study.

Concerning head receptacle weight, it is clear from data in the same table, that there were significant differences between the receptacle weight of the selected clones in both seasons of study. Clones K.D₁₆, K.D₂₁ and K.D₇ produced the highest values of receptacle weight in both seasons of study. They produced receptacles of 77.58, 76.58 and 75.0g. in 2005/2006 season and 79.41, 76.0 and 72.3g. in 2006/2007 season, respectively. On the other hand, the lowest values of receptacle weight in 2005/2006 season was produced by control, K.D₂₂ and K.D₈. They produced receptacle weight of 52.3g., 56.33g. and 57.77g., respectively, while the lowest receptacle weight in 2006/2007 season was obtained by control followed by K.D₈ and K.D₂₂.

They produced receptacle weight of 50.67, 58.94 and 58.94g. It is clear also from these data that there were significant differences the highest values and lowest values of receptacle weight in both seasons of study. These results are in agreement with those obtained by Mc-Erlich (1983), Kasim (1994) and Kasim *et al.* (2002) they mentioned that the averages of head weight and head receptacle weight in the early yield of artichoke differed from clone to another. This variation may be attributed to their different genotypes.

III.3.2. Chemical characteristics of the receptacle:

Five clones were chosen from the ten selected clones according to some of the studied traits to study the chemical characteristics of their receptacle of the early yield. Data in Table 7 indicate that there were significant differences among these clones in their receptacle chemical composition in both seasons of study. Concerning nitrogen percentage, it is clear that the differences between these clone and the control were significant in both seasons of study. In 2005/2006 season, the highest nitrogen percentage was obtained by clone K.D₈ followed by clones K.D₆, K.D₁₆, K.D₇, K.D₂₁, control and K.D₂₂. They produced nitrogen percentage values of 3.12, 2.84, 2.42, 2.40, 2.35, 2.24 and 1.87% respectively. In 2006/2007 season these clones showed the same trend. In this latter season the highest nitrogen percentage values were 3.01, 2.8, 2.4, 2.37, 2.33, 2.29 and 1.94% for clones K.D₈, K.D₆, K.D₁₆, K.D₇, K.D₂₁, control and K.D₂₂, respectively. Clone K.D₈ surpassed all other clones in this trait in both seasons of study.

Table 6: Heads physical characteristics of selected French globe artichoke clones of the early yield during 2005/2006 and 2006/2007 seasons.

Clone	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
*K.D ₆	234.17	220.58	10.43	9.58	8.39	8.18	60.62	61.33
K.D ₇	216.25	215.47	10.55	10.44	7.60	7.80	75.00	72.30
K.D ₈	211.50	214.11	10.24	10.18	8.00	7.88	57.77	58.94
K.D ₉	238.15	235.11	10.11	9.58	8.10	7.81	73.23	70.89
K.D ₁₆	239.42	236.58	10.62	10.64	8.20	8.01	77.58	79.41
K.D ₁₉	219.33	212.78	10.00	9.30	7.88	7.66	64.25	63.89
K.D ₂₀	227.00	226.82	10.05	9.61	8.37	8.03	65.60	66.55
K.D ₂₁	234.17	229.33	10.13	9.80	7.55	7.55	76.58	76.00
K.D ₂₂	215.33	213.00	10.20	9.98	8.08	8.00	56.33	58.94
K.D ₂₃	210.00	215.58	10.35	9.36	8.00	7.86	61.23	62.95
**Cont.	184.83	180.00	9.23	8.74	7.20	7.19	52.30	50.67
L.S.D 0.05%	7.80	7.32	0.84	0.73	0.50	0.33	5.55	6.94

* K.D: Kafr El-Dawar

**Cont.: The common used variety (hyrious)

As for phosphorus percentage in the receptacle, it is clear from data in the same table that in 2005/2006 season clone K.D₇ produced the highest value of phosphorus percentage (0.289%) followed by clones K.D₁₆ (0.284%),

K.D₂₁ (0.278%), K.D₂₂ (0.252), K.D₈ (0.248%) K.D₆ (0.246) and control (0.244%), while in 2006/2007 second season clone K.D₇ produced the highest value of phosphorus percentage (0.291%) followed by clones K.D₁₆ (0.286%), K.D₂₁ (0.279%), K.D₈ (0.251%), K.D₆ (0.250%), K.D₂₂ (0.248%) and control (0.235%) but the differences were not significant in both seasons of study.

As regard to potassium percentage, it is clear from data in table (7) that there were significant differences among the selected clones in this trait in both seasons of study. In 2005/2006 season, the highest value of potassium percentage was produced by clone K.D₇ (5.93%), followed by clones K.D₁₆ (5.09%), K.D₈ (4.83%), control (4.49%), K.D₂₁ (4.45%), K.D₆ (4.37%) and K.D₂₂ (4.01%). Clone K.D₇ surpassed significantly all other selected clones and control. Also, clone K.D₁₆ surpassed significantly clones K.D₈, control, K.D₂₁ and K.D₂₂, while the difference between clone K.D₂₁ and control was significant. In 2006/2007 season K.D₇ produced the highest value of potassium percentage (5.83%) followed by clones K.D₁₆ (5.0%), K.D₈ (4.79%), control (4.44%), K.D₂₁ (4.42%), K.D₆ (4.39%) and K.D₂₂ (4.3%). Clone K.D₇ surpassed significantly all other selected clones and control in this respect. Also clone K.D₁₆ surpassed significantly clones K.D₈, control, K.D₂₁, K.D₂₂ and K.D₆ in this respect.

Concerning protein percentage, it is clear from data in the same table, that the differences among protein percentage values produced by the selected clones and control were significant in both seasons of study. In 2005/2006 season clone K.D₈ produced the highest protein percentage (19.13%) followed by clones K.D₆ (17.75%), K.D₁₆ (15.13%), K.D₇ (15.0%), K.D₂₁ (14.69), control (14%) and K.D₂₂ (11.88%). Clone K.D₈ surpassed significantly all other selected clones and control. There were no significant differences among protein percentage values of clones K.D₁₆, K.D₇ and K.D₂₁, but these clones surpassed significantly control and clone K.D₂₂ in protein percentage. In 2006/2007 season, protein percentage values showed nearly the same trend.

As for Fibers percentage in the heads receptacle, it is clear from data in the same table that, there were significant variations among the selected clones in both seasons of study (table7). The lowest fibers percentage was produced by clone K.D₆ followed by clones K.D₇, K.D₁₆, K.D₂₁, control, K.D₂₂ and K.D₈. They produced 8.1%, 8.83%, 9.79%, 9.94%, 10.47%, 15.16% and 15.18% fibers, respectively in 2005/2006 season. Also, the same trend was obtained in 2006/2007 season. These results are in agreement with those obtained by Kasim *et al.* (2002) who found that there were obvious variations among receptacle chemical composition (i.e nitrogen, phosphorus, potassium, protein and fibers percentage) of different globe artichoke clones.

Table 7: Chemical composition of the receptacle (g/100g. dry weight) of selected French globe artichoke clones of the early yield during 2005/2006 and 2006/2007 seasons.

Clone	N%		P%		K%		Protein%		Fibers%	
	2005/ 2006	2006/ 2007	2005/ 2006	2006/ 2007	2005/ 2006	2006/ 2007	2005/ 2006	2006/ 2007	2005/ 2006	2006/ 2007
*K.D ₆	2.84	2.80	0.246	0.250	4.37	4.39	17.75	17.50	8.10	7.62
K.D ₇	2.40	2.37	0.289	0.291	5.93	5.83	15.00	14.81	8.83	8.30
K.D ₈	3.12	3.01	0.248	0.251	4.83	4.79	19.13	18.81	15.18	14.31
K.D ₁₆	2.42	2.40	0.284	0.286	5.09	5.00	15.13	15.06	9.79	9.22
K.D ₂₁	2.35	2.33	0.278	0.279	4.45	4.42	14.69	14.56	9.94	9.36
K.D ₂₂	1.87	1.94	0.252	0.248	4.01	4.30	11.88	12.13	15.16	14.27
**Cont.	2.24	2.29	0.244	0.235	4.49	4.44	14.00	14.33	10.47	9.83
L.S.D 0.05%	0.11	0.28	N.S	N.S	0.07	0.10	0.67	1.76	0.12	0.13

* K.D: Kafr El-Dawar

**Cont.: The common used variety (hyrious)

Conclusion:

This investigation is considered a start stage to improve French globe artichoke. The quality of this cultivar is deteriorated as a result of frequent vegetatively propagation by the farmers, without selecting the proper seeds. Two promising clones were selected i.e. K.D₁₆ and K.D₆ while the other selected clones need a continue selection program in the future.

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سلالات جديدة منتخبة من الخرشوف الصنف الفرنسي (هريوس)

عفاف توفيق محمود قاسم

قسم بحوث البطاطس والخضار خضرية التكاثر -معهد بحوث البساتين - مركز البحوث الزراعية

أجري هذا البحث خلال مواسم ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥، ٢٠٠٥/٢٠٠٦، ٢٠٠٦/٢٠٠٧ في مزرعة بحوث الخضار بقها- معهد بحوث البساتين .
في موسم ٢٠٠٣/٢٠٠٤ تم زراعة ٣٨ نبات أمهات تم انتخابها في موسم ٢٠٠٢/٢٠٠٣ من عشيرة ١٢٠٠ نبات بمزرعة خاصة بقرية كوم البركة مركز كفر الدوار محافظة البحيرة طبقاً لصفات التبرير والمحصول وجودته وأعتبر كل نبات كسلالة وزرعت كتجربة ميدانية للملاحظة .
في نهاية هذا الموسم تم انتخاب ١٥ سلالة طبقاً لمواصفاتهم وزرعت في موسم ٢٠٠٤/٢٠٠٥ وفي نهاية هذا الموسم تم انتخاب عشرة سلالات طبقاً لمواصفاتهم وزرعت في موسمي ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ .

يمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

- ١- الصفات الخضرية:
 - ١-١. أعطت السلالة K.D₁₆ أعلى عدد من الخلفات/نبات يليها السلالتين K.D₉، K.D₂₀ بينما أقل عدد من الخلفات/نبات أنتجته السلالة K.D₂₂.
 - ١-٢. أعلى ارتفاع للنبات تم الحصول عليه من السلالة K.D₇ والسلالة K.D₁₆ بينما أقل ارتفاع للنبات كان من المقارنة.
 - ١-٣. أعلى عدد من الأوراق/نبات تم الحصول عليه من السلالة K.D₁₆ يليها السلالات K.D₉، K.D₇ بينما أقل عدد من الأوراق/نبات تم الحصول عليه من السلالة K.D₂₁ في الموسم ٢٠٠٦/٢٠٠٥ والسلالة K.D₂₃ في موسم ٢٠٠٦/٢٠٠٧.
- ٢- المحصول المبكر والكلبي:
 - ١-٢. المحصول المبكر:
 - تم إنتاج أعلى محصول مبكر من السلالة K.D₆ يليها السلالات K.D₁₆، K.D₂₁ بينما أقل محصول مبكر أنتج بواسطة المقارنة يليها السلالات K.D₂₀، K.D₂₂.
 - ٢-٢. المحصول الكلبي:
 - أعلى محصول كلي أنتج بواسطة السلالة K.D₆ يليها السلالات K.D₁₆، K.D₂₀، K.D₁₉ بينما أقل محصول كلي تم الحصول عليه من المقارنة يليها السلالة K.D₂₃.
 - ٢- صفات الرأس:
 - ١-٢. الصفات الطبيعية:
 - أ- أعلى وزن للنوره أنتج من السلالة K.D₁₆ يليها السلالات K.D₉، K.D₆، K.D₂₁ بينما أقل وزن للنوره تم الحصول عليه من المقارنة.
 - ب- أعلى طول للنوره أنتج من السلالة K.D₁₆ يليها السلالات K.D₇ بينما المقارنة أنتجت أقل طول للنوره.
 - ت- أعلى قطر للنوره أنتج من السلالة K.D₆ يليها السلالات K.D₂₀، K.D₁₆ بينما أقل قطر للنوره تم الحصول عليه من المقارنة.
 - ث- السلالة K.D₁₆ أنتجت أعلى وزن للتخت يليها السلالات K.D₂₁ و K.D₇ بينما أقل وزن للتخت تم الحصول عليه من المقارنة.
 - ٢-٣. الصفات الكيماوية للرأس:
 - أ- أعلى نسبة مئوية للنيتروجين تم الحصول عليها من السلالة K.D₈ يليها السلالات K.D₆، K.D₁₆، K.D₇ و K.D₂₁ بينما أقل نسبة مئوية للنيتروجين تم الحصول عليه من السلالة K.D₂₂.
 - ب- أعلى نسبة مئوية للفوسفور تم الحصول عليها من السلالة K.D₇ يليها السلالات K.D₁₆، K.D₂₁ بينما أقل نسبة مئوية للفوسفور أنتجت من المقارنة ولكن الفروق لم تكن معنوية.
 - ت- أعلى نسبة مئوية للبتاسيوم أنتجت من السلالة K.D₇ يليها السلالات K.D₁₆ بينما أقل نسبة مئوية للبتاسيوم تم الحصول عليها من السلالة K.D₂₂.
 - ث- أنتجت السلالة K.D₈ أعلى نسبة مئوية للبروتين يليها السلالات K.D₆، K.D₁₆، K.D₇، K.D₂₁ بينما السلالة K.D₂₂ أنتجت أقل نسبة مئوية للبروتين.
 - ج- أقل نسبة مئوية للألياف وجدت في السلالة K.D₆ يليها السلالات K.D₇، K.D₁₆، K.D₂₁ بينما أعلى نسبة مئوية للألياف وجدت في السلالة K.D₈.