

## EFFECT OF TRANS PLANTING DATE AND CULTIVAR ON GROWTH, YIELD AND QUALITY OF BROCCOLI

<sup>1</sup>Shehata, S.A., <sup>2</sup> Ahmed, O.K., <sup>3</sup>Abd El-All, H.M., <sup>4</sup>Mahmed, M.A And Abd El- Gawad, K.F

<sup>1</sup> Vegetable Crops Dep., Fac. Of Agric., Cairo Univ., Giza, Egypt.

<sup>2</sup> Biochemistry Dep., Fac. Of Agric., Cairo Univ., Giza, Egypt.

<sup>3</sup> Vegetable Res. Dep., Hort Res. Inst., Dokki., Giza, Egypt.

<sup>4</sup> Horticulture Dep., Fac. of Agric., Beni-Suef Univ., Beni-Suef, Egypt.

### ABSTRACT

This investigation was conducted at the experimental station of the Faculty of Agriculture, Cairo University, Giza, during the two successive winter seasons of 2013/2014 and 2014/2015 to study the effect of three planting dates, three F1 cultivars and their interactions on growth, yield and quality of broccoli plants. The planting dates were as follows, 1<sup>st</sup> September, 1<sup>st</sup> October and 1<sup>st</sup> November with three F1 cultivars, viz. Marathon, Heraklion and Centauro, respectively. Results showed that plant growth, yield and quality of heads were greatly affected by the three cultivars in planting dates. In this respect, second planting date 1<sup>st</sup> October gave the highest values of most vegetative growth traits expressed as number of leaves, leaf area and total fresh weight plant. As well as the highest values of main head and total heads yield/plot and /fed. Plants gave the highest values of most of vegetative growth characteristics, yield and quality of broccoli followed by Marathon plus 1<sup>st</sup> November planting date recorded the lowest values of growth, yield and its components. With respect to the interaction, Centauro plus 1<sup>st</sup> October planting date was superior in total head yield and physical characteristics of heads expressed as average head length, diameter and weight. Therefore, it could be recommended for to obtain the highest values of head yield and quality of broccoli we are advised to plant Centauro and Marathon, respectively in planting date 1<sup>st</sup> October.

**Keywords:** Broccoli, *Brassica oleracea* L. var. Italica, planting date, cultivars, growth, yield and quality.

### INTRODUCTION:

Broccoli (*Brassica oleracea* L. var. Italica) is one of most important cole crops grown in the world. The health benefits of broccoli are partly associated with secondary plant compounds known for their antioxidant activity (Jones *et al.*, 2006). In Egypt, Broccoli still grown in a very limited scattered areas and the total cultivated area is not exactly known. Eating larger portions may also have additional benefits, since broccoli is a rich source of many vitamins and minerals

such as vitamins A and C, carotenoids, dietary fiber, calcium and folic acid (Michaud *et al.*, 2002). The green inflorescence is a commercial product of the broccoli plant. It is rich in chlorophyll, ascorbic acid and a good source of vitamins and minerals (Fabek *et al.*, 2012) and some bioactive compounds such as phenolics, flavonoids and gluconsinolates that possess antioxidant and anticancer effects (Beecher, 1994). Considering broccoli sensitivity to high and low temperature, careful investigation and attention for its commercial production, according to the proper schedule in every region is of great importance. The planting dates have a significant effect on yield and other yield contributing characters of broccoli. The yield decreased with delay planting. Head yield is higher when crops are planted earlier and show a linear decreasing trend with a delay in planting dates (Bianco *et al.*, 1996). Early planted crops resulted in longer duration and produced taller plants with more number of leaves; higher plant spread and more leaf size index as well as a lower percentage of abnormal curds than late planted crops and finally attributed to higher curd yield (Gautam *et al.*, 1998). So, there is enough scope to identify the optimum planting date to maximize the broccoli yield. Broccoli genotypes have also a significant effect on yield of broccoli. Cultivar Captain produced the highest total yield as well as top and lateral head yields, the largest top head weight and marked earliness which was followed by CVs Lucky, General, Griffen, Liberty and Milady (Toth *et al.*, 2007). Several broccoli genotypes are cultivated in Egypt those differ in yield. So, it is essential to identify high yielding genotypes to maximize broccoli yield. Therefore, the present experiment was undertaken to find out the optimum planting date and appropriate genotype for maximum yield of Broccoli. It is known that planting date is critical for a successful broccoli production. The planting dates directly affect yield and several quality parameters (Aktaş *et al.*, 1999; Eşiyok and Dönmez, 1998; Sari *et al.*, 2000).

The aim of this work was to study the effect of three planting dates and three broccoli cultivars on growth, yield and quality.

#### **MATERIALS AND METHODS**

This investigation was conducted at the experimental station of the Faculty of Agriculture, Cairo university, Giza, during the two successive winter seasons of 2013/ 2014 and 2014/ 2015 to study the effect of planting date and cultivars variation on broccoli vegetative growth characteristics, yield and quality of heads.

This experiment includes nine treatments resulted from the combination of three planting dates and three F<sub>1</sub> cultivars as follows:

- A. Planting dates: 1<sup>st</sup> September, 1<sup>st</sup> October and 1<sup>st</sup> November.
- B. Broccoli F<sub>1</sub> cultivars: Marathon, Heraklion and Centauro.

## ***EFFECT OF TRANS PLANTING DATE AND CULTIVAR..... 60***

Seeds of broccoli were sown in the nursery 45 days before the three transplanting dates separately for both seasons.

The chemical properties of the soil under experiments are presented in Table 1 according to Jackson (1965). The plot area was 12.8 m<sup>2</sup> it consisted of 4 rows, each of 80 cm in width and 4 m in length. The transplants were transplanted at 60 cm apart on one side of the row after 45 days from seed sowing in the nursery. The rate of NPK fertilizers was applied at the standard rate for all treatments at 75 kg N, 60 Kg P<sub>2</sub>O<sub>5</sub> and 48 kg K<sub>2</sub>O/fed. The amounts specified for each plot were divided into two equal parts. The first part was applied after 3 weeks from transplanting and the second part was added three weeks later. The sources of fertilizers used were ammonium nitrate (33.5%N), calcium super phosphate (15.5% P<sub>2</sub>O<sub>5</sub>) and potassium sulfate (48%K<sub>2</sub>O). Other cultural practices were carried out according to the recommendations for such crop.

**Table (1): The chemical properties of the soil under experiments.**

| Depth cm | pH of 1:2.5 soil: water suspension | Organic matter % | E.C. ds/m at 250 1:5 soil:water | CaCO <sub>3</sub> % | Minerals |      |     |                              |
|----------|------------------------------------|------------------|---------------------------------|---------------------|----------|------|-----|------------------------------|
|          |                                    |                  |                                 |                     | N%       | P%   | K%  | SO <sub>4</sub> <sup>-</sup> |
| 0-30     | 8.5                                | 2.1              | 0.67                            | 1.77                | 0.34     | 0.63 | 4.1 | 0.55                         |
| 0-30     | 8.3                                | 2.5              | 0.69                            | 1.82                | 0.45     | 0.69 | 4.5 | 0.61                         |

The air temperature during the two growing seasons of the study at the Cairo district are presented in Table 2. Data during the period of the experiment was collected from the Egypt Meteorological Department.

**Table(2): Mean monthly air temperature at Cairo district during the winter growing seasons of 2014 and 2015.**

| Month | 2013 / 2014 |       |       | 2014 / 2015 |       |       |
|-------|-------------|-------|-------|-------------|-------|-------|
|       | Max.        | Min.  | Mean  | Max.        | Min.  | Mean  |
| Aug.  | 38.67       | 23.49 | 30.89 | 39.13       | 24.47 | 31.84 |
| Sep.  | 34.34       | 20.90 | 27.29 | 35.83       | 22.02 | 28.68 |
| Oct.  | 30.24       | 19.11 | 24.14 | 32.23       | 19.84 | 25.86 |
| Nov.  | 23.58       | 14.26 | 18.71 | 23.41       | 14.11 | 18.07 |
| Dec.  | 20.91       | 11.71 | 16.15 | 17.80       | 9.08  | 13.40 |
| Jan.  | 19.32       | 10.42 | 14.80 | 18.42       | 8.82  | 13.61 |
| Feb.  | 21.25       | 10.43 | 15.89 | 21.32       | 11.00 | 16.28 |

**The following data were recorded:**

### **(a) Vegetative growth:**

Five plants were randomly chosen from each experimental plot after 60 days from transplanting and the following data were recorded during the two seasons:

1. Plant height (cm<sup>2</sup>); measured starting from the ground level to the apical meristem of the plant.
2. Total number of leaves per plant.
3. Leaf area / plant (cm<sup>2</sup>).
4. Total fresh weight per plant (kg).

**(b) Yield of heads:**

A head was considered mature at the time before it started to lose compactness or just before buds started to break up. In each experimental plot, all plants of the two middle rows were allocated to record observations on total head yield. The following parameters were considered:

1. Main head/ plot (kg).
2. Secondary head/ plot (kg).
3. Total head yield/ plot (kg); theoretically calculated by plus total main and secondary heads.
4. Total head yield/ Fed (ton); theoretically calculated by using the relationship between are total head yield/ plot and ratio area fed.

**1- Physical characteristics of heads:**

1. Heads weight per plant; sum of the weights of three pickings of the apical heads.
2. Diameter and height of head; determined at each harvesting date.

**2- Chemical composition of head:**

- 1- Total chlorophyll content was determined colorimetrically as described in the A.O.A.C. (1990).
- 2- Vitamin C content was determined in fresh samples by titration with 2,6 dichloro phenol indephenol as described in A.O.A.C. (1990).

**Statistical analysis:**

Data were tabulated and subjected to analysis of variance using M- State program. The new LSD method (Waller and Duncn,1969) was used for testing the significance of means in all experiments conducted.

**Results and Discussion**

**A- Vegetative growth**

**1- Effect of planting date**

Data obtained on the effect of planting dates on vegetative growth of broccoli are presented in Table 3. These data indicate that there was a significant difference among the tested planting dates on all vegetative growth traits of broccoli plants during both seasons of study. Such data show that plant height was significantly highest in first planting date (1<sup>st</sup> September), while the third planting date (1<sup>st</sup> November) gave the lowest value in all measured growth aspects in this respect in both seasons. In this regard, the second planting date (1<sup>st</sup> October)

## ***EFFECT OF TRANS PLANTING DATE AND CULTIVAR..... 62***

exhibited the highest number of leaves and leaf area/ plant in both seasons of growth. Meanwhile, there were no significant differences between 1<sup>st</sup> September and 1<sup>st</sup> October in total fresh weight in both seasons. In addition, the lowest value was recorded in third planting date (1st November) in both seasons. In this connection higher vegetative growth of the medium, planting date might be due to the prevailing suitable temperature (Table 1) and better meteorological conditions, i.e., sunshine and day length of the medium planting date compared with early and late planting dates. These moderate conditions allow more photosynthesis and more metabolites reflecting better vegetative growth in addition the suitable temperature for absorption and translocation of soil solution by the root system. While at the latest planting date, low temperature prevailed during early stages of growth stimulated curd initiation and stopped the emergence of more leaves which is the source of food storage and this resulted in plants with poor growth. These results agree with Chung and Strickland (1986) who suggested that the lower growing temperatures of later sowings might cause floral initiation at a younger physiological age. Plants therefore develop heads before reaching full size and the spears are small and take a longer time to reach maturity. The latest planting date (1<sup>st</sup> Nov.) decreased total fresh weight and number of leaves per plant. This could be interpreted as that at the latest planting date the low temperature prevailed during early stages of growth stimulated curd initiation rather than leaves.

These results are in agreement with those obtained by Preeti *et al.* (2009); Abd El-Rahman, *et al.*, (2010); Singh *et al.*, (2010); Abd El-Rahman (2011); Hossain *et al.* (2011); Hossain *et al.*, (2011) and Abo El-Magd (2013).

### **2- Effect of cultivars**

Data in the same Table 3 show that the tested cultivars differed significantly in their vegetative growth trait, viz., plant height, number of leaves, leaf area and total fresh weight/ plant. Data obtained on the effect of cultivar on plant height and number of leaves are presented in Table 3, such data show that plant height and number of leaves were significantly recorded higher mean values with a case of Marathon in both seasons. Centauro had the highest values of leaf area and total fresh weight/ plant in both seasons. The differences among cultivars in vegetative growth might be due to their genetic differentiation which allows some to use the natural resources with high potentiality. The genetic potentiality of some cultivars enables their plants to absorb more nutrients of the soil and more photosynthetic surfaces which allow better photosynthetic capacity. In this respect, Diputado *et al.*,

**Table(3):Vegetative growth characteristics of broccoli as affected by planting dates, cultivars and their interactions during 2013/2014 and 2014/2015 seasons.**

| Treatment                                       | Plant height (cm)     | Number of leaves /plant | Leaf area/ plant (cm <sup>2</sup> ) | Total fresh weight/ plant (kg) | Plant height (cm) | Number of leaves/ plant | Leaf area/ plant (cm <sup>2</sup> ) | Total fresh weight/ plant (kg) |
|---|-----------------------|-------------------------|-------------------------------------|--------------------------------|-------------------|-------------------------|-------------------------------------|--------------------------------|
|   | <b>2013-2014</b>      |                         |                                     |                                | <b>2014-2015</b>  |                         |                                     |                                |
|   | <b>Planting dates</b> |                         |                                     |                                |                   |                         |                                     |                                |
| <b>1<sup>st</sup> September (P<sub>1</sub>)</b> | 85.27                 | 22.67                   | 808.7                               | 3.696                          | 84.56             | 23.00                   | 853.1                               | 3.683                          |
| <b>1<sup>st</sup> October (P<sub>2</sub>)</b>   | 71.28                 | 24.33                   | 1009.0                              | 3.867                          | 68.39             | 23.67                   | 1070.0                              | 3.850                          |
| <b>1<sup>st</sup> November (P<sub>3</sub>)</b>  | 37.17                 | 11.44                   | 399.5                               | 1.033                          | 38.10             | 12.33                   | 386.2                               | 1.100                          |
| <b>L.S.D<sub>0.05</sub></b>                     | 0.61                  | 1.01                    | 88.1                                | 0.546                          | 1.92              | 1.66                    | 94.4                                | 0.334                          |
|   | <b>cultivars</b>      |                         |                                     |                                |                   |                         |                                     |                                |
| <b>cv. Marathon (C<sub>1</sub>)</b>             | 66.39                 | 22.67                   | 563.9                               | 2.926                          | 65.43             | 22.67                   | 609.4                               | 2.967                          |
| <b>Cv. Heraklion (C<sub>2</sub>)</b>            | 62.61                 | 19.44                   | 536.5                               | 2.556                          | 62.94             | 19.67                   | 547.9                               | 2.633                          |
| <b>cv. Centauro (C<sub>3</sub>)</b>             | 64.72                 | 16.33                   | 1117.0                              | 3.115                          | 62.67             | 16.67                   | 1152.0                              | 3.033                          |
| <b>LSD<sub>0.05</sub></b>                       | 0.81                  | 1.27                    | 49.94                               | 0.534                          | 1.62              | 1.41                    | 64.1                                | 0.326                          |
|   | <b>Interaction</b>    |                         |                                     |                                |                   |                         |                                     |                                |
| <b>P<sub>1</sub> * C<sub>1</sub></b>            | 85.66                 | 26.00                   | 602.3                               | 4.077                          | 83.67             | 26.00                   | 625.7                               | 3.900                          |
| <b>P<sub>1</sub> * C<sub>2</sub></b>            | 80.50                 | 23.00                   | 551.7                               | 3.367                          | 82.83             | 23.00                   | 581.3                               | 3.400                          |
| <b>P<sub>1</sub> * C<sub>3</sub></b>            | 90.66                 | 19.00                   | 1272.0                              | 3.644                          | 87.17             | 20.00                   | 1352.0                              | 3.750                          |
| <b>P<sub>2</sub> * C<sub>1</sub></b>            | 75.00                 | 27.00                   | 725.2                               | 3.700                          | 71.33             | 27.00                   | 852.3                               | 3.800                          |
| <b>P<sub>2</sub> * C<sub>2</sub></b>            | 70.33                 | 25.00                   | 709.0                               | 3.500                          | 67.33             | 24.00                   | 723.7                               | 3.600                          |
| <b>P<sub>2</sub> * C<sub>3</sub></b>            | 68.50                 | 21.00                   | 1593.0                              | 4.400                          | 66.50             | 20.00                   | 1635.0                              | 4.150                          |
| <b>P<sub>3</sub> * C<sub>1</sub></b>            | 39.50                 | 15.00                   | 364.0                               | 1.000                          | 41.30             | 15.00                   | 350.3                               | 1.200                          |
| <b>P<sub>3</sub> * C<sub>2</sub></b>            | 37.00                 | 10.33                   | 349.0                               | 0.800                          | 38.66             | 12.00                   | 338.7                               | 0.900                          |
| <b>P<sub>3</sub> * C<sub>3</sub></b>            | 35.00                 | 9.000                   | 485.5                               | 1.300                          | 34.33             | 10.00                   | 469.5                               | 1.200                          |
| <b>LSD<sub>0.05</sub></b>                       | 1.400                 | 2.21                    | 86.5                                | 0.924                          | 2.81              | 2.44                    | 111.0                               | 0.565                          |

(1989) reported that cv. Centauro recorded denser leaves and higher values of fresh weight of leaves, stems and total plant which offered wider photosynthetic surface and enables Centauro plants to higher photosynthetic capacity leading to higher dry matter accumulation in its leaves, stems and consequently total plant. Showed that leaves number varied with cultivars and appeared to be related to their varying time to curd initiation. They added that plant dry matter production varied with cultivars. Wide variations were recorded among the vegetative growth of the different cultivars results reported similar Sterret *et al.*, (2004; Siomos *et al.*, (2004); Abou El-Magd, *et al.*, (2006) and El-Helaly, (2006).

### **3- Effect of Interaction between planting date and cultivars**

Data presented in Table 3 show that the highest value of plant height was recorded with 1<sup>st</sup> September plus Centauro in both seasons. The highest values of a number of leaves were recorded with 1<sup>st</sup> October plus Marathon in both season. The interaction between 1<sup>st</sup> October plus Centauro had highest values of leaf area

## ***EFFECT OF TRANS PLANTING DATE AND CULTIVAR..... 64***

in both season. The interaction between 1st October plus Centauro had significantly the highest total fresh weight in the both seasons. Some investigators reported that the combined effect of planting date and cultivars affected broccoli growth (El-Hifny *et al.*, 2002 and Vagen *et al.*, 2004).

### **b- Head yield and its components**

#### **1. Effect of planting date:**

Table 4 displays the third planting date 1st November reflected negative significant influences on head yield and its components (main head / plot, secondary head / plot and total head yield / plot and total head yield / fed.) in comparison with the first or second planting in both seasons. Meanwhile, differences in the previously mentioned traits between first and second planting date was not true, in two seasons. The only exception was in secondary head/ plant in the first season where difference between first and second planting date was not significant. The second planting date 1st October is improved broccoli plant growth and development through enhancing number of leaves/ plant, leaf area/ plant and total fresh weight/ plant in Table 3. This reflected positively on head yield and its components. These results are in agreement with those obtained by Emam, (2005); El-Helaly, (2006). Abd El-Rahman, *et al.*, (2010) and Abd El-Rahman, (2011) who indicated that primary and secondary head yield were the highest in the mid transplanting date (1<sup>st</sup> October) compared with (1<sup>st</sup> September and 1<sup>st</sup> November).

#### **2. Effect of cultivars**

Results of statistical analysis in Table 4 displayed that Centauro, significantly, resulted in higher mean value of main head/ plot than Marathon and Heraklion and total head yield/ plot and fed than Heraklion in both seasons. Difference between Marathon and Centauro on total head yield/ plot or fed was not significant, in second season. In other hand, Marathon gave the highest value of secondary head/ plot, in both seasons. This result which explains the superiority of Centauro in main head and cv. Marathon F1 inside head might be also due to the genetic composition for cultivars with that increase GA3 and IAA in the Apical meristem in cv. Centauro While cytokines in cv. Marathon F1 which leads to side branches and yield. These results were similar with many investigators Abd El-Rahman, *et al.*, (2010) and Abd El-Rahman, (2011). and Abou El-Magd, (2013.)

**Table (4): Head yield of broccoli as affected by planting dates , cultivars and their interactions during 2013/2014 and 2014/2015 seasons.**

| Treatment                                   | Main head (Kg/plot)   | Secondary head (Kg/plot) | Total head Yield (Kg/plot) | Total head yield (ton/ fed) | Main head (Kg/plot) | Secondary head (Kg/plot) | Total head yield (Kg/plot) | Total head yield (ton/ fed) |
|---|-----------------------|--------------------------|----------------------------|-----------------------------|---------------------|--------------------------|----------------------------|-----------------------------|
|   | <b>2013-2014</b>      |                          |                            |                             | <b>2014-2015</b>    |                          |                            |                             |
|   | <b>Planting dates</b> |                          |                            |                             |                     |                          |                            |                             |
| 1 <sup>st</sup> Septemper (P <sub>1</sub> ) | 12.75                 | 11.15                    | 23.90                      | 7.989                       | 14.07               | 12.73                    | 26.80                      | 8.933                       |
| 1 <sup>st</sup> October (P <sub>2</sub> )   | 16.97                 | 12.91                    | 29.87                      | 9.958                       | 16.17               | 16.08                    | 32.25                      | 10.75                       |
| 1 <sup>st</sup> November (P <sub>3</sub> )  | 7.27                  | 0.89                     | 8.15                       | 2.718                       | 6.70                | 0.74                     | 7.44                       | 2.48                        |
| LSD <sub>0.05</sub>                         | 0.85                  | 2.56                     | 2.93                       | 0.936                       | 1.14                | 2.61                     | 1.78                       | 0.59                        |
|   | <b>Cultivars</b>      |                          |                            |                             |                     |                          |                            |                             |
| cv. Marathon (C <sub>1</sub> )              | 11.18                 | 9.582                    | 20.76                      | 6.940                       | 11.47               | 11.621                   | 23.09                      | 7.696                       |
| Cv. Heraklion (C <sub>2</sub> )             | 9.31                  | 7.843                    | 17.15                      | 5.717                       | 9.13                | 9.461                    | 18.59                      | 6.198                       |
| cv. Centauro(C <sub>3</sub> )               | 16.50                 | 7.522                    | 24.02                      | 8.007                       | 16.33               | 8.463                    | 24.80                      | 8.265                       |
| LSD <sub>0.05</sub>                         | 1.82                  | 1.135                    | 2.26                       | 0.772                       | 1.02                | 1.831                    | 2.09                       | 0.696                       |
|   | <b>Interaction</b>    |                          |                            |                             |                     |                          |                            |                             |
| P <sub>1</sub> * C <sub>1</sub>             | 11.93                 | 12.57                    | 24.50                      | 8.22                        | 12.60               | 15.08                    | 27.68                      | 9.228                       |
| P <sub>1</sub> * C <sub>2</sub>             | 9.22                  | 9.99                     | 19.21                      | 6.40                        | 10.00               | 12.20                    | 22.20                      | 7.401                       |
| P <sub>1</sub> * C <sub>3</sub>             | 17.10                 | 10.90                    | 28.00                      | 9.33                        | 19.60               | 10.91                    | 30.51                      | 10.171                      |
| P <sub>2</sub> * C <sub>1</sub>             | 14.60                 | 14.50                    | 29.10                      | 9.70                        | 15.20               | 18.15                    | 33.35                      | 11.120                      |
| P <sub>2</sub> * C <sub>2</sub>             | 13.30                 | 12.55                    | 25.85                      | 8.62                        | 12.40               | 15.61                    | 28.01                      | 9.336                       |
| P <sub>2</sub> * C <sub>3</sub>             | 23.00                 | 11.67                    | 34.67                      | 11.56                       | 20.90               | 14.48                    | 35.38                      | 11.790                      |
| P <sub>3</sub> * C <sub>1</sub>             | 7.00                  | 1.67                     | 8.673                      | 2.89                        | 6.60                | 1.63                     | 8.23                       | 2.744                       |
| P <sub>3</sub> * C <sub>2</sub>             | 5.40                  | 0.99                     | 6.39                       | 2.13                        | 5.00                | 0.57                     | 5.57                       | 1.858                       |
| P <sub>3</sub> * C <sub>3</sub>             | 9.40                  | 0.00                     | 9.40                       | 3.13                        | 8.50                | 0.00                     | 8.50                       | 2.833                       |
| LSD <sub>0.05</sub>                         | 3.14                  | 1.97                     | 3.92                       | 1.34                        | 1.760               | 3.17                     | 3.61                       | 1.205                       |

**3- Effect of the interaction between planting date and cultivar:**

The illustrated result in Table 4 indicates that the highest main head / plot and total head yield/ plot or fed. was recorded with 1<sup>st</sup> October plus Centauro in both seasons. The interaction between 1<sup>st</sup> October plus Marathon was the superior in secondary head / plot in both seasons.

These results were similar. Abou El-Magd, *et al.*, (2006); Abd El-Rahman, *et al.*, (2010) and Abd El-Rahman (2011). Who reported that broccoli head yield was widely affected by the combined effect of planting dates and cultivars.

**C- Quality of Head****1-planting date**

Data obtained on the effect of planting date on head weight/ plant, diameter of head, head height, vitamin C and total chlorophyll during 2014 and 2015 seasons are presented in Table 5. In this connection, significant differences were detected among planting dates on head quality of broccoli. The second planting date (1<sup>st</sup> October) gave the highest values of weight and diameter of the head in both seasons. Meanwhile, the third planting date had the lowest values of these

## ***EFFECT OF TRANS PLANTING DATE AND CULTIVAR..... 66***

characters in both seasons. In the first season, there were no significant differences of head height. As shown in Table 5, there were no significant differences between 1<sup>st</sup> September and 1<sup>st</sup> October planting on vitamin C and total chlorophyll in both seasons, in addition, planting on 1<sup>st</sup> November had no significant effect on vitamin C in the second season. This result may be due to the narrow range of the difference between day and night temperature in the second planting date compared with first and third planting dates. This moderate condition allows more photosynthesis and more metabolites reflecting better head quality. These results are in agreement with those obtained by El-Hamd and Esmail (2005); El –Helaly (2006); Abou El-Magd *et al.*, (2006); Abd El All (2008), Abd El-Rahman *et al.* (2010) and Abd El-Rahman (2011).

### **2- Effect of cultivars:**

It appears from the data in Table 5 that there was a significant difference between cultivars on head quality. Centauro had the highest values of head weight/ plant , diameter and height in both seasons, while the cv. Heraklion F1 gave the lowest value of these characters during the 2014 and 2015 season. Cv. Heraklion F1 gave the highest values of vitamin C and total chlorophyll in both seasons. These results are in agreement with investigators (Abd El-All, 2008. and Abou El-Magd, *et al.*, 2006).

### **3- Effect of the interaction between planting date and cultivar**

With respect to the interaction between planting date and cultivar, data presented in Table 5 show that the highest values of head weight/ plant and diameter of the head were observed with the interaction between 1<sup>st</sup> October plus Centauro in both season.

The interaction between 1<sup>st</sup> September plus Centauro had significantly the highest head height in both seasons. The highest values of vitamin C were recorded with the interaction between 1<sup>st</sup> September plus Heraklion, 1<sup>st</sup> October plus Marathon and 1<sup>st</sup> October plus Heraklion in both season. In both years of the study there was a significant difference on chlorophyll. The interaction between (1<sup>st</sup> September \* cv. Heraklion F1) had the highest values of total chlorophyll in both season. However, the interaction between (1<sup>st</sup> November \* cv. Marathon F1) and (1<sup>st</sup> November \* cv. Centauro F1) had the lowest values of total chlorophyll.

**Table 5: Head quality of broccoli as affected by planting dates , cultivars and their interactions during 2013/2014 and 2014/2015 seasons.**

| Treatment   | Head weight/<br>plant (g) | Diameter<br>of head<br>(cm) | Head<br>height<br>(cm) | Vit. C<br>(mg/100 fw) | Total<br>Chlorophyll<br>(mg/100 fw) | Head<br>weight/<br>plant (g) | Diameter<br>of head<br>(cm) | Head<br>Height<br>(cm) | Vit. C<br>(mg/100 fw) | Total<br>Chlorophyll<br>(mg/100 fw) |
|---|---------------------------|-----------------------------|------------------------|-----------------------|-------------------------------------|------------------------------|-----------------------------|------------------------|-----------------------|-------------------------------------|
| <b>2013-2014</b>                                    |                           |                             |                        |                       | <b>2014-2015</b>                    |                              |                             |                        |                       |                                     |
| <b>Planting dates</b>                               |                           |                             |                        |                       |                                     |                              |                             |                        |                       |                                     |
| <b>1<sup>st</sup> September<br/>(P<sub>1</sub>)</b> | 637.6                     | 20.50                       | 17.03                  | 117.5                 | 76.50                               | 703.3                        | 20.37                       | 14.15                  | 118.8                 | 77.53                               |
| <b>1<sup>st</sup> October<br/>(P<sub>2</sub>)</b>   | 848.3                     | 22.98                       | 17.96                  | 120.8                 | 76.16                               | 808.3                        | 21.70                       | 15.40                  | 111.0                 | 77.72                               |
| <b>1<sup>st</sup> November<br/>(P<sub>3</sub>)</b>  | 363.3                     | 14.98                       | 17.61                  | 108.3                 | 53.10                               | 335.0                        | 15.76                       | 13.03                  | 109.4                 | 54.67                               |
| <b>LSD<sub>0.05</sub></b>                           | 42.3                      | 1.18                        | 1.85                   | 3.5                   | 2.07                                | 976.0                        | 0.47                        | 1.01                   | 25.7                  | 3.60                                |
| <b>Cultivars</b>                                    |                           |                             |                        |                       |                                     |                              |                             |                        |                       |                                     |
| <b>cv. Marathon<br/>(C<sub>1</sub>)</b>             | 558.9                     | 18.80                       | 17.71                  | 118.0                 | 61.11                               | 573.3                        | 18.95                       | 14.29                  | 119.5                 | 62.69                               |
| <b>Cv. Heraklion<br/>(C<sub>2</sub>)</b>            | 465.3                     | 17.07                       | 15.10                  | 121.7                 | 79.87                               | 456.7                        | 17.10                       | 11.98                  | 122.4                 | 81.35                               |
| <b>cv. Centauro<br/>(C<sub>3</sub>)</b>             | 825.0                     | 22.59                       | 19.78                  | 106.9                 | 64.77                               | 816.7                        | 21.78                       | 16.29                  | 97.22                 | 65.88                               |
| <b>LSD<sub>0.05</sub></b>                           | 90.7                      | 0.57                        | 1.01                   | 1.7                   | 4.51                                | 50.7                         | 0.34                        | 0.51                   | 20.21                 | 2.24                                |
| <b>Interaction</b>                                  |                           |                             |                        |                       |                                     |                              |                             |                        |                       |                                     |
| <b>P<sub>1</sub> * C<sub>1</sub></b>                | 596.7                     | 19.75                       | 16.23                  | 120.8                 | 68.86                               | 630.0                        | 20.12                       | 13.53                  | 121.8                 | 69.95                               |
| <b>P<sub>1</sub> * C<sub>2</sub></b>                | 461.0                     | 17.26                       | 12.73                  | 123.3                 | 91.10                               | 500.0                        | 17.98                       | 10.49                  | 124.5                 | 92.10                               |
| <b>P<sub>1</sub> * C<sub>3</sub></b>                | 855.0                     | 24.50                       | 22.12                  | 108.3                 | 69.54                               | 980.0                        | 23.00                       | 18.42                  | 110.0                 | 70.54                               |
| <b>P<sub>2</sub> * C<sub>1</sub></b>                | 730.0                     | 22.19                       | 18.23                  | 125.0                 | 66.17                               | 760.0                        | 21.23                       | 15.13                  | 127.0                 | 68.08                               |
| <b>P<sub>2</sub> * C<sub>2</sub></b>                | 665.0                     | 20.33                       | 15.75                  | 125.0                 | 85.42                               | 620.0                        | 18.88                       | 13.83                  | 126.0                 | 87.11                               |
| <b>P<sub>2</sub> * C<sub>3</sub></b>                | 1150.0                    | 26.43                       | 19.90                  | 112.5                 | 76.88                               | 1045.0                       | 25.00                       | 17.23                  | 79.9                  | 77.98                               |
| <b>P<sub>3</sub> * C<sub>1</sub></b>                | 350.0                     | 14.45                       | 18.66                  | 108.3                 | 48.30                               | 330.0                        | 15.50                       | 14.22                  | 109.8                 | 50.03                               |
| <b>P<sub>3</sub> * C<sub>2</sub></b>                | 270.0                     | 13.63                       | 16.83                  | 116.7                 | 63.10                               | 250.0                        | 14.45                       | 11.63                  | 116.7                 | 64.85                               |
| <b>P<sub>3</sub> * C<sub>3</sub></b>                | 470.0                     | 16.85                       | 17.33                  | 100.0                 | 47.90                               | 425.0                        | 17.33                       | 13.23                  | 101.8                 | 49.13                               |
| <b>LSD<sub>0.05</sub></b>                           | 157.2                     | 0.98                        | 1.75                   | 2.8                   | 7.81                                | 87.9                         | 0.60                        | 0.89                   | 35.0                  | 3.88                                |

This result may be due to these moderate a condition allows more photosynthesis and more metabolites reflecting better head quality. These results are in agreement with many investigators, (Tapi and Pati 2003; Abou El-Magd, et al., 2006 and Abd El-All 2008).

### References

- A.O.A.C., (1990).** Association of Official Analytical Chemists. Official Methods of Analysis. 13<sup>th</sup> Ed., Washington, D.C., USA.
- Abd El-All, H.M. (2008)** Effect of sowing and harvesting dates on growth, yield, quality and chemical constituents of broccoli plants (*Brassica oleracea var. italica*). Agricultural Research Journal; Suez Canal University, 77-84.
- Abd El-Rahman, A.H. (2011).** Effect of Planting Dates and Potassium Fertilization on Growth and Productivity of some Broccoli Cultivars in Sandy Soils. A.sc. Thesis, Fac. Agric. Ainshams University.

***EFFECT OF TRANS PLANTING DATE AND CULTIVAR..... 68***

- Abd El-Rahman, A.H.; Zaki, M.F.; El-Behairy, O.A. and Abou El-Magd, M.M. (2010).** Effect of planting dates on productivity and heads quality of some broccoli cultivars under sandy soil conditions. *Egypt J. Appl. Sci.*, 25(2A): 52-65.
- Abou El-Magd M.M.; El-Bassiony, A.M., and Fawzy Z.F. (2006).** Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of Broccoli plants. *Journal of Applied Science Research*. 2(10): 791-798.
- Abou El-Magd. M.M. (2013)** Evaluation of some broccoli cultivars growth, head yield and quality under different planting dates. *Journal of Applied Science Research*, 9(11): 5730-5736.
- Ahmed, M. J. and Siddique, W. (2004).** Effect of sowing dates on growth and yield of broccoli (*Brassica oleracea* L.). *Asian Journal of plant Science* 3(2): 167-169.
- Aktaş, H.; Köksal, N. and Sarı, N. (1999).** Çukurova koşullarında brokkoli yetiştirildiğinde ekim ve dikim zamanlarının ve taç iriliğine etkileri. III. Ulusal Bahçe Bitkileri Kongresi. s:554-558. ISBN: 975-482-484-3. Ankara.
- Ara, N.; Kaiser, M.O.; Khalequzzaman, K.M.; Kohinoor, H. and Ahamed, K.U. (2009).** Effect of different dates of planting and lines on the growth, yield and yield contributing characteristics of cauliflower. *Journal Soil Nature*, 3(1):16-19.
- Beecher, C. (1994).** Cancer preventive properties of varieties of *Brassica oleracea*. A Review, *Amer. J. Clin. Nutr.*, 59: 1166-1170.
- Bianco, V. V.; Darnato, G.; Pomarici, R.; Dias, J. S.; Crute, I. and Monteiro, A. A. (1996).** Sowing and transplanting date in four Cima de Rapa (*Brassica rapa* L.) cultivars. I. Sowing dates. *Acta Horticulture* 407:293-298.
- Chang, B., and Strickland, H. L. (1986).** Effect of sowing time on the once-over harvest yield of broccoli cultivars in north-west Tasmania. *Australian Journal of Experimental Agriculture* 26,497-500.
- Diputado, M. T. and Nichols, M. A. (1989).** The effect of sowing date and cultivar on the maturity characteristics of broccoli (*Brassica oleracea* var. *italica*). *Acta Horticulturae*. 247: 59-66.
- El-Hamd, A.S.A.A. and Esmail, A.A.M. (2005).** Effect of planting dates on the yield and quality of broccoli. *Annals of Agricultural Science, Moshtohor.*, 43 (2): 781-790.

**El-Helaly, M.A. (2006).** Studies on Growth and Development of Broccoli. PH. D. Thesis, Fac. Agric. Cairo Univ.

**El-Helaly, M.A. (2012).** Effect of nitrogen fertilization rates and potassium sources on broccoli yield, quality and storability. Research Journal of Agriculture and Biological Sciences, 8(4): 385-394.

**El-Hifny, I.M.; Abdallah, M.M.F. and Gomaa, S.S. (2002).** Influence of sowing date, production method and cultivars on broccoli transplants production. Arab Universities Journal of Agricultural Science., 10 (3): 867- 877.

**Emam, M.S. (2005).** Effect of transplanting date and spacing on growth, yield and head quality of broccoli and influences of hydro cooling and wrapping on the keeping quality of broccoli. Journal of Productivity and Development., 10(1): 75-96.

**Eşiyok, D. and Dönmez, A. İ. (1998).** Brokkoli yetiştiriciliğinde October zamanı, bitki sıklığı ce tepe budamasının verim üzerine etkileri. II. Sebze Tarımı Sempozyumu, s:285-289, Tokat

**Fabek, S.; Toth, N.; Redovnikovic, I.R.; Custic, M.H.; Benko, B. and Zutic, I. (2012).** The effect of nitrogen fertilization on nitrate accumulation, and the content of minerals and glucosinolates in broccoli cultivars. Food Technology Biotechnology, 50(2): 183-191.

**Gautam, B. P.; Shadeque, A. and Saikia, L. (1998).** Effect of sowing dates and varieties on growth and yield of early cauliflower. Journal of Vegetable Science 25(1):1-4.

**Hossain, M. F.; Ara, N.; Uddin, M. R.; Dey, S. and Islam, M. R. (2011).** Effect of time of sowing and plant spacing on broccoli production. Tropical agriculture Research & extension, 14(4), 90-92.

**Jackson, M.L., (1965).** Soil chemical analysis, advanced course, Puble. By Author, Madison, Wisconsin, USA.

**Jones, R.B.; Faragher, J.D. and Winkler, S. (2006).** A review of the influence of postharvest treatments on quality and glucosinolate content in broccoli (*Brassica oleracea* var. *italica*) heads. Postharvest Biology Technology 41: 1-8.

**Michaud, D.S.; Pietnen, P.; Taylor, R.R.; Virtanen, M.; Vitramo, J. and Albanes, D. (2002).** Intakes of fruits and vegetables, carotenoids and vitamins A, E, C in relation to the risk of bladder cancer in the ATBC cohort study. Br.J. Cancer, 87: 960-965.

**Preeti, S., Srivastava, B.K.; Singh, M.P. and Singh, P.K. (2009).** Effect of date of planting and spacing on the performance of broccoli. Journal of Horticulture, 66(1): 137-140.

***EFFECT OF TRANS PLANTING DATE AND CULTIVAR..... 70***

- Sarı, N.; Daşkan, H. Y. and Abak, K. (2000).** Effects of sowing times on yield and head size of broccoli grown in the GAP area, Turkey. *Acta Horticulturae*, 533: 299-305.
- Singh, B. K.; Pathak, K. A.; Sarma, K. A. and Thapa, M. (2010).** Effect of transplanting dates on plant growth, yield and quality traits of cabbage (*Brassica oleracea* var. capitata L.) cultivars. *Indian Journal of Hill Farming* 23(2):1-5.
- Siomos, A.K.; Papadopoulou, P.P. and Dogras, C.C. (2004).** Compositional differences of stem and floral portions of broccoli heads. *Journal of Vegetable Crop Production*, 10(2): 107-118.
- Sterrett, S.B.; Haynes, K.G. and Savage, C.P. Jr. (2004).** Cluster analysis on quality attributes identify broccoli cultivars suitable for early and mid-season harvests on the Eastern Shore of Virginia. *Hort Technology*, 14(3): 376-380.
- Tapi, M. K. and Pati, M. K. (2003).** Effect of sowing date and variety on the growth and curd yield of early cauliflower. *Environment and Ecology*, Calcutta, India. 21(3):664-666.
- Toth, N.; Borosic, J.; Zutic, I.; Novak, B. and Benko, B. (2007).** Yield components of broccoli cultivars grown in the continental climate of Croatia. *Acta Horticulture* 729: 255-260.
- Vagen, I.M.; Shjelvag, A.O. and Bonesmo, H. (2004).** Growth analysis of broccoli in relation to fertilizer nitrogen application. *Journal of Horticultural Science and Biotechnology*, 79 (3): 484- 492
- Waller, R.A. and Duncan, D.B. (1969).** Abays rule for the symmetric multiple comparison problems. *Amer. Stat. Assoc. J.*, 64: 1485-1503.

**تأثير مواعيد الشتل والسنف على النمو والمحصول وجودة البروكلي**

أ.د / سعيد عبد الله شحاتة أستاذ الخضر ، كلية الزراعة ، جامعة القاهرة

أ.د / أسامة قنصوة أحمد أستاذ الكيمياء الحيوية ، كلية الزراعة ، جامعة القاهرة

أ.د / حاتم محمد عبد العال رئيس بحوث الخضر، معهد بحوث البساتين ، مركز البحوث الزراعية، الدقي، مصر

د / كريمة فاروق عبد الجواد مدرس الخضر، كلية الزراعة ، جامعة القاهرة

محمود عبد الحميد محمد مدرس مساعد البساتين (الخضر) ، كلية الزراعة ، جامعة بني سويف

وقد أجريت هذه الدراسة في محطة التجارب الزراعية لكلية الزراعة، جامعة القاهرة، الجيزة، خلال الموسمين الشتاء المتتاليين من 2014/2013 و2015/2014 لدراسة تأثير ثلاثة مواعيد الزراعة، ثلاثة أصناف F1 والتداخل بينهما على النمو والمحصول و جودة البروكلي. كانت مواعيد الزراعة على النحو التالي، 1 سبتمبر، 1 أكتوبر و1 نوفمبر مع ثلاثة أصناف مراثون، هيراكليون و سنتورو، على التوالي. وأظهرت النتائج أن نمو النبات والمحصول وجودة الرؤوس تأثرت كثيرا بالأصناف الثلاثة في مواعيد الزراعة. وفي هذا الصدد، اتضح أن الميعاد الثاني 1 أكتوبر أعطي أعلى القيم لمعظم صفات النمو الخضري ( عدد الأوراق، مساحة الورقة و الوزن الطازج الكلي للنبات). وكذلك أعلى القيم من وزن الرأس الرئيسي و المحصول الكلي للرؤوس للقطعة التجريبية و الفدان. أعطت النباتات أعلى القيم لمعظم خصائص النمو الخضري والمحصول وجودة القرنبيط مع الصنف مراثون ولكن ميعاد الزراعة 1 نوفمبر سجلت أقل قيم النمو والمحصول ومكوناته. وفيما يتعلق بالتفاعل بين الصنف سنتورو وميعاد الزراعة 1 أكتوبر كان متفوق في محصول الرؤوس الكلي والخصائص الفيزيائية للرؤوس كنسبة متوسط طول الرأس و القطر والوزن. لذلك، يمكن أن ينصح للحصول على أعلى قيم لمحصول الرؤوس وجودة البروكلي ننصح بزراعة الصنف سنتورو و مراثون علي التوالي في ميعاد الزراعة 1 أكتوبر.

**الكلمات المفتاحية:** البروكلي، مواعيد الزراعة، الأصناف، النمو، المحصول، الجودة.