

*Annals Of Agric. Sc., Moshtohor,*  
*Vol. 43(2): 781-790, (2005).*

**EFFECT OF PLANTING DATES ON THE YIELD AND QUALITY OF  
BROCCOLI  
BY**

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**ABSTRACT**

Two experiments in 1993-1994 and 1994-1995 seasons were carried out at a private farm in Meniet El-Sebaa-Banha, Qalubia government, on broccoli cultivar "De Cicco" to study five different dates of planting on yield and quality of broccoli spears at harvesting. The highest early yield for primary and secondary spears was obtained from planting in October 1<sup>st</sup> and 7<sup>th</sup>. The highest primary and secondary total yields, from planting in September 15<sup>th</sup> the longest spear diameter, and the highest fresh weight from planting in September 15<sup>th</sup> the least values of total defect exerted were obtained from planting in September 15<sup>th</sup>. The spear contents of T.S.S., ascorbic acid and total sugars were not affected by the various planting dates. The total chlorophyll concentration significantly decreased with every delay in the planting dates.

**INTRODUCTION**

The aim of establishing this work on the broccoli is to exert the suitable planting date under the conditions of our experiment. So, it was mentioned that the time of spear formation in broccoli was affected by the various planting dates and a positive correlation between the prevailed temperature and the number of days to maturity was noticed (Yamasaki, 1962). Similar conclusion was obtained on the same crop where delaying the sowing date reduced the marketable spears yield from 15.6 t/ha in December to 10.5 t/ha in January and 5.7 t/ha March (Chung, 1985).

A scope on spear diameter of broccoli caught up from the review cleared that this character was affected to great extent by planting dates according to the weather prevailed. Thus, it was noticed that the delay in sowing time from April and early May to early July gave smaller heads (Salter *et al.*, 1984). On the other hand, secondary spears in broccoli were affected also by planting dates. It was observed that this weight was more big in the late sowing of October 3<sup>rd</sup> than the early sowing one of September 20<sup>th</sup> (Higashio, 1990).

Certain attributes in the quality of broccoli spear were affected greatly by sowing date, these attributes are considered of major importance in choosing the spears for commercial production. Hence, cool weather resulted a reduction in bractiness, axillary bud development and the incidence of hollow stem (Burton *et*

*al.*, 1973). While as some experiments on cauliflower showed that ascorbic acid content was higher in the early than the late cultivars (Hassani *et al.*, 1987). The chlorophyll concentration in broccoli spears is important for the spear appearance. However, few investigations showed interest in studying its response to the different planting dates.

Worthy, in consideration what has been paid by many workers to follow the accumulation of sugars in cool crops planted in different dates, it was found in general, that there was no significant differences in the contents of sugars of white cabbage (Pashold and Scheunemann, 1984).

### MATERIALS AND METHODS

The variety "De Cicco" of broccoli (*Brassica L.*, var Italian Plenck) was used in this investigation. Two trials were conducted in a private farm at Miniut El-Sebaa near Banha, Kalubia Governorate during two successive wither seasons of 1993-1994 and 1994-1995, to follow the effect of planting date on the yield and its characteristics. The soil type of this area is silt-loam.

The design of the experiment done on the effect of planting dates was complete randomized blocks with four replicates. The size of each plot was 21 m<sup>2</sup> and consisted of 6 rows. Each was 5 m. long and 70cm. wide. Surface furrows irrigation was applied and other agriculture practices took place whenever it was necessary according to the recommendation of Hassan (1989).

Seeds in both seasons of 1993-1994 and 1994-1995 were sown in seedbed on August 15<sup>th</sup>, September 1<sup>st</sup>, September 15<sup>th</sup>, October 1<sup>st</sup>, and October 15<sup>th</sup>. Plants were transplanted in the field on September 19<sup>th</sup>, October 11<sup>th</sup>, October 19<sup>th</sup>, November 15<sup>th</sup>, and December 1<sup>st</sup> in the previous seasons, respectively. Spacing between rows was 70 cm apart, and 50 cm between plants. All the harvested spears at 20 days age were cut with a stem length of 15 cm and the leaves longer than 1 cm were removed from the spears. Data were recorded on the primary and secondary yields in the determination of the total yield, meanwhile all the other determinations were on the primary yield only.

#### A- Yield:

Early medium, and late of primary and secondary yields beside the total yield were determined by weight per plot.

#### B- Spear characteristic:

- a- **Physical characteristics:** Diameter, fresh weight and quality defects percentage.
- b- **Chemical characteristics:** Total soluble solids, ascorbic acid, total chlorophyll, and total sugars.

#### Determination procedures:

##### a) Physical Characteristics:

- 1- **Diameter:** The average diameter of the spear was estimated by venier caliper in cm.

2- **Fresh weight:** The average weight of the spear was determined.

3- **Loss in weight percentage:** The percentage of loss in weight was calculated as follows:

$$\text{Loss in weight percentage} = \frac{\text{Loss in weight at the sampling date}}{\text{Initial weight of spears}} \times 100$$

4- **Unmarketable spears percentage:** The percentage of unmarketable spears was determined according to the following equation:

$$\text{Unmarketable spears (\%)} = \frac{\text{Total number of unmarketable spears at the sampling date}}{\text{The initial number of spears}} \times 100$$

**The initial number of spears**

5- **Quality defects:** Defects of primary spears which were described by Thompson and Taylor (1976) were assessed subjectively as follows:

a- **Hollow stem:** A breakdown in the pith which result in cavity, oval in transverse section and several centimeters long.

b- **Bractiness:** Bracts, which occur within the inflorescence.

c- **Bud uniformity:** Some variation in bud size within the inflorescence is tolerable excessive variation is considered unattractive.

d- **Auxillary buds:** Development of auxiliary buds on the portion of stem harvested detract from the appearance of the product and make trimming more difficult.

e- **Irregular bud cluster:** The inflorescence is comprised of buds arranged in several discrete groups, which should be indistinct to give an overall regular appearance of the spear. The opposite picture is not permitted.

**b) Chemical characteristics:**

1- **Total soluble solids percentage** was determined by Abbe refractometer (A.O.A.C., 1980).

2- **Ascorbic acid content** was determined by using the dye 2,6 dichlorophenolindophenol method (A.O.A.C., 1980). The results were calculated as mg./100g. fresh weight.

3- **Total chlorophylls concentration** was determined as mg./100g. fresh weight according to Robbelen method (1957).

4- **Total sugars** were determined adopting the colorimetric method for the determination of sugar and related substances according to Dubois *et al.*, (1956). The results were calculated as g./100g. dry weight.

**C) Yield:**

The average of primary and secondary yields beside the total sum of yields were determined as kg. per plot. The yields were harvested at six equal intervals of 5 days each, then divided to three equal parts (10 days interval) representing early, medium, and late yields.

**Statistical analysis:**

The physical and chemical results of the planting dates were statistically analyzed using the analysis of variance method described by Snedecor (1956).

## RESULTS AND DISCUSSION

### A) Yield:

The values in table (1) clear the effect of planting dates on the early medium, late and total primary and secondary spears yield during the two seasons of 1993-1994 and 1994-1995. It is obvious from such results that the obtained early yield increased for both the two types of spears from the first planting date in August 15<sup>th</sup> up to October 1<sup>st</sup> then tended to decrease at the last examining date on October 15<sup>th</sup>. However, sowing on both October 1<sup>st</sup> and 15<sup>th</sup> enhanced the production of the early yield of the two types of spears compared with the other planting dates. On the other hand, the least early yields were obtained from sowing in August 15<sup>th</sup> and September 1<sup>st</sup>.

Concerning the effect on the medium yield, it is clear that there was an increase in the yield of both the two types of spears with every delay in the sowing date up to September 15<sup>th</sup> then a decrease trend was followed during the last two planting dates on October 1<sup>st</sup> and 15<sup>th</sup>. The highest figures, however were obtained from sowing in September 1<sup>st</sup> and 15<sup>th</sup> for the two types of spears. Whereas the lowest ones resulted from sowing in August 15<sup>th</sup> for the primary spears and October 15<sup>th</sup> for the secondary ones.

Data pertaining to the late yield point to continuous decreases by the delay of the planting dates. In other words, the highest value resulted from the earliest date (August 15<sup>th</sup>) and the minimum from the latest one (October 15<sup>th</sup>) where the differences reached the significance level. This is agreement with (Chung, 1985) on broccoli.

The figures of the effect of planting dates on the total primary and secondary yields in the two seasons of 1993-1994 and 1994-1995 show that sowing in September 15<sup>th</sup> gave rise in the highest significant values over the other examined dates. The two dates September 1<sup>st</sup> and October 1<sup>st</sup> exerted approximately the same yields. Whereas the minimum resulted from the latest one in October 15<sup>th</sup>. These results agree with (Salter *et al.*, 1984) on broccoli spears.

### B- Spear characteristics:

#### a- Physical characteristics:

The changes in spear diameter due to the various planting dates in the two seasons of 1993-1994 and 1994-1995 are presented in table (2). It is evident from the results that the spear diameter increased up to the sowing date in September 15<sup>th</sup>, then tended to decrease at the last two examining dates in October 1<sup>st</sup> and 15<sup>th</sup>. The results in the two seasons cleared that the widest spears resulted from those plants planted in September 15<sup>th</sup> whereas the narrowest were obtained from the latest date in October 15<sup>th</sup>. This is agreement with (Higashio, 1990) on broccoli spears.

Table (1): Effect of different planting dates on the early, medium, late and total yields (kg. per plot).

Planting dates	Early		Medium		late		Total		total
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary	
<b>1993-1994 season</b>									
15 Aug.	1.82	1.85	4.46	5.56	4.86	4.94	12.14	12.35	24.49
1 Sept.	1.86	1.98	7.46	7.96	3.11	3.32	12.43	13.26	25.69
15 Sept.	2.76	2.70	8.27	8.12	2.76	2.70	13.79	13.52	27.31
1 Oct.	3.77	3.70	6.88	6.76	2.34	2.30	12.99	12.76	25.75
15 Oct.	3.45	2.78	6.32	5.02	1.72	1.14	11.49	8.94	20.43
L.S.D at 5%	1.15	1.26	1.42	1.49	1.36	1.29	2.03	2.06	3.73
<b>1994-1995 Season</b>									
15 Aug.	1.89	1.78	5.93	5.58	4.80	4.51	12.62	13.15	25.77
1 Sept.	1.95	2.04	7.16	7.49	3.91	4.08	13.02	13.61	26.63
15 Sept.	2.87	2.79	7.94	7.66	3.61	3.48	14.43	13.93	28.36
1 Oct.	4.36	4.22	6.82	6.60	2.46	2.37	13.64	13.19	26.83
15 Oct.	3.78	3.53	5.41	5.50	1.62	1.51	10.81	10.09	20.90
L.S.D at 5%	1.21	1.32	1.52	1.62	1.46	1.38	2.54	2.67	5.43

Table (2): Effect of different planting dates on spear physical characteristics.

Planting dates	Spear diameter (cm.)	Spear fresh weight (g)	Quality defects (%)					Total defects
			Hollow stem	Bracts	Bud Variability	Auxillary bud develop	Irregular hud dusters	
<b>1993-1994 Season</b>								
15 Aug.	20.70	202.30	6.25	-	3.75	6.25	5.00	21.25
1 Sept.	21.40	207.10	5.00	-	3.75	5.00	3.75	17.50
15 Sept.	23.60	229.80	3.75	-	2.25	3.50	2.50	11.95
1 Oct.	22.80	216.40	3.75	1.25	2.20	3.50	2.50	13.20
15 Oct.	18.90	190.90	2.50	3.00	2.20	3.50	2.50	13.70
L.S.D at 5%	2.50	16.38	2.40	1.40	1.18	1.46	2.20	1.32
<b>1994-1995 Season</b>								
15 Aug.	21.30	210.40	7.00	-	4.25	7.20	6.50	24.95
1 Sept.	22.90	216.90	6.50	-	4.00	6.30	4.30	21.10
15 Sept.	24.80	240.50	3.90	-	2.50	3.75	2.90	13.65
1 Oct.	23.80	227.40	3.80	1.75	2.50	3.75	2.90	14.70
15 Oct.	19.30	180.20	3.80	4.50	2.50	3.75	2.90	17.45
L.S.D at 5%	2.60	16.00	2.52	2.12	1.47	1.92	2.68	1.43

The effect of planting dates on the spear weight in the two seasons of 1993-1994 and 1994-1995 is shown in table (2). It is obvious that, there was an increase trend in spear fresh weight with the delay of sowing dates up to September 15<sup>th</sup> after which a decrease tendency took place. It is evident that sowing dates significantly affected the spear weight. However, in both seasons the highest figures resulted from sowing in September 15<sup>th</sup> followed by October 1<sup>st</sup> whereas the lowest ones were obtained from sowing in August 15<sup>th</sup> and October 15<sup>th</sup>.

The differences among the various planting dates concerning the quality defects in the two seasons of 1993-1994 and 1994-1995 (table 2), clear that the values of hollow stem, bud variability and irregular bud clusters were decreased with the delay of planting date. Whereas, the appearance of bracts was increased. The biggest values of total defects resulted from the early planting date in August 15<sup>th</sup> which was followed by September 1<sup>st</sup>. on the contrary, the least values exerted from sowing in September 15<sup>th</sup>.

#### **b- Chemical characteristics:**

The effect of planting dates on total soluble solids percentage in the two seasons of 1993-1994 and 1994-1995 are shown in Table (3). The results indicated that the different planting dates did not materially affect the spear T.S.S in both seasons.

The results in Table (3) show the effect of various planting dates on the spear ascorbic acid content in the two seasons of 1993-1994 and 1994-1995. It is obvious that there were no significant differences among the various examined dates in both seasons. There results agreement with (Hassani *et al.*, 1987) on cauliflower.

Presented date in table (3) clear the effect of planting dates on the concentrations of total chlorophyll in the spear in the two seasons of 1993-1994 and 1994-1995. Such results indicate that this concentration decreased with the delay of the planting dates. In other words, the planting date in August 15<sup>th</sup> resulted spears characterized with the highest chlorophyll concentrations as compared to the latest planting date in October 15<sup>th</sup>.

The changes in total sugars due to the effect of different planting dates in the two seasons of 1993-1994 and 1994-1995 are demonstrated in table (3). It is evident that there were no significant differences in the total sugars among the various planting dates. This is agreement with (Pashold and Scheunemann, 1984) on with cabbage.

On discussing the previous results, it is easy to notice that delay in planting dates from August 15<sup>th</sup> to October 1<sup>st</sup> exerted an increase trend in both the primary and secondary spears of the early yield. In spite of the reduction which happened in the yield when sowing took place in October 15<sup>th</sup> gave rise to the highest figures of early yield over the other examined dates. The early appearance of spears in October comparatively to the other planting dates may be due to the prevalence of low

temperature and short day length between germination of seed and harvest of spears, namely juvenility, spear induction and spear growth. The duration, number of each phase is more or less influenced by the environmental conditions (Wurr *et al.*, 1981). On the same crop (Yamasaki, 1962) reported that relationship between planting dates and maturity.

**Table (3): Effect of different planting dates on the spear, chemical characteristics.**

Planting dates	T.S.S (%)	Ascorbic acid (mg/ 100 g.f.w)	T. chlorophyll (mg/ 100 g.f.w)	Total sugars (g/100 g.d.w)
<b>1993-1994 season</b>				
15 Aug.	10.90	105.70	56.00	50.60
1 Sept.	10.50	105.80	56.00	50.80
15 Sept.	10.80	106.90	55.20	51.60
1 Oct.	10.16	105.30	54.30	51.20
15 Oct.	10.00	105.20	49.40	50.30
L.S.D at 5%	N.S	N.S	5.09	N.S
<b>1994-1995 SEASON</b>				
15 Aug.	11.20	111.40	58.00	52.90
1 Sept.	11.00	110.90	58.00	53.10
15 Sept.	11.30	112.50	56.30	53.90
1 Oct.	10.90	110.90	54.00	53.20
15 Oct.	10.50	108.70	48.90	51.80
L.S.D at 5%	N.S	N.S	3.51	N.S

The reasons for non-uniform development of the inflorescence are not known. But if broccoli behaves in a similar physiological manner to other cultivated Brassicas than it may logical to assume that much of non-uniformity is a resultant of differences among plants in their quantitative cold requirements for floral induction. Thus, cool temperature may induce inflorescence initiation in plants which are more sensitive to cold resulting non-uniform initiation of the inflorescence (Fontes *et al.*, 1967).

From the horticultural point of view, the total yield is the important target from any plantation. However, under the conditions of our experiment there is no doubt that September 15<sup>th</sup> is the most suitable date for sowing broccoli (Table 4). Planting in this date induced the best diameter and fresh weight which led consequently to the heaviest yield. In our consideration of the normal role of temperature and day length we have been mainly concerned here with their direct effect on the economical product. However, broccoli has its own temperature requirements at the optimum range of conditions such as the various processes of photosynthesis, respiration, assimilation, ...etc. which induced the peak capacity of production. The question of this exerted high yield may be accounted comparatively to the favourite temperature followed this date which suit the growth and development of broccoli within the two fundamental processes.

Photosynthesis and respiration which preceding in such a way throughout the life cycle of the plant building the highest vegetative growth and yields (Wurr *et al.*, 1981).

Regarding the results of the effect of planting dates on spear physical characters and defects, it is obvious that the widest spears, the highest fresh weight and the minimum values of total defects resulted from those plants sowed in September 15<sup>th</sup>. These results cleared the important role of the planting date or in other words, temperature and day length in the formation of spear and its quality defects. (Burton *et al.*, 1973).

Table (4): The average monthly temperature (°C) and relative humidity (%) in the two seasons of 1993-1994 and 1994- 1995 in Kalubia Governorate.

Month/ Year	Temp. (°C)			R.H. (%)
	Min	Max	Avg.	
July, 1993	18.72	33.62	26.62	62.12
Aug.	18.66	33.66	26.26	66.16
Sept.	16.95	33.05	25.25	62.15
Oct.	14.62	29.92	22.62	59.22
Nov.	10.40	24.40	17.60	68.20
Dec.	7.20	20.40	13.10	75.20
Jan., 1994	5.30	18.90	12.10	65.00
Feb.	5.40	21.50	13.60	58.00
Mar.	7.60	23.10	16.20	55.00
Apr.	10.30	27.60	19.20	51.00
May	13.50	31.70	23.10	47.00
June	17.00	34.40	26.30	47.00
July	18.60	33.50	26.50	62.00
Aug.	18.50	33.50	26.10	66.00
Sept.	16.80	32.90	25.10	62.00
Oct.	14.40	29.70	22.40	59.00
Nov.	10.20	24.20	17.40	68.00
Dec.	7.00	20.20	12.90	75.00
Jan., 1995	4.80	18.40	11.60	64.50
Feb.,	5.00	21.10	13.60	57.60
Mar.	7.00	22.50	15.60	54.40
Apr.	9.60	26.90	18.50	50.30

Source: Central Laboratory for Agricultural climate (CLAC), Agricultural Research Center, Ministry of agriculture.

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### تأثير مواعيد الزراعة على المحصول والجودة في البروكلي

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أجريت هذه الدراسة على أفراس البروكلي صنف 'دي سيكو' لدراسة تأثير مواعيد الزراعة المختلفة على المحصول وجودة الأفراس عند الحصاد، وقد تم زراعة نباتات التجربة خلال موسمي ١٩٩٣-١٩٩٤، ١٩٩٤-١٩٩٥ بجهة منية السباع بمحافظة القليوبية. زرعت البذور بالمشتل في خمسة مواعيد مختلفة اعتباراً من ١٥ أغسطس حتى ١٥ أكتوبر في موسم الزراعة بفواصل زمني قدره ١٥ يوماً بين كل ميعاد والآخر حيث تم شتل النباتات الناتجة على مسافة ٧٠سم بين الخطوط، ٥٠سم بين النباتات داخل الخط، ثم قطف الأفراس بالساق القرصية بطول ١٥سم مع إزالة الأوراق التي زاد طولها عن ١سم حيث تم تقدير الصفات موضع الدراسة. وتتلخص أهم النتائج المتحصل عليها في الآتي:

كان أعلى محصول مبكر من الأفراس الرئيسية والثانوية عند الزراعة في ميعادي أول ، ١٥ أكتوبر. كما أعطت الزراعة في ١٥ سبتمبر أعلى محصول كلي للأفراس الرئيسية والثانوية. اتضح أن الأفراس الأكبر قطراً والأعلى وزناً والأقل نسبة في عيوب الجودة نتجت من الزراعة في ١٥ سبتمبر، لم يكن لمواعيد الزراعة تأثيراً معنوياً على محتويات الأفراس من المواد الصلبة الذائبة الكلية وحامض الإسكوربيك والسكريات الكلية. قل محتوى الأفراس من الكلوروفيلات الكلية بتأخر ميعاد الزراعة.