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EFFECTS OF SOWING DATE AND PINCHING ON BROCCOLI SEED PRODUCTION

[11]

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ABSTRACT

A field experiment was conducted at the experimental farm of the Faculty of Agriculture, Ain Shams University, Shoubra Elkheima, Kalubia governorate, during 2002/2003 and 2003/2004 seasons to study the effects of three sowing dates, i.e., the first of each of September, October and November, and four pinching treatments (pinching the apical head just after appearance, pinching the main head at the marketable stage, pinching the axillary head just after appearance (disbudding) and without pinching) on broccoli plants (*Brassica oleracea* var *Italica*), cultivar "Emperor". Plants were grown in Kaliobia under loamy soil conditions. Plants of the second sowing date (first of October) produced the tallest plants and the highest number of leaves per plant. Plants grown on the first of October plantation, pinching the main head at the marketable stage or the combination between them recorded the highest values of number of siliques/ plant, number of seeds/ plant, and seed yield.

INTRODUCTION

Broccoli (*Brassica oleracea* var *Italica*. L.) is one of the most prominent vegetables grown all over the world. Broccoli is considered as an important crop for export in the future. It belongs to *Brassicaceae* family. It has great economical importance due to its medicinal and dietetic values since ancient times.. It has a very high nutritional value due to its high content of protein, carbohydrates, fibers, calcium, iron, carotene, thiamine, riboflavin and ascorbic acid. It also helps in digestion and assimilation of food in human **body (Hassan, 2004).** Air temperature and solar radiation are major environmental factors affecting crop development **(Mourao and Hadley, 1998).** The proper time of sowing is one of the basic requirements for obtaining maximum yield and high return of any crop. Many experiments regarding sowing and transplanting time were conducted in different parts of the world which revealed that total yield of the crop is markedly influenced by different sowing and transplanting times. **Kleinhenz and Wszelaki (2003)** reported that planting date effects on cabbage head size are generally attributed to differences in air temperature during head development, with smaller heads being produced under conditions of high temperatures.

Irwin and Aarssen (1996) mentioned that pinching the axillary buds increased seed and biomass production. Damage to the shoot apex commonly causes release of lateral meristems due to the apical dominance in plants, this has been shown in some species to increase seed production by stimulating lateral branching. Shoot apex removal may also reduce or prevent reproduction **(Venecz and Aarssen, 1998).** Many plants exhibit apical dominance, where the presence of the main stem apex inhibits the growth of the lateral branches. This inhibition is generally assumed to be mediated by hormonal control, but changes in environmental conditions can also modify the growth of lateral branches **(Miguel *et al* 1998).** Such conditions include shading, nutrient supply and damage to other branches. Seed production of broccoli revealed that removal of either the axillary or terminal head produced higher seed yield than when no buds were removed. It was therefore

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possible to harvest both a vegetable crop (760 kg/ha for axillary and 4380 kg/ha for terminal shoot removal) and seed crop without affecting the seed quality (**Ghimire *et al* 1993**).

Few studies of compensatory responses in plants, however, followed the effects of shoot apex removal into subsequent growing season, although general cultural information for broccoli head production are largely available, little is known about cultural practices required for seed production

As optimum sowing date and the best pinching treatments for broccoli seed production can vary according to cultivation and climatic conditions, information suggested in the literature are not suitable for different situations. Therefore, the objective of this study was to determinate the effect of different sowing dates and pinching treatments on seed production in Egypt.

MATERIAL AND METHODS

Two field experiments were carried out during the growing seasons of 2002 / 2003 and 2003 / 2004, at Experimental Station Farm, Faculty of Agriculture, Ain Shams University , Shoubra El-khiema , Egypt , in order to investigative the effects of sowing dates , pinching treatments and their interactions on vegetative growth, yield and quality of broccoli seeds.

Three sowing dates were studied, namely the first of each of September, October and November. Four pinching treatments were used as follows: pinching the apical head just after appearance, pinching the main head at the marketable stage, pinching the axillary head just after appearance (disbudding) and without pinching (control).

A split plot design with three replicates was used where the sowing dates were the main plots and the pinching treatments were located in the subplots.

Field growing conditions: Seeds of broccoli cultivar "Emperor" open pollinated (obtained from Sun seeds Co. Japan) were sown in the shading screen nursery in foam trays (84 eyes), using mixture of peatmoss and vermiculite (1: 1 v/v) (the recommended transplant production media for protected cultivation), according to the recommendations of the Egyptian Ministry of Agriculture. Transplants were planted after thirty days from seed sowing (3-4 leaf stage). The area of the experimental plot was 14 m^2 consisted of five rows, each row was 4 m length and 0.7 m width, and the plant distance was 0.5 m apart. Other agricultural practices were carried out whenever necessary according to the recommendation of the ministry of Agriculture Harvesting was carried out when seeds were matured (yellowing of leaves and siliques) for each sowing date in both seasons. Data were collected on vegetative growth (plant height, stem diameter and leaf number) just after the appearance of the apical head and seed yield (number of siliques/plant, number of seeds/plant, weight of thousand-seed and weight of total seed yield /plant).

Germination tests were performed in the dark in incubators at constant 20 °C. Seeds were placed in plastic Petri dishes volume 10 on a double layer of Whatman No.1 filter papers moistened with 5 ml of distilled water. Percentage of germination as radical protrusion and the rate of germination were recorded. All experiments in the laboratory were conducted with four randomized blocks with 100 seeds from each treatmen .

Average metreologi al data for Kaliobia region, at Shoubra El-Khe ma, during the growing seasons of broccoli (20(2/2003 and 2003/2004) were obtained from the central meteorological laboratory, Dokki, Giza, Ministry of Agriculture, A.R .E. **(Table 1).**

Table 1. Meteorological data of the two growing seasons, 2002/2003 and 2003/2004, at Shoubra El-kheima, El kaliobia location

Month	Temperature (°C)			
	2002-2003		2003-2004	
	Max.	Min.	Max.	Min.
September	34.44	22.79	32.15	21.02
October	29.08	15.86	30.21	19.00
November	25.51	14.41	25.12	15.20
December	20.79	10.86	20.25	10.05
January	21.14	10.31	18.94	10.01
February	20.12	10.03	20.88	10.26
March	24.62	12.96	24.13	12.82
April	27.76	15.44	27.37	15.56
May	33.68	20.49	31.49	20.18

* Central meteorological laboratory, Dokki, Giza, Ministry of Agriculture, A.R .E.

The obtained data were statistically analyzed using Duncan's multiple range tests at P≤0.05 level to verify differences among treatment means according to **Snedecor and Cochran (1989).**

RESULTS AND DISCUSSION

Data presented in **Table (2)** showed that the studied sowing dates affected significantly the plant height, stem diameter and number of leaves per plant. Planting on the first of October produced the highest values of plant height and leaf number, in the two seasons. Whereas planting on the first of November recorded the lowest values in the two seasons. Concerning stem diameter, planting on the first of November gave the highest stem diameter in the two seasons, Whereas planting on the first of October recorded the lowest stem diameter in the two seasons.

Table 2. Effect of planting dates on vegetative growth of broccoli plant, just after the appearance of the apical head, in the two seasons (2002/ 2003 and 2003/ 2004)

Characteristics	Planting dates					
	Sep.	Oct.	Nov.	Sep.	Oct.	Nov.
	First season			Second season		
Plant height (cm)	50B	57 A	46 C	50B	56A	45C
Stem diameter(cm)	4.9B	4.6C	5.0 A	4.7B	4.4C	4.8A
Number of leaves/plant	22B	23A	20 C	22B	24A	20C

* Values within the column followed by the same latter (s) are not statistically different; at the 0.05 level (Duncan's multiple range test).

It could be concluded that sowing broccoli seeds cv. Emperor on the first of October was the most favorable for stimulating the vegetative growth of plants compared to the other tested sowing dates. As mentioned in **Table (1)**, the meteorological data showed that the average day air temperature during Sept., Oct and Nov. of 2002 were 28.62, 24.47 and 19.96 °C; meanwhile, it was 26.56, 24.06 and 20.16 °C for Sept., Oct. and Nov. of 2003, respectively. The prevailing temperatures during October plantation, at Kaliobia, region, were the most favorable for broccoli vegetative growth.

The obtained results agree with those of **Damato (2000), Trotta and Damato (2000); Muhammad *et al* (2002); Abd El-Kader (2003); Gomaa (2003) and Jamil & Siddique (2004),** who found significant, plant height differences among the sowing dates. These results might be due to the differences in growth behavior and responses of the climatic conditions.

Data presented in **Table (3)** indicated that, in both seasons, the first of October planting date produced the maximum number of siliques/ plant compared with the other studied dates . Similar results were obtained by **Incalcaterra and Iapichino (2000),** who found significant differences in the number of siliques/plant among sowing dates. These results might be due to the differences in growth behavior and responses of the climatic conditions.

Pinching the marketable main head produced the maximum number of siliques/ plant compared with the other studied pinching treatments. These results were true in both seasons. Similar results were obtained by **Ghimire *et al* (1993); Irwin & Aarssen (1996); Miguel *et al* (1998) and Venecez & Aarssen (1998),** who found that the removal of either the axillary or terminal head produced higher number of siliques/ plant than when no buds were removed.

As for the effect of interaction between sowing dates and pinching treatments, the sowing on the first of October with pinching the main head at the marketable stage gave the maximum number of siliques/ plant.

The highest number of seeds per plant was obtained in plants raised from seed sown on the first of October whereas the lowest values were obtained from plants sown on the first of November **(Table, 4).** Similar results were obtained by **Incalcaterra & Iapichino (2000); Kazi *et al* (2002) and Muhammad *et al* (2002).** The data in the same table showed that pinching the main head at the marketable stage produced the highest number of seeds per plant compared with the other studied pinching treatments These results were true in both seasons. Similar results were obtained by **Venecez & Aarssen (1998) and Naber & Aarssen (1998).**

As for the effect of interaction between sowing dates and pinching treatments, sowing on the first of October with pinching the main head at the marketable stage gave the highest number of seeds per plant.

Table 3. Effect of planting dates, pinching and their interactions on number of siliques per broccoli plant, in the two seasons (2002/ 2003 and 2003/ 2004)

Treatments	Planting dates							
	Sep.	Oct.	Nov.	Mean	Sep.	Oct.	Nov.	Mean
	First season				Second season			
Pinching main head	1454cd	1823a	1158cde	1478A	1532a	2019a	1342bc	1631A
Pinching of apical meristeim	1196cde	1634ab	1035e	1335AB	1154bc	1519b	837c	1173B
Disbudding	985e	1151bc	994de	1043B	978b	1063bc	722bc	920B
Without pinching (Control)	1163de	1259cd	1086cd	1169B	1069c	1029bc	706bc	935B
Mean	1201B	1467A	1068C		1183B	1403A	902C	

* values within the column followed by the same latter (s) are not statistically different; at the 0.05 level (Duncan's multiple range test), small letters (interaction).

Table 4. Effect of planting dates, pinching and their interactions on number of seeds per broccoli plant, in the two seasons (2002/ 2003 and 2003/2004)

Treatments	Planting dates							
	Sep.	Oct.	Nov.	Mean	Sep.	Oct.	Nov.	Mean
	First season				Second season			
Pinching main head	8721cd	12759a	6950cde	9477A	9194a	12119a	8052bc	9788A
Pinching of apical meristeim	7175cde	11436ab	6211e	8824AB	8079bc	9178b	5023c	7427B
Disbudding	5912e	8055bc	5964de	6644B	6844b	7420bc	4334bc	6199B
Without pinching (Control)	6979de	8812cd	6518cde	7436B	7486c	6177bc	4237bc	5884B
Mean	7204B	10266A	6411C		7901B	8724A	5412C	

* values within the column followed by the same latter (s) are not statistically different at the 0.05 level (Duncan's multiple range test), small letters (interaction).

Sowing dates and pinching treatments significantly affected broccoli seed production **(Table, 5)**. The highest seed production was obtained from plants raised by sowing seeds on the first of October compared with the other studied dates. Similar results were obtained by **Incalcaterra and Iapichino (2000)**, who found significant seed yield differences among sowing dates. Pinching the main head at the marketable stage produced the highest seed yield in both seasons. Similar results were obtained by **Ghimire *et al* (1993)**. The interaction showed that at the best treatment was sowing on the first of October with pinching the main head at the marketable stage, in both seasons.

Table 5. Effect of plantir g dates, pinching and their interactions on seed yield (g) per broccoli plant, in the two seasons (2002/2003 and 2003/2004)

Treatments	Planting dates							
	Sep.	Oct.	Nov.	Mean	Sep.	Oct.	Nov.	Mean
	First season				Second season			
Pinching main head	38.55 d	56.77a	33.08cde	42.8A	46.98a	66.41a	30.18bc	52.18A
Pinching of apical meristeim	32.65c de	51.12ab	25.36e	36.38AB	42.50bc	45.25b	23.26c	37.20B
Disbudding	25.39 e	41.31bc	28.51de	31.17B	37.78bc	38.66bc	22.84bc	33.09B
without pinching (Control)	30.15 le	39.83cd	30.44cde	33.47B	33.39c	35.21bc	23.26bc	30.62B
Mean	31.68 B	47.26A	29.35C		40.16B	46.38A	25.04C	

* values within the column followed by the same latter (s) are not statistically different; at the 0.05 level (Duncan's multiple range test), small letters (interaction).

Concerning germinati on, data in **Tables (6 and** 7) show the effect of so wing dates and pinching treatments and their inte actions on the rate and percent of germination c f broccoli seeds. Generally, the percentages of seed germination were insignificantly differed t y sowing dates in both seasons. Also, insignifici nt differences had been obtained as a result of using different pinching treatments in the seconc seasons, While, in the first growing season, pinc hing of apical meristeim gave the highest percent ige of seed germination compared with pinching axillary head. The interaction effects between planting dates and pinching treatments showed insignificant differences in the first growing season. While, in the second growing season, planting on the first October and pinching the main or the axillary head gave the highest percentage of seed germination compared with pinching of apical meristeim with planting on the first November that gave the lowest percentage.

Table 6. Effect of plantii g dates, pinching and their interactions on germination percentage of broccoli seeds, in the two seasons (2002/2003 and 2003/2004)

Treatments	Planting dates							
	Sep.	Oct.	Nov.	Mean	Sep.	Oct.	Nov.	Mean
	First season				Second season			
Pinching main head	92a	99a	98a	96AB	96ab	100a	98ab	98A
Pinching of apical meristeim	98a	97a	97a	97A	95ab	98ab	91b	95A
Disbudding	92a	98a	91a	91B	99ab	100a	93ab	98A
Without pinching (Control)	95a	93a	97a	95AB	96ab	95ab	95ab	96A
Mean	93A	95A	96A		97A	98A	95A	

* values within the column followed by the same latter (s) are not statistically different; at the 0.05 level (Duncan's multiple range test), small letters (interaction).

Table 7. Effect of planting dates, pinching and their interactions on rate of germination for broccoli seeds, in the two seasons (2002/2003 and 2003/2004)

Treatments	Planting dates							
	Sep.	Oct.	Nov.	Mean	Sep.	Oct.	Nov.	Mean
	First season				Second season			
Pinching main head	1.24ab	1.01b	1.26ab	1.17A	1.02b	1.00b	1.06b	1.03A
Pinching of apical meristeim	1.29ab	1.32ab	1.31ab	1.31A	1.05b	1.00b	1.15a	1.07A
Disbudding	1.25ab	1.31a	1.15ab	1.24A	1.05b	1.00b	1.01b	1.16A
Without pinching (Control)	1.18ab	1.40a	1.26ab	1.28A	1.05ab	1.03b	1.02b	1.03A
Mean	1.22A	1.26A	1.25A		1.15A	1.01A	1.06A	

* values within the column followed by the same latter (s) are not statistically different; at the 0.05 level (Duncan's multiple range test), small letters (interaction).

Concerning the rate of germination, the results showed that the germination rate of broccoli seeds was insignificantly differed due to sowing dates in both seasons. Also, insignificant differences were obtained as a result of using different pinching treatments in the both seasons. The interaction effects between planting dates and pinching treatments showed significant differences in both growing season. In the first growing season, planting on the first October with either pinching the axillary head or without pinching gave the highest percentage rate compared with pinching the main head at the marketable stage with planting on same date. While, no clear trend was obtained, in second season. The obtained results did not agree with those of **Incalcaterra and Iapichino (2000)**, who found significant influences differences in rate and germination percent among the sowing dates.

In summary, the climatic conditions prevailing during the tested sowing dates affected the seed production of cv Emperor. The sowing date must be, therefore, timed in such a way to avoid subjecting either the young plants at the first stages of development, or the mature plants at the flowering to the unfavorable climatic conditions. This can be achieved in Egypt by sowing on the first of October and pinching the main head at marketable stage, under the experiment conditions.

We can generally conclude that pinching treatment for head at marketable stage, resulted in a good seed yield that i did not affect the percentage of marketable head yield, besides may increase the economic net return per unit area.

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مجلة اتحاد الجامعات العربية
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تأثير مواعيد الزراعة وعمليات التطويش على إنتاج بذور البروكولى

[١١]

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أجريت هذه الدراسة في أرض طمية بالمزرعة البحثية التابعه لكلية الزراعة جامعة عين شمس شبرا الخيمة محافظة القليوبية خلال موسمي الزراعة ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ لدراسة تأثير ثلاثة مواعيد زراعة للبذرة (الأول من سبتمبر والأول من أكتوبر والأول من نوفمبر) وكذلك أربع معاملات تطويش (عند بداية ظهور القمة المرستيمية للرأس والبراعم المرستيمية الجانبية والقرص الرئيسي عند مرحلة التسويق وبدون تطويش) على إنتاج بذور البروكولى صنف إمبريور. وأوضحت النتائج أن زراعة البذور في الأول من أكتوبر أعطت افضل نمو خضري مقدرة على أساس (ارتفاع النبات و عدد الأوراق)، أما بالنسبة للصفات الثمرية والبذرية المقدرة على أساس (عدد الثمار لكل نبات و عدد البذور لكل نبات و وزن البذور لكل نبات) فإن كلا من معاملتي تطويش القرص الرئيسي عند مرحلة التسويق والزراعة في الأول من أكتوبر قد أدت إلى الحصول على افضل النتائج.

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