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DETERMINATION OF TRANSPLANTING DATES OF BROCCOLI (*BRASSICA OLERACEA* L. VAR. ITALICA PLENCK) UNDER ANTAKYA CONDITIONS

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ABSTRACT

The objective of this study was to determine the most suitable transplanting dates of broccoli under Antakya conditions. Seed of 'Jade' F_1 broccoli cultivar was used as the experimental material. Seed sowing was conducted approximately one month prior to transplanting date. The seeds were planted on viols having peat. The experiments were repeated for two years; the transplanting was done on four different dates i.e. 1st, 10th and 20th September and October during first 1st year, 10th, 20th September, 1st and 12th October during second year. The seedlings were at their three-five- leaf stages at the time of transplanting. The highest total yield was recovered from 10th September transplanting during first year (1978kg/da) and the second year (1863kg/da), respectively. In both l years, the days from transplanting to harvest were longest for 1st October. The results indicated that the first two weeks of September is a most suitable period for broccoli transplanting for Antakya conditions. The transplanting dates earlier or later than this period resulted in lower yield and longer maturation dates thus not recommended**.**

Key words: adaptation, Crucifer, earliness, Mediterranean, production.

INTRODUCTION

Broccoli (*Brassica oleracea* var. *italica*) is a member of Crucifer having many important vegetables such as cauliflower, cabbage, kale, Chinese kale of the family (Günay, 1994).

Broccoli has many health benefits. Cancer research center of USA indicated that broccoli has several anti-cancerogen effects (Damato *et al*., 1994; Guo *et al*., 2001). Broccoli is an ideal diet food because of its nutritional content. A 100 g broccoli has 40 calories, 5 g protein, 1 g fat, 10 mg carbohydrate, 3880 IU vitamin A, 0.14 mg B1, 0.3 mg B2, 1.2 mg Niacin, 50 mg calcium and 1.7 mg iron (Splittstoesser, 1990). One of the most appealing characteristics of broccoli is its high vitamin C content which has been reported to 82-140 mg (Albaracin *et al*., 1995; Vural *et al*., 2000)

The ideal temperature for broccoli is 16-18°C (Lestrange *et al*., 1996). Higher and lower temperature negatively affects the head quality. Kar and Uzun (2000) reported that the broccolis subjected to 0-3.3°C temperature for 36 h died. Moreover, it is known that the low temperature during head formation results in reduction in main stem size. High temperatures also have negative effects. The high temperatures (30°C) results in early flower initiation and reduction in quality parameters (Björkman and Pearson, 1998).

Broccoli production is conducted in different periods in Turkey and the world. Broccoli is grown during summer in regions with continental climates while it is grown in spring and fall in regions with milder climate such as Mediterranean, for this reason, broccoli is planted in various times in different production regions in Turkey.

The Mediterranean region of Turkey has similar climatic conditions to California, Italy, thus broccoli sowing is done in July or August (Francke, 1999). Aktaş *et al*. (1999) and Sarı *et al*. (2000) tested several planting dates from July to October for Çukurova and southeast regions of Turkey. Eşiyok and Dönmez (1998) sowed broccoli seeds in August and September in Aegean Regions and transplanted the seedlings one month after sowing.

It is known that planting date is critical for a successful broccoli production. The planting dates directly affect yield and several quality parameters (Eşiyok and Dönmez, 1998; Aktaş *et al*., 1999; Sarı *et al*., 2000). In this study, we aimed to determine the best suitable time of broccoli transplanting; to study the planting dates effects on yield and quality under Antakya conditions.

MATERIALS AND METHODS

The experiments were conducted on Mustafa Kemal University, Agriculture Faculty Research Facilities for two consecutive years. The soil properties of the experimental site (Aydın *et al*., 1999) and metarolojik data for Antakya are presented in Table 1.

The cultivar 'Jade' supplied by May Seed Company, Bursa, Turkey was used as experimental material. The cultivar is early maturing having uniform, dark green head which are suitable for fresh consumption as well as processing (Anonymous, 2001b). The seed

sowing and transplanting dates of the experiments are presented in Table 2.

The seeds were sow on viols having peat with high water holding capacity and rich in organic matter and plant nutrient elements. The viols were kept under shade to avoid high temperature and sun light damage. Approximately four weeks after sowing, the seedlings reached their three-five-leaf stage which is the optimum time for transplanting. They were transplanted at this stage and regularly irrigated until the seasonal rains.

The experiments were conducted on 6.3 m^2 plots having 20 plants planted on 10 x 45 cm distances. The experiments were conducted in randomized complete block design with three repetitions. Before transplanting, the experimental site was supplied by 50 kg/da of 15:15:15 N:P:K fertilizer during the production season 25 kg/da ammonium sulfate and 25kg/da potassium nitrate were applied in two splits. This fertilization program was recommended by soil analyses of the experimental site as well as previous recommendations (Toivonen *et al*., 1994). The experimental site was also treated with pesticides against *Erwinia caratowora*.

Total yield (kg/da), main-stem yield (kg/da) and lateral stem yield (kg/da), average main stem weight (g), main stem width (cm), main stem (cm) 1 cm above the main stem junction and days from transplanting to harvested were recorded. The number of harvest varied based on the main stem junction. The number of harvest varied based on the transplanting dates; three to twelve harvests were made during the experiment. The harvests were discontinued on January and February for the first and second year of the experiments when flowering was initiated.

The data were analyzed through analysis of variance technique using SAS procedures. The significant variables were subjected to mean separation using Duncan's test at 5% significance level.

Table 1: Soil properties and the climate data of the experimental site during the experimental period.

Soil properties						
Depth (cm)	**pH**	**Salt (%)**	**Lime (%)**	**Organic matter (%)**	**Available P_2O_5**	**Total nitrogen (%)**
0-10	7.64	0.052	0.77	1.18	5.544	0.134
10-20	7.59	0.035	0.53	1.13	4.039	0.140
Climate data						
	Maximum	**Minimum**	**Mean**	**Humidity (%)**	**Precipitation (mm)**	
First experimental year						
August	33.2	24.8	28.2	71.5	4.0	
September	31.7	21.5	25.7	69.7	25.8	
October	26.9	15.4	20.3	69.2	41.5	
November	23.0	8.6	14.6	74.0	29.5	
December	13.6	5.9	9.5	80.8	161.7	
January	14.1	6.4	10.1	79.3	88.4	
February	15.6	6.1	10.5	76.4	208.4	
Second experimental year						
August	32.1	25.7	28.3	76.3	1.9	
September	30.8	22.8	26.1	75.6	17.8	
October	27.7	16.7	21.5	71.7	53.3	
November	17.9	9.0	13.0	72.5	113.1	
December	12.4	7.7	9.8	85.4	337.0	
January	11.8	3.3	7.0	74.5	204.0	

Table 2: Sowing and planting dates of the experiments.

	First year		**Second year**	
Period	Sowing date	Planting date	Sowing date	Planting date
I	01 August	01 September	10 August	10 September
II	10 August	10 September	20 August	20 September
III	21 August	20 September	01 September	01 October
IV	01 September	01 October	10 September	10 October

RESULTS AND DISCUSSION

First experimental year: The total yield, main stem and lateral stem yields as well as days from transplanting to harvest are presented in Table 3. The highest yields (1798 kg/da) were recovered from 10th September transplanting while 1st October transplanting gagged the lowest total yields (1366kg/da). The days from planting to harvest

varied between 70.7 to 94.7 for transplanting dates. The least number of days were recorded for September transplanting while October had the longest period from transplanting to harvest (Table 3).

Although main be consistent yield varied between 905.0 to 1266.0 kg/da. There were no significant differences for this variable, while lateral stem yield varied between 395.0-668.3 kg/da. The mean values for the average main stem weight, width and length variables presented in table 3 depicted significant differences for all three variables. The highest main stem width and length varied to a lesser ratio although statistically significant differences were recorded for both variables. The 10th September transplanting treatment was between the greatest mean group for both width and length while October was between the least mean groups for these size parameters (Table 3).

Second experimental year: The yield values varied in the second experimental year as well. The mean separation indicated that the highest yield was recorded from the plots transplanted at 10th September; this period was followed by 20th September, 1st October and 10th October. The same trend was appetent for main head and the lateral head. The main head yield ranged between 270.7 to 1180.0 g/da while the lateral head yield ranged between 241.7 to 683.0 g/da. The days from transplanting to harvest ranged between 65.3 to 106.0 days depending on the transplanting dates. The shortest interval was averaged in 12th September transplanting and the days progressively increased with delayed transplanting (Table 3).

Similar trends were obtained for main head size variables, the average main head weight, width and length. All these variables were significant for planting dates. All four transplanting dates were in different mean groups. The greatest main heads were recovered from the first transplanting date (12th September) for weight, width and length (421.8 g, 16.1 cm and 14.8 cm, respectively). The smallest heads were recorded at the latest transplanting date (1162 g, 11.1 cm and11.3 cm, respectively) (Table 3).

Table 3: Several horticultural characteristics of broccoli planted on four different periods and grown on the Antakya conditions.

Planting date	Total yield (kg/da)	Main head yield (kg/da)	Lateral head yield (kg/da)	Average main head weight (g)	Average main head width (cm)	Average main head length (cm)	Days from planting to harvest (day)
First experimental year							
1 September	1573 ab	905.0	668.3 a	373.7 b	16.0 a	14.2 b	82.0 b
10 September	1798 a	1204.0	594.0 a	420.3 a	16.5 a	15.0 a	70.7 d
20 September	1779 a	1226.0	552.3 ab	305.4 c	14.1 b	15.5 a	77.0 c
1 October	1366 b	970.0	395.0 b	280.7 d	13.8 b	13.8 b	94.7 a
Second experimental year							
10 September	1863.0 a	1180.0 a	683.7 a	421.8 a	16.1 a	14.8 a	65.3 d
20 September	1121.0 b	668.0 b	452.7 b	257.0 b	14.0 b	13.3 b	80.7 c
1October	712.7 c	396.3 c	316.3 c	166.0 c	12.6 c	12.8 c	95.0 b
10 October	502.3 c	270.7 c	241.7 c	116.2 d	11.1d	11.3d	106.0 a

Means with different letters are significantly different each other by Duncan test conducted at 5% significance level.

Broccoli is a new vegetable for Antakya; however, due to its nutritional value and anticancerogen effects, its popularity is rapidly increasing. In present study the highest total yields were recorded (1789 and 1863 kg/da, respectively) from the plots transplanted on 10th September from both the years. Similar also; Trotta and Damato (2000) tested the four transplanting dates (mention period here) in Italy. They recorded the highest and least yields from the first and the last transplanting and their yield varied between 440 – 1010 kg /da. In another study, the yield was expressed was in plant basis which was between 218 – 893 g / plant. Sarı *et al*. (2000) compared the performance of broccoli cultivars under Southeastern region of Turkey and recovered 91 – 741 g / plant. The highest yield was achieved on 16th June transplanting. These studies suggest that the yield of broccoli considerably vary among cultivars and transplanting dates.

Except the first period of the first years, the average main head weights decreased as the transplanting dates progressed. The cold weather conditions resulted in quality decrease in the second transplanting period of both experimental years. Similar results were obtained by Aktaş et al. (1999); Açıkgiz and Şalk (2000); Sarı *et al*., (2000) and Trotta and Damat (2000). Conversely, Kar and Uzun (2000) reported that the average head weights ranged between 125 – 130 g and did not significantly changes among the planting dates. However, Açıkgiz and

Şalk (2000) showed that the average main head weight can be decreased to 50 g / head in the late plantings.

The average main head width decreased as the transplanting dates progressed. The widest head were recovered from second period (10 September) in both years. The range in our study was 11.1 – 16.5 cm and ranged based on the transplanting dates and experimental years. Aktaş *et al.* (1999) reported 11.5 – 14.4 cm of average main head width, 20th June plantings giving the widest heads. Our results are comparable to those of Aktaş *et al.* (1999).

One of the disadvantages of the late transplanting of broccoli culture is prolonged days from transplanting to harvest days. These dates ranged between 65 and 105 days in our study. The shortest intervals were recovered from second period (10 September) transplanting in both years. The fact that the temperature considerably dropped after the third and the fourth transplanting period resulted in longer intervals on these transplanting. Albaracin *et al.* (1995) demonstrated that several broccoli genotypes (XPH 5611, FMX 96 and FMX 121) can reach to harvest in 35 days. However, Diputado and Nichols (1989) showed that this period can be as long as 148 days in late plantings. In their study, the shortest periods were observed from 18 September planting while the latest was from 21 March.

Conclusion: Based on the results of the current experiments, it may be concluded that the optimum seed sowing date for Antakya is the first half of September. The periods with earlier dates can result in some physiological problems because of high temperatures. For this reason, if this period has to be used, the shading material should be utilized for the seedlings. The transplanting dates after the first half of September can result in the increase in the days from transplanting to harvesting dates. It can also conclude that, based on our results, 'Jade' F_1 is a suitable broccoli cultivar for Antakya region given that it is planted on the appropriate time.

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