

*Full Length Research Paper*

# The effect of harvesting methods on the yield in some broccoli varieties

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In order to research the effect of harvesting methods on the yield in some broccoli varieties, four varieties as: V<sub>1</sub> (Shogun F<sub>1</sub>); V<sub>2</sub> (Pirate F<sub>1</sub>); V<sub>3</sub> (Sultan F<sub>1</sub>); and V<sub>4</sub> (Marathon F<sub>1</sub>) and three sowing times as: July, August and September were used in the study. For single harvest, the weight of primary shoots and for continuous harvest; besides the primary shoot weight, the weight and quantity of secondary shoot and the length of the plant were also marked. As a result, while the effect of varieties and characteristics of the plant were not, the sowing time was significant on harvesting methods. The weights of primary and secondary shoots, the number of secondary shoots and plant length were significant in continuous harvesting for which the yield changed between 550.17 - 68.34 g plant<sup>-1</sup>. However, the weight of primary shoot was significant in single harvest where the yield varied between 526.11 - 68.21 g plant<sup>-1</sup>. Total yield varied between 3,173.8 - 24,356.7 kg ha<sup>-1</sup> in the single harvest and between 3,163.8 - 25,470.6 kg ha<sup>-1</sup> in the continuous harvest. The head diameters and harvest times showed uniformity though their effects were low in the single harvest. Although the yield was high in the continuous harvest, approaching to the end of harvest the observation of decreasing marketable product quality and the requirement of more labour and time in the harvest stated that the single harvest would be preferred.

**Key words:** Broccoli, harvesting methods, yield.

## INTRODUCTION

Broccoli is an edible vegetable with its immature, green coloured flower buds and thick meaty flower stems and seems morphologically to cauliflower (Vural et al., 2000) specially the edible green shoots are very rich of vitamin C. There is 70 mg of Vitamin C in the fresh weight of 100 g Broccoli which contains selenium in its structure. Selenium with Vitamin E acts like an antioxidant. It is known that having antioxidant elements in the body decreases the frequency of coroner heart diseases and positively counteracts against cancer (Krauss et al., 1996). The parts of broccoli which are used as vegetable consist of main head carrying flower shoots (spears) with unopened small flower buds and side shoots. The diameters of main heads are between 5 - 25 cm. and their weights are 100 - 500 g (Esiyok and Donmez, 1998). If the ecological circumstances and growing conditions are suitable, after harvesting the main head; immature small flower buds occur on the side shoots, thus, more than one harvesting can be done (Acikgoz and Salk, 2000).

The diameters of the side shoots are smaller than the main head and their weights change between 25 - 100 g. (Esiyok and Donmez, 1998). The number of side shoots is positively related to plant length and this condition affects continuous harvest (Neiuwhof, 1969). For broccoli, the fact that the harvest is not just once but long-lasting is due to the continuous harvest. The long undertaking of the harvest period causes the total yield per plant to increase (Esiyok, 1996). A very few difference is observed in single harvest rather than continuous harvest and most important of all the labour cost diminishes (Withoit et al., 1990; Heij, 1989).

In broccoli growing, harvest machines which are mounted on a specially designed tractor have been used for the practice of single harvest. By the help of this harvest machine, primary heads are taken by cutting from the body and transferred to the wrapping boxes by a conveyor band. Through this method, the harvest of 60 - 90 primary heads per minute could be done (Casada et al., 1989).

**Table 1.** Average primary shoot weight (g) related to the varieties and sowing times.

Varieties	Sowing Times			Variety main effect
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	
V <sub>1</sub>	462.94	140.50	80.71	228.05
V <sub>2</sub>	387.81	147.16	76.40	203.79
V <sub>3</sub>	526.11	127.50	68.21	240.60
V <sub>4</sub>	463.17	109.46	70.37	241.33
Sowing main effect	460.007A	131.15B	73.92C	221.69

Sowing main effect: 5%.  
LSD: 46.10.

**Table 2.** Total shoot weight per plant (g) related to the varieties and sowing times

Varieties	Sowing times			Variety main effect
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	
V <sub>1</sub>	492.16	160.37	83.62	245.38
V <sub>2</sub>	392.81	164.14	77.31	211.42
V <sub>3</sub>	550.17	148.24	72.44	256.95
V <sub>4</sub>	464.12	120.70	68.34	227.72
Sowing main effect	482.31A	148.36B	75.42C	235.36

Sowing main effect: 5%.  
LSD: 1.15.

## MATERIALS AND METHODS

This study was conducted in the growing area of Corlu Vocational High School, Namik Kemal University and the varieties of V<sub>1</sub> (Shogun F<sub>1</sub>); V<sub>2</sub> (Pirate F<sub>1</sub>); V<sub>3</sub> (Sultan F<sub>1</sub>); and V<sub>4</sub> (Marathon F<sub>1</sub>) and three different sowing times as: July the 1<sup>st</sup> (S<sub>1</sub>), August the 1<sup>st</sup> (S<sub>2</sub>) and September the 1<sup>st</sup> (S<sub>3</sub>) were used in the experiment.

Broccoli seedlings were grown in PE bags which were filled in with peat and those of which the closed dimensions were 15 × 15 cm and a thickness of 0.15 mm; and which are black coloured in order to stop algae. Bags had drainage holes for irrigation. In the experiment, the combinations of variety and sowing were placed according split-plot experimental design with 3 replications (Duzgunes et al., 1987). Five plants per parcel were used and they were placed as 45 × 40 cm distances between the rows and in the rows respectively and with border plant on their sides.

### Cultural program was:

1<sup>st</sup> Sowing Time: July the 1<sup>st</sup>  
1<sup>st</sup> Planting Time: August the 10<sup>th</sup>  
2<sup>nd</sup> Sowing Time: August the 1<sup>st</sup>  
2<sup>nd</sup> Planting Time: September the 5<sup>th</sup>  
3<sup>rd</sup> Sowing Time: September the 1<sup>st</sup>  
3<sup>rd</sup> Planting Time: October the 16<sup>th</sup>

Irrigation was supplied with a watering can in the seedling period by furrow irrigation method in the development period. Nitrogen (N) used in growing increases shoots development by 38 - 61% (Masson et al., 1991). Therefore, NH<sub>4</sub>NO<sub>3</sub> was given during the growing (Bracy et al., 1994). The average temperature was 17.7°C, the average rainfall was 44.3 mm, the average humidity was 68.2%

and the average wind speed was 2.1 m s<sup>-1</sup> in the months (July - October) when the experiment was conducted.

## RESULTS AND DISCUSSION

### Primary shoot weight

According to the variance analysis, main sowing effect was found to be significant for the primary shoot weight. The highest primary shoot weight was determined as 460.007 g in the sowing time of July (Table 1).

### Total shoot weight per plant

As the result of the variance analysis, main sowing effect was found to be significant for the total shoot weight per plant. The sowing time of July gave the highest total shoot weight per plant as 482.31 g (Table 2).

### Secondary shoot weight

Main sowing effect was found to be significant for the secondary shoot weight. The sowing time of July gave the plants which had the greatest secondary shoot weight as 26.31 g (Table 3).

**Table 3.** Average secondary shoot weight (g) related to the varieties and sowing times

Varieties	Sowing times			Variety main effect
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	
V <sub>1</sub>	29.22	20.83	8.93	19.66
V <sub>2</sub>	21.12	16.84	8.90	15.62
V <sub>3</sub>	24.10	20.74	9.12	17.98
V <sub>4</sub>	30.82	25.42	9.24	21.82
Sowing main effect	26.31A	20.95B	9.04C	18.76

Sowing main effect: 5%.  
LSD: 0.60.

**Table 4.** Average number of secondary shoot (unit) related to the varieties and sowing times.

Varieties	Sowing times			Variety main effect
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	
V <sub>1</sub>	35.50	20.00	3.00	19.50
V <sub>2</sub>	30.65	21.65	3.00	18.43
V <sub>3</sub>	28.50	21.65	3.00	17.71
V <sub>4</sub>	26.66	21.65	2.65	16.98
Sowing main effect	30.32A	21.23B	2.91C	18.15

Sowing main effect: 5%.  
LSD: 1.10.

**Table 5.** Average plant length related to the varieties and sowing times.

Varieties	Sowing times			Variety main effect
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	
V <sub>1</sub>	57.50	21.00	15.20	31.23
V <sub>2</sub>	56.65	21.15	14.80	30.86
V <sub>3</sub>	56.60	22.26	15.15	31.33
V <sub>4</sub>	57.60	24.00	14.50	32.03
Sowing main effect	57.11A	22.10B	14.91C	31.36

Sowing main effect: 5% LSD: 6.92.

### Number of secondary shoot

After the variance analysis conducted, main sowing effect was found to be significant for the number of secondary shoot. From the sowing in July a great number of secondary shoots were taken. The highest number of secondary shoots was finally given by V<sub>1</sub> (Shogun F<sub>1</sub>) as 35 unit plant<sup>-1</sup> (Table 4).

### Plant length

The main sowing effect was found to be significant for the plant length after the variance analysis realized. The superior variety was V<sub>4</sub> (Marathon F<sub>1</sub>) with 57.60 cm. The

tallest plants were obtained from the sowing time of July. As a conclusion of the research; primary shoot weight, total yield per plant, number of secondary shoots, secondary shoot weight and plant length were marked for the determination of harvest methods. Primary shoot weight was considered for single harvest; while total yield per plant, secondary shoot weight and number, and plant length were taken into consideration for continuous harvest (Table 5).

The sowing time of July was found to be significant in both of the harvesting methods and affected the yield. In the sowing time of July; for the single harvest, the yield between 68.21 and 526.11 g but it was 68.34 - 550.17 g per plant for the continuous harvest. Total yield changed between 3,173.8 and 24,356.7 kg ha<sup>-1</sup> in the single

**Table 6.** General results according to the type of harvests.

Characteristics analyzed	Single harvest data interval	Continuous harvest data interval
Primary shoot weight (g)	68.21- 526.11	68.21 - 526.11
Total yield per plant (g)	68.21 - 526.11	68.34 - 550.17
Secondary shoot weight (g)	-	08.90 - 30.82
Number of secondary shoot (unit plant <sup>-1</sup> )	-	02.65 - 35.50
Plant length (cm)	14.50 - 57.60	14.50 - 57.60
Total yield (kg ha <sup>-1</sup> )	3173.8 - 24356.7	3163.8 - 25470.6

harvest and between 3,163.8 and 25,470.6 kg ha<sup>-1</sup> in the continuous harvest. Although the yield was high in the continuous harvest, approaching to the end of harvest the observation of decreasing marketable product quality and the requirement of more labour and time for harvest stated that the single harvest would be preferred (Table 6).

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