Timing in Watermelon (*Citrullus lanatus*) Harvest Period using Greenhouse and Plastic Tunnels in Cukurova

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Manuscript Received: February 2015 Accepted: May 2017

Abstract

The 10 watermelon cultivars in early, middle and late groups were grown in unheated greenhouse, high tunnels, low tunnels and open field. Results of experiments showed that in low tunnels, high tunnels and unheated greenhouse had the earliness of 14-21 days, 22-44 days and 36-53 days, respectively depending on the cultivars, comparing to the open field. The last week of April or the beginning of May for greenhouse, the middle of May for high tunnels, and the first week of June for low tunnels were determined for the beginning of harvest period for early watermelon cultivars. The highest yield was obtained from the high tunnels which were 8.8 kg/m^2 as the average of the 10 cultivars and 7.7 kg/m^2 as the average of early-season cultivars, the average yield from low tunnels was 7.2 kg/m^2. The lowest total yields were obtained in open field (5.5 kg/m^2) and greenhouse (5.9 kg/m^2). The period between sowing and first harvest were 105 days, 116 days, 130 days and 147 days in open fields low tunnels, high tunnels and greenhouse, respectively and the average of 10 cultivars.

Keywords: Turkey, tunnel, watermelon, greenhouse

Introduction

With 3.5 million tons of production, Turkey is one of the biggest producers of watermelon in the world. Cukurova plain is the most important region for crop and about 20% of total production belongs to this plain. The main characteristic of the region is the earliness. The first watermelon is issued from Cukurova in the middle of June in open field growing. Cultivation under low tunnels has provided 15-20 days earliness for the past decade. Before that period, there was no watermelon production in the country and market requirements were supplied by import, especially from Iran. Cultivation under low tunnels, high tunnels and greenhouses could provide considerable earliness in watermelon growing. Tseklee (1981) carried out an experiment with four watermelon varieties and reported that compared to open field cultivation, low tunnel, non-heated greenhouse and heated greenhouse cultivations offered 4 days, 24 days and 29 days earliness and 45%, 53% and 145% yield increases were obtained, respectively. Iapichino and Gagliano (1983) reported that 15 days earliness and about 100% yield increases were obtained under low tunnel cultivation. Buitelaar (1981) investigated greenhouse cultivation of watermelon and obtained good results with small-fruited Sugar Baby and big-fruited Panonia watermelon cultivars. The present study was carried out to investigate how many days

earliness could be obtained in this crop in Cukurova plain, growing in low tunnels, high tunnels and greenhouse. In this way, it was aimed to spread the harvesting period to spring and early summer.

Materials and Methods

The study was conducted in Research and Implementation Area of Cukurova University, Faculty of Agriculture in Adana in 1991. As plant material 10 watermelon cultivars composed by six F1, hybrids (Red Cuite, Early Star, Fabiola, Panonia, Rubin and Summer chaser) and four open pollinated varieties (Black Sweet, Crimson Sweent, Halep Karast and Sugar Baby) were used. The low tunnels were constructed using 2 m length and 6 mm diametered convolute iron. The width of the tunnel was 80 cm, height 60 cm and length 30 m. As covering material, 0.03 mm thick polyethylene was used. High tunnels were constructed in 3 m width, 2 m hight and 30 m length using 2 cm diameter and 6.5 m long galvanized iron pipes and covered by 0.25 mm thick polyethylene.

The surface area of the greenhouse used was 480 m^2 (12 × 40 m). This glasshouse was constructed from galvanized steel. Open field growing was also took place as control. For greenhouse, high tunnel, low tunnel and open field cultivation, the seeds were sown on the 7th of December, 11th of January, 4th of February and 11th of March, respectively. The seedlings were grown in a greenhouse using 10 12 cm-sized transparent PE tubes. The planting in the greenhouse, high tunnel, low tunnel and open field were performed on the 22th of January, 28th of February, 8th of March and 15th April, respectively. The seedlings were planted into the soil. The spacing between the rows was 150 cm and the distance between the plants was 50 cm. For all covering types, the experiment was established in repeated Randomized Block Design according to Duzgunes (1961) with 3 repetitions and 8 plants per plot. The varieties were randomly changed in the repetitions. Each trial in different cover systems was considered a repeated place of trials. None of the cover system was heated. Plantations were irrigated by drip irrigation system in greenhouse and by sprinkler in tunnels and open field, and they were fertilized equally. In each plot, the first harvesting dates were recorded daily per plant and average of the first harvesting dates was determined. In addition, total yield performances of each variety were calculated for each covering type.

Results and Discussion

Results

Data related to the first fruit maturing dates of 10 watermelon varieties which were cultivated under different covering types and open field, were shown in Table 1. The results of earliness with respect to open field, obtained from different covering types were given in Table 2. As it is shown in the Tables, in open field cultivation, the first harvest was done at the second half of June (18-27 June) for early-season cultivars and at the first half of July for late-season varieties. Under low tunnel cultivation the first harvest was realized at the end of May and beginning of June (27 May-6 June) for early-season varieties, and at the second half of June (13-21 June) for late-season cultivars. Low tunnels provided 22 days earliness in average of first harvest dates. In the high tunnels the first harvest was done at the middle of May (14-17 May) for early-season cultivars and at the first half of June (4-20 June) for late-season varieties. High tunnel trials offered approximately 35 days and 13 days earliness in comparison with open field and low tunnel cultivations respectively in average of all genotypes.

The earliness obtained under greenhouse conditions was found to be 48 days, 26 days and 13 days comparing to open filed low tunnel and high tunnel growing, respectively in average of genotypes. In greenhouse, the first harvesting was done at the beginning of May, and at the end of April (25 April-10 May) for early-season watermelon cultivars. For late- season varieties the first harvest was done at the end of May and beginning of June (21 May-6 June). The time period from sowing to the first fruit maturing date was calculated and the data were shown in Table 3. The sowing to first harvest period for all varieties was found to be least in open field growing and this was followed by low tunnel, high tunnel and greenhouse trials. This period was

obtained as 110 days, 123 days, 140 days and 157 days in open field, low tunnel, high tunnel and greenhouse cultivations, respectively as average of 10 genotypes. From this viewpoint, genotypes also showed significant differences. Red Cutie, Sugar Baby, Rubin, Summer Chaser and Early Star were observed to be earliest ones and followed by Panonia, Fabiola and Crimson Sweet. Halep Karasi and Black Sweet was latest genotypes.

When the yield is considered, significant differences were observed between genotypes and also between covering types. The yield obtained from late and middle-season watermelon genotypes (Table 4) was generally found to be higher than early season genotypes. Among cover types, the highest yield was obtained in high tunnel and followed by low tunnel growing; open field. The greenhouse trials gave the lowest yield. In respect to open field growing, low tunnel and high tunnel trials produced 30% and 59% higher yield, respectively. However, statistical analysis showed that the interaction between the genotype and covering type was significant in terms of yield. Panonia in open field, Halep Karasi in low tunnel, Crimson Sweet, Fabiola and Black Sweet in high tunnel and Black Sweet, Halep Karasi in greenhouse were found to be the highest yielded genotypes.

Table 1 Dates of first harvest of various watermelon genotypes under different cover systems and in open field

Cultivars	Open field	Low tunne	High tunnel	Green house
Red Cuite	18 June	04 June	14 May	25 April
Sugar Baby	22 June	03 June	14 May	04 May
Early Star	27 June	01 June	14 May	06 May
Summer Chaser	27 June	01 June	17 May	04 May
Rubin	27 June	27 May	14 May	08 May
Panonia	27 June	01 June	25 May	10 May
Fabiola	27 June	06 June	27 May	09 May
Crimson Sweet	02 July	13 June	04 June	21 May
Halep Karasi	06 July	20 June	07 June	24 May
Black Sweet	11 July	21 June	20 June	06 June

Table 2 Earliness obtained by over systems is comparison to open field (days)**.**

Cultivars	Low tunnel	High tunnel	Greenhouse
Red Cuite	14	35	53
Sugar Baby	19	39	49
Early Star	26	43	51
Summer Chaser	26	41	54
Rubin	31	44	50
Panonia	26	33	48
Fabiola	21	31	49
Crimson Sweet	19	29	43
Halep Karasl	16	30	44
Black Sweet	21	22	36
Means	21.9[c]	34.7[b]	47.7[a]

Discussion

The outcome of the investigation showed that the protected cultivation and cultivar selection are two effective tools to manage the harvesting period in watermelon growing. The first harvest date coinciding between 18-27 of June in open field cultivation for early season genotypes can be brought to the end of May and beginning of June by low tunnel cultivation, at the middle of May in high Tunnel and at the beginning of May and even the end of April in non-heated greenhouse cultivations. These results are in agreement with the results obtained by Tseklee (1981) and Ruggeri (1981). It seems to be possible to take the first harvesting date at the middle of April and even the beginning of April when the high tunnels and greenhouse are heated. However, for this purpose, it is necessary to establish a new experiment and to realize an economical analysis considering the price of crop and fuel expenses.

From the point of yield, the best results were obtained in high tunnels. Under low tunnel and high tunnel yield was observed to be 30% and 60% higher than open field growing, respectively. These differences were due to effectiveness of plastic tunnels that kept the plants close to the biological optimum temperature requirement during growing period. The results obtained by Belik and porokhnya (1974), Pakyurek and Kaska (1992) support our observations. The yield of greenhouse cultivation was found to be lower than tunnels and it was similar

in open field growing. The fact that the yield in high and low tunnels was higher than greenhouse seems to be contradictory. But there is no contrast here. Sowing and planting were not done on the same date for all cover systems. Because sowing for greenhouse cultivation was done earlier than high and low tunnels, the temperature in greenhouse were lower than high and low tunnels. This resulted in low yield in greenhouse.

Differences observed over time from sowing to harvest between cover systems can be explained by sum degrees day's requirements of watermelon (Onsinejad, 1993). From the point of maturing-duration, significant differences were found among genotypes. It was concluded that yield emergence could be changed 20 days, 25 days, 45 days and 50 days in open field, low tunnel, high tunnel and greenhouse growing, respectively between earliest and latest season genotypes. When the genotype and covering patterns are considered together, harvesting period could be spread in to 3 months.

Table 3 Sowing to harvest time of various watermelon genotypes grown under different cover systems and in open field (days)

Cultivars	Open field	Low tunnel	High tunnel	Greenhouse	Means
Red Cuite	99.3	119.5	129.6	140.1	122.1^{e}
Sugar Baby	103.3	118.9	130.1	148.9	125.3^{de}
Early Star	108.0	117.3	126.6	151.1	126.5^{de}
Summer Chaser	108.0	116.8	131.5	148.9	126.3^{de}
Rubin	108.0	112.0	129.2	153.2	125.6^{de}
Panonia	108.0	116.8	140.4	154.9	130.0^{cd}
Fabiola	108.0	121.6	141.6	154.3	131.4^{c}
Crimson Sweel	112.7	129.1	149.8	165.5	139.3^{b}
Halep Karasl	117.1	135.9	152.5	168.8	143.6^{b}
Black Sweet	122.4	136.9	149.8	182.0	151.7^{a}
Means	109.5^{d}	122.5^{c}	140.0^{b}	156.8^{a}	-

Table 4 Yield of various watermelon genotypes grown under different cover systems and in open field (kg/m^2)

Cultivars	Open field	Low tunnel	High tunnel	Greenhouse	Means
Red Cuite	3.69^{h}	5.07^{f-h}	4.18^{gh}	4.35^{gh}	4.32^{c}
Sugar Baby	6.06^{d-h}	4.19^{gh}	5.37^{f-h}	5.60^{f-h}	5.31^{dc}
Early Star	5.34^{f-h}	6.36^{d-h}	7.91^{a-h}	5.60^{f-h}	6.30^{bcde}
Summer Chaser	6.02^{d-h}	6.33^{d-h}	5.65^{f-h}	5.77^{e-h}	5.94^{cde}
Rubin	6.36^{d-h}	6.56^{d-h}	8.86^{a-g}	5.29^{f-h}	6.77^{abcd}
Panonia	8.31^{a-h}	6.96^{a-h}	9.95^{a-f}	6.77^{c-h}	7.90^{abc}
Fabiola	6.78^{c-h}	8.70^{a-g}	11.81^{a-b}	4.84^{f-h}	8.03^{ab}
Crimson Sweel	4.03^{gh}	8.50^{a-h}	11.92^{a}	6.88^{b-h}	7.84^{abc}
Halep Karasl	5.02^{f-h}	10.71^{a-e}	10.84^{a-d}	7.08^{a-h}	8.41^{a}
Black Sweet	3.63^{h}	8.60^{a-h}	11.56^{a-c}	7.18^{a-h}	7.74^{abc}
Means	5.52^{c}	7.20^{b}	8.76^{a}	5.94^{c}	-

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