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Physical and Chemical Attributes of Peach Cultivars Grown under Ecological Conditions in Van

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Summary

This study was carried out to determine fruit characteristics at different harvest periods of 'Halehaven', 'Dixired', 'Glohaven', 'Jeferson', 'J.H. Hale', 'Redhaven', 'Earlyred', 'June Gold' and 'Blake' peach cultivars grown under ecological conditions in Van province during 1999 and 2000, and also to estimate their suitable harvest times. Fruits were harvested at five days intervals in 1999, and at three days intervals during 2000. In the cultivars, phenological properties, physical traits and chemical analyses were determined for two years. Fruit weights varied to cultivars, harvest times and years. In 2000, 'J.H. Hale' (94.0 g), 'Blake' (86.2 g), 'Redhaven' (79.2 g) had the highest fruit weights. In 1999, fruit weights in the majority of cultivars were lower than those in 2000. In both years, 'Earlyred' had the highest total soluble solid content: 17.2 % in 1999 and 19.2 % in 2000. This cultivar was followed by 'Redhaven' with 16.2 % and 'Dixired' with 16.2 % in 1999. The soluble solid contents were lower than those of the first year, depending on cultivars and on harvest times. Titratable acidity varied from 0.14 % ('Dixired', 1999) to 0.88 % ('Halehaven', 1999). In both years, harvest time for 'Earlyred' was earlier than that of other cultivars.

Zusammenfassung

Physikalische und chemische Eigenschaften von in der Provinz Van ökologisch kultivierten Pfirsichsorten. Ziel dieser Untersuchungen war es, die Fruchteigenschaften der Pfirsichsorten 'Halehaven', 'Dixired', 'Glohaven', 'Jeferson', 'J.H. Hale', 'Redhaven', 'Earlyred', 'June Gold' und 'Blake', die in den Jahren 1999 und 2000 unter ökologischen Bedingungen in der Provinz Van kultiviert wurden, zu ermitteln und den jeweils optimalen Erntezeitpunkt zu bestimmen. 1999 wurden die Früchte in Intervallen von fünf Tagen und 2000 von drei Tagen geerntet. Über die zwei Vegetationsperioden wurden phänologische, physikalische und chemische Eigenschaften der Sorten bestimmt. Das Fruchtgewicht variierte in Abhängigkeit von Sorte, Erntezeitpunkt und Jahr. 2000 wiesen 'J.H. Hale' (94.0 g), 'Blake' (86.2 g) und 'Redhaven' (79.2 g) die höchsten Fruchtgewichte auf. 1999 war das Fruchtgewicht der meisten Sorten geringer. In beiden Jahren war der Gehalt an löslichen Kohlenstoffen bei 'Earlyred' mit 17.2 % (1999) bzw. 19.2 % (2000) am höchsten. 1999 folgten 'Redhaven' mit 16.2 % und 'Dixired' mit 16.2 %. Die Kohlenstoffgehalte waren im zweiten Jahr in Abhängigkeit von Sorte und Erntezeitpunkt niedriger als 1999. Die titrierbare Säure variierte von 0.14 % ('Dixired', 1999) bis 0.88 % ('Halehaven', 1999). In beiden Jahren lag der optimale Erntezeitpunkt für 'Earlyred' früher als bei den übrigen Sorten.

Key words. Peach – cultivar – harvest period – fruit characteristics

Introduction

Peach (*Prunus persica* L.) is grown almost in every region of Turkey except for areas with very cold climates. With approximately 400.000 tons production, Turkey is among the main peach producing countries (KAŞKA 2001). In Turkey, peach is a fruit species of moderate climate in Bursa and Samsun provinces, of subtropical climate in İzmir, Antalya, Adana, Mersin and Hatay provinces, of plateau climate in Erzincan and of hard climate in Amasya province. The harvest time is late and the fruit quality decreases in the places where climate is cool in summer (DEMIRSOY and BILGINER 1996). In the places with plateau climate, the limiting factors for peach growing are late spring frosts and temperature fluctuations in late winter (BURAK and ERIŞ 1992; DEMIRÖREN 1995). Precipitation is also a limiting factor in Van area when compared with the other peach producing provinces in Turkey. The amount of precipitation, is three or four times higher in Bursa and Samsun provinces than in Van area, especially in June and July when fruit occurrence is highest (ANONYMOUS 1998).

The growing and production of peach is highly influenced by soil conditions, as well. It can easily grow in sandy, clay, loam, silty, alluvial soils and in the soils whose pH is between 6 and 7 (DEMIRÖREN 1995). Heavy soil conditions might lead to smaller and tasteless fruits.

The extension of harvest seasons of peach cultivars and their climatic adaptations that offer greater market opportunities, is one of the main breeding efforts (HESSE 1975; SCORZA and OKIE 1991). In Van prov-

ince where is not a commercial production region yet, the vegetation period begins later than in other regions, which could be an advantage for an extended marketing period. But, high temperatures in summer lead sometimes to fruit drops in this region. A similar situation has also been reported by TOSUN et al. (2001) for peach cultivars adapted to the GAP (The Southeast Anatolia Regional Project) area. KAŞKA (2001) reported that late maturing peach cultivars should be preferred for colder regions and higher growing areas. With approximately 1725 m altitude and climatic conditions of colder temperate in the winter, Van region might be suitable for late ripening peach cultivars.

The suitable harvest time of peach is often varied depending on the distance of the market. For distant markets, they should be harvested while their fruit flesh firmness is higher (ÖZBEK 1978; KARAÇALI 1993). In addition, attractive shape and colour, fine texture, free stone and good flavour are among consumer quality aspects (HESSE 1975).

In Turkey, regional harvest dates of most peach cultivars have not been determined (ERTAN et al. 1982; KAŞKA 2001). The number of studies on the determination of harvesting times and adaptations of peach cultivars in different areas is low in Turkey (ERTAN et al. 1982; KOYUNCU and CAVUŞOĞLU 2000). The aim of this study was to determine suitable harvesting times of the nine peach cultivars grown under ecological conditions of Van province.

Materials and Methods

This study was conducted on the cultivars of 'Halehaven', 'Dixired', 'Glohaven', 'Jeferson', 'J.H. Hale', 'Redhaven', 'Earlyred', 'June Gold', and 'Blake' grown in the experimental garden of the Department of Horticulture of Yuzuncu Yıl University in the years 1999 and 2000. Phenological properties (bud swelling, bud breaking, first blooming, full blooming end, first leafing, pink bud period, petal fall) of peach cultivars were monitored according to KURNAZ and KAŞKA (1992). The peach trees were grafted on peach seedling rootstocks and were six years old. Their fruit loads in two years were low to medium. The soil samples from different places of the peach orchard were taken from 0–20, 20–40, 40–60, 60–80 cm deep, and analysed to identify soil structure (KACAR 1982).

In order to determine the harvesting times of the peach cultivars, ten fruits were taken from 5 trees of each peach cultivar during 4 periods with 5 days intervals in the first year (1999) and 3 days intervals in the second year (2000). Then, their physical characteristics [fruit weight (g), fruit diameter (cm), fruit length (cm), fruit height (cm), fruit flesh firmness (kg), seed weight (g), seed diameter (cm), seed length (cm), seed height (cm)] were determined and chemical analyses [total soluble solid content (%), pH, titratable acidity (%), total sugar (%), reducing sugar (%), sucrose (%)] were carried out. For the statistical analysis, a completely randomized design and Duncan's multiple range test (P=0.05) were used for mean separation (DÜZGÜNEŞ 1963).

Results

The soil properties of the growing site

The soil samples from 4 different places and 4-different deeps of the orchard were taken and analysed. It was found that the soil had loam structure between 0–80 cm. The soil had a pH value of 8.0, 1.3 % organic matter, 9.9 % chalk, 5.3 ppm usable P, 442 ppm K, 4590 ppm Ca, 234 ppm Mg, 469 ppm Fe, 10.7 ppm Mn, 0.7 ppm Zn and 1.5 ppm Cu. This means that the soil of peach orchard showed weak alkaline reaction; with poor usable P, moderate chalk content and sufficient variable cations (K, Ca, Mg) and usable micro nutrients (Fe, Mn, Zn, Cu).

Phenological observations

Table 1 shows the phenological observations of peach trees in the years 1999 and 2000. In both years, the earliest bud swelling was observed for the cultivars 'J.H. Hale' and 'June Gold' in the both years. The first blooming variety was 'June Gold', and in the second year, 'June Gold' and 'Blake' started to bloom at the same day, followed by 'Jeferson' (28.04.2000), 'Halehaven', 'Glohaven', 'Redhaven' (29.04.2000) and 'Dixired', 'J.H. Hale', and 'Earlyred' (01.05.2000). Petal leaves of all cultivars fell on 20 May in the first and second year. The first date of falling of petal leaves was 14 May in 1999 ('Earlyred') and 15 May in 2000 ('Redhaven', 'Earlyred', 'June Gold', 'Blake'). During

Table 1. Phenological observations of peach cultivars during 1999 / 2000.

Peach Cultivars	Bud swelling	Bud breaking	First leafing	Pink bud period	First blooming	Full blooming	Blooming end	Petal fall
'Halehaven'	04.04/04.04	19.04/18.04	22.04/24.04	23.04/26.04	27.04/29.04	06.05/06.05	11.05/11.05	20.05/20.05
'Dixired'	05.04/06.04	22.04/18.04	23.04/26.04	27.04/29.04	29.04/01.05	03.05/06.05	11.05/11.05	20.05/17.05
'Glohaven'	05.04/06.04	21.04/18.04	23.04/24.04	27.04/27.04	29.04/29.04	06.05/06.05	11.05/09.05	20.05/17.05
'Jeferson'	06.04/06.04	22.04/18.04	23.04/24.04	27.04/26.04	28.04/28.04	06.05/03.05	09.05/08.05	18.05/17.05
'J.H. Hale'	03.04/04.04	23.04/23.04	24.04/26.04	27.04/29.04	28.04/01.05	07.05/06.05	09.05/11.05	18.05/20.05
'Redhaven'	05.04/06.04	22.04/18.04	23.04/24.04	27.04/26.04	27.04/29.04	06.05/06.05	09.05/09.05	15.05/15.05
'Earlyred'	05.04/05.04	23.04/24.04	23.04/26.04	27.04/29.04	27.04/01.05	07.05/05.05	09.05/09.05	14.05/15.05
'June Gold'	03.04/04.04	20.04/18.04	22.04/22.04	22.04/24.04	23.04/25.04	02.05/03.05	08.05/09.05	15.05/15.05
'Blake'	06.04/07.04	23.04/18.04	23.04/22.04	24.04/24.04	27.04/25.04	04.05/03.05	09.05/08.05	15.05/15.05

Table 2. Some pomological characteristics of peach cultivars at different harvest periods grown in Van area in 1999.

Peach Cultivars	Harvest dates	Fruit diameter (cm)	Fruit length (cm)	Fruit height (cm)	Fruit weight (g)	Fruit flesh firmness (kg)	TSS (%)	Titratable acidity (%)	pH	Seed diameter (cm)	Seed length (cm)	Seed height (cm)	Seed weight (g)
'Halehaven'	17.08	4.7 a^k	4.6 a^k	5.0 a^k	66.6 a^k	11.5 a^k	13.4 b^k	0.88 a^k	4.0	1.5±0.02	3.0±0.03	2.1±0.05	6.1±0.08
	22.08	4.9 a	4.7 a	5.0 a	67.8 a	3.8 b	13.0 b	0.82 a	4.2	1.5±0.02	3.0±0.04	2.3±0.02	5.8±0.09
	27.08	4.7 a	4.6 ab	4.9 a	65.1 a	2.0 b	13.2 b	0.68 b	4.1	1.5±0.04	2.8±0.03	2.1±0.03	5.6±0.04
	02.09	5.0 a	4.5 ab	4.9 a	64.1 a	0.5 c	15.7 a	0.65 b	4.0	1.4±0.05	2.7±0.02	2.1±0.06	4.9±0.05
'Dixired'	10.08	3.7 b^l	4.0 b^l	3.5 b^l	35.7 b^l	6.2 a^l	14.2 b^l	0.75 a^l	4.3	1.2±0.02	2.4±0.06	1.7±0.02	2.7±0.07
	15.08	4.6 a	4.3 a	4.4 a	47.9 a	6.0 a	13.4 b	0.67 a	4.4	1.2±0.03	2.4±0.02	1.6±0.05	3.1±0.07
	20.08	4.5 a	3.9 b	4.5 a	45.0 ab	1.2 b	16.1 a	0.37 b	5.0	1.3±0.02	2.0±0.04	1.5±0.05	2.9±0.05
	25.08	4.0 b	3.9 b	3.9 b	42.8 ab	0.7 b	16.2 a	0.14 b	5.3	1.3±0.02	2.3±0.02	1.9±0.03	3.1±0.04
'Glohaven'	31.08	4.3 a^m	4.1 a^m	4.3 a^m	60.5 ab^m	3.4 a^m	11.4 a^m	0.36 a^m	4.1	1.7±0.04	2.5±0.02	2.1±0.05	5.0±0.05
	05.09	4.9 a	4.3 a	4.7 a	63.5 a	1.4 b	12.1 a	0.36 a	4.2	1.5±0.03	2.7±0.03	2.0±0.06	4.1±0.09
	10.09	4.4 a	4.0 a	4.3 a	53.5 b	1.0 b	13.0 a	0.32 a	4.2	1.4±0.03	2.5±0.06	2.0±0.02	4.0±0.08
'Jeferson'	14.09	5.3 a^n	5.3 a^n	5.4 a^n	86.0 a^n	7.9 a^n	12.0 a^n	0.59 b^n	3.8	1.4±0.02	3.3±0.06	2.2±0.04	4.9±0.08
	19.09	4.6 b	4.8 b	4.7 ab	67.5 b	5.2 ab	12.4 a	0.57 b	3.7	1.4±0.05	3.2±0.05	2.6±0.02	4.9±0.05
	24.09	4.5 b	4.5 b	4.4 b	64.9 b	3.7 bc	10.7 b	0.62 ab	3.8	1.4±0.04	3.2±0.02	2.3±0.02	4.5±0.07
	29.09	4.5 b	4.4 b	4.5 b	56.0 c	1.1 c	12.1 a	0.76 a	4.2	1.4±0.02	3.0±0.04	2.0±0.04	4.4±0.04
'J.H. Hale'	14.09	5.3 a^x	5.1 b^x	5.4 a^x	89.7 b^x	5.7 a^x	12.5 b^x	0.51 a^x	3.8	2.0±0.05	2.3±0.03	2.0±0.03	4.9±0.05
	19.09	5.6 a	5.6 a	5.5 a	100.4 a	5.5 a	14.1 ab	0.50 a	3.6	2.1±0.05	1.8±0.02	2.1±0.06	5.0±0.05
	24.09	5.0 a	5.0 b	4.9 b	78.2 c	4.7 a	16.0 a	0.48 a	3.7	1.7±0.02	1.9±0.05	1.9±0.04	4.9±0.04
'Redhaven'	17.08	4.2 a^v	4.1 ab^v	4.3 ab^v	46.9 b^v	5.1 b^v	16.0 a^v	0.70 a^v	4.2	1.6±0.02	2.9±0.05	2.2±0.04	4.8±0.06
	22.08	4.6 a	4.4 a	4.7 a	40.7 c	7.0 a	16.1 a	0.55 b	4.4	1.5±0.03	2.8±0.03	2.1±0.03	4.7±0.09
	27.08	4.6 a	4.2 ab	4.5 ab	59.3 a	4.3 b	16.2 a	0.50 b	4.4	1.5±0.03	2.7±0.05	2.0±0.02	4.9±0.06
	02.09	4.4 a	3.9 b	4.2 ab	42.4 bc	1.2 c	16.2 a	0.46 b	4.7	1.5±0.04	2.4±0.04	1.9±0.03	3.9±0.07
'Earlyred'	28.07	4.3 a^w	4.1 a^w	4.3 a^w	50.6 b^w	5.0 a^w	13.0 b^w	0.66 a^w	4.1	1.3±0.02	3.0±0.02	1.8±0.05	3.6±0.08
	02.08	4.1 a	4.0 a	4.1 ab	56.4 a	5.1 a	15.1 ab	0.67 a	4.3	1.4±0.05	2.8±0.04	1.7±0.05	3.6±0.04
	07.08	3.7 b	3.7 b	3.5 b	39.7 c	4.6 ab	15.2 ab	0.65 a	4.0	1.2±0.04	2.4±0.04	1.7±0.04	3.2±0.03
	12.08	3.7 b	3.5 b	3.7 b	36.8 c	3.5 b	17.2 a	0.62 a	4.2	1.2±0.05	2.3±0.02	1.6±0.05	3.1±0.04
'June Gold'	02.08	4.1 a^y	4.2 a^y	3.9 a^y	40.1 a^y	5.3 a^y	13.6 a^y	0.76 a^y	4.2	1.3±0.03	2.2±0.03	1.6±0.06	3.4±0.05
	07.08	3.6 b	3.4 b	3.3 a	34.0 b	5.6 a	14.7 a	0.70 a	4.2	1.1±0.05	2.2±0.06	1.5±0.04	2.3±0.03
	12.08	3.6 b	3.9 b	3.4 a	35.1 b	3.0 b	14.8 a	0.65 a	4.1	1.1±0.02	2.2±0.02	1.5±0.03	2.1±0.09
'Blake'	01.09	4.5 a^z	4.6 b^z	4.7 b^z	60.7 c^z	10.2 a^z	12.0 b^z	0.47 a^z	3.9	1.5±0.04	2.6±0.05	2.6±0.03	4.9±0.05
	06.09	4.6 a	5.3 a	5.2 a	78.6 a	6.6 b	12.2 b	0.45 a	3.9	1.5±0.03	3.4±0.03	2.2±0.02	5.4±0.04
	11.09	4.9 a	5.0 ab	4.9 b	67.5 b	4.5 b	14.1 a	0.42 a	4.1	1.3±0.02	3.1±0.02	2.2±0.05	4.5±0.06
	16.09	4.6 a	4.6 b	4.4 b	60.7 c	2.5 c	14.7 a	0.38 a	4.4	1.5±0.02	3.1±0.04	2.1±0.02	4.1±0.07

$^{k, l, m, n, x, v, w, y, z}$ Based on Duncan's Multiple Range Test ($P<0.05$) for mean separation in column represented by each cultivar.

the two experimental years, flower buds of investigated peach cultivars were not damaged by late spring frosts.

The harvesting periods and fruit traits of the cultivars

The harvest times of peach cultivars varied from 28 July to 29 September in 1999 and from 28 July to 15 September in 2000 depending on cultivars. The harvest dates of 'Jeferson', 'J.H. Hale' and 'Blake' cultivars were later than those of the other culivars in both years. Fruit diameter was between 3.6 cm in 'June Gold' (7 August) and 5.6 cm in 'J.H. Hale' (19 September) in 1999, and between 4.4 cm in 'June Gold' (6 August) and 5.4 cm in 'J.H. Hale' (15 September) in 2000, depending on cultivars and different harvest dates (Table 2 and 3).

In 1999, no significant differences ($p<0.05$) for following fruit characteristics at different harvest dates were found: fruit diameter for 'Halehaven', 'Glohaven', 'J.H. Hale', 'Redhaven' and 'Blake'; fruit length for 'Halehaven' and 'Glohaven'; fruit height for 'Halehaven', 'Glohaven', 'Redhaven' and 'June Gold'; fruit weight for 'Halehaven'; fruit flesh firmness for 'J.H. Hale'; soluble solid contents for 'Glohaven', 'Redhaven' and 'June Gold'; titratable acidity 'Glohaven', 'J.H. Hale', 'Earlyred', 'June Gold' and 'Blake'. For the same fruit characteristics of the other cultivars

Table 3. Some pomological characteristics of peach cultivars at different harvest periods grown in Van area in 2000.

Peach Cultivars	Harvest dates	Fruit diameter (cm)	Fruit length (cm)	Fruit height (cm)	Fruit weight (g)	Fruit flesh firmness (kg)	TSS (%)	Titratable acidity (%)	pH	Seed diameter (cm)	Seed length (cm)	Seed height (cm)	seed weight (g)
'Halehaven'	22.08	5.0 a^{k}	5.1 a^{k}	5.2 a^{k}	78.4 a^{k}	7.9 a^{k}	11.2 a^{k}	0.49 a^{k}	4.5	1.6±0.04	3.0±0.03	2.3±0.04	5.4±0.05
	25.08	5.0 a	4.9 ab	5.2 a	75.8 a	7.0 a	12.0 a	0.61 a	4.5	1.5±0.02	2.9±0.04	2.3±0.06	5.2±0.09
	28.08	5.0 a	5.0 ab	5.0 a	77.2 a	4.6 b	10.8 a	0.49 a	4.6	1.5±0.03	2.8±0.06	2.1±0.05	4.8±0.05
	01.09	4.9 a	4.8 b	5.0 a	73.0 a	4.3 b	7.7 b	0.50 a	4.5	1.6±0.03	2.8±0.02	2.2±0.06	4.3±0.04
'Dixired'	31.07	4.6 a^{l}	4.3 a^{l}	4.7 a^{l}	57.8 a^{l}	8.7 a^{l}	9.8 b^{l}	0.51 ab^{l}	4.4	1.5±0.02	2.7±0.04	2.1±0.05	4.7±0.08
	03.08	4.6 a	4.3 a	4.6 a	57.9 a	6.6 a	11.4 ab	0.46 b	4.6	1.4±0.05	2.6±0.06	2.0±0.04	4.2±0.04
	06.08	4.6 a	4.4 a	4.8 a	60.1 a	2.5 b	12.3 a	0.53 ab	4.0	1.6±0.05	2.8±0.06	2.0±0.04	4.3±0.04
	09.08	4.5 a	4.3 a	4.6 a	58.6 a	0.5 c	11.2 ab	0.62 a	4.0	1.4±0.03	2.7±0.02	2.0±0.03	3.8±0.06
'Glohaven'	28.08	5.2 a^{m}	4.9 a^{m}	5.2 a^{m}	78.4 a^{m}	5.4 a^{m}	10.2 ab^{m}	0.60 a^{m}	4.4	1.5±0.03	2.7±0.04	2.0±0.02	5.0±0.09
	01.09	5.2 a	4.7 a	5.1 a	78.0 a	4.5 a	9.8 b	0.60 a	4.5	1.5±0.04	2.6±0.02	2.0±0.02	4.6±0.05
	04.09	5.1 a	4.7 a	5.3 a	79.1 a	5.7 a	13.5 a	0.46 b	4.6	1.5±0.02	2.6±0.06	2.0±0.04	4.8±0.09
'Jeferson'	12.09	4.7 a^{n}	4.9 a^{n}	5.0 a^{n}	71.8 a^{n}	7.7 a^{n}	9.2 a^{n}	0.59 a^{n}	4.6	1.6±0.02	3.1±0.05	2.3±0.04	5.3±0.07
	15.09	4.9 a	4.9 a	4.9 a	69.8 a	6.5 a	8.6 a	0.72 a	4.3	1.7±0.04	3.1±0.02	2.1±0.03	5.2±0.06
'J.H. Hale'	12.09	4.9 b^{x}	5.1 a^{x}	5.1 a^{x}	82.8 b^{x}	8.2 a^{x}	10.8 a^{x}	0.75 a^{x}	4.5	1.6±0.03	3.2±0.06	2.2±0.04	6.1±0.04
	15.09	5.4 a	5.4 a	5.4 a	94.0 a	6.5 a	10.4 a	0.70 a	4.4	1.7±0.05	3.2±0.05	2.1±0.04	5.9±0.09
'Redhaven'	22.08	4.8 b^{v}	4.5 b^{v}	4.9 ab^{v}	64.6 b^{v}	7.7 a^{v}	12.8 a^{v}	0.70 a^{v}	4.4	1.5±0.04	2.7±0.05	2.1±0.03	4.4±0.08
	25.08	4.8 b	4.5 b	4.8 ab	63.0 b	7.1 a	12.0 a	0.62 a	4.2	1.3±0.02	2.7±0.03	2.1±0.03	4.5±0.08
	28.08	5.3 a	4.8 a	5.1 a	79.2 a	4.2 b	12.2 a	0.68 a	4.4	1.6±0.03	2.6±0.06	2.0±0.06	4.0±0.04
	01.09	4.9 b	4.4 b	4.7 b	65.5 b	3.0 b	11.5 a	0.65 a	4.3	1.6±0.02	2.6±0.03	2.0±0.04	3.9±0.04
'Earlyred'	28.07	4.8 a^{w}	4.6 a^{w}	4.6 ab^{w}	60.2 a^{w}	7.1 a^{w}	10.6 c^{w}	0.60 ab^{w}	4.4	1.5±0.05	2.9±0.03	2.0±0.02	3.4±0.05
	31.07	4.7 ab	4.3 b	4.5 ab	57.6 ab	5.0 b	13.1 b	0.59 b	4.3	1.3±0.03	2.7±0.02	1.8±0.05	3.9±0.07
	03.08	4.6 ab	4.3 b	4.4 b	55.6 ab	3.1 c	13.8 b	0.65 ab	4.5	1.3±0.02	2.7±0.04	1.8±0.05	3.3±0.07
	06.08	4.5 b	4.3 b	4.8 a	50.9 b	2.5 c	19.2 a	0.80 a	3.9	1.2±0.03	2.7±0.04	1.7±0.06	3.1±0.05
'June Gold'	28.07	5.0 a^{y}	5.1 a^{y}	4.8 a^{y}	61.7 b^{y}	4.8 a^{y}	9.8 b^{y}	0.55 ab^{y}	4.3	1.7±0.04	3.1±0.02	2.1±0.04	4.5±0.09
	31.07	5.1 a	5.0 a	4.8 a	75.1 a	4.8 a	11.3 ab	0.48 b	4.5	1.5±0.03	2.9±0.05	1.9±0.03	5.0±0.05
	03.08	4.5 b	4.6 b	4.4 b	62.4 b	4.4 a	12.0 a	0.50 ab	4.6	1.7±0.02	3.0±0.05	2.0±0.04	4.6±0.05
	06.08	4.4 b	4.5 b	4.3 b	58.6 b	4.3 a	14.0 a	0.64 a	4.0	1.5±0.02	2.9±0.06	1.9±0.05	4.4±0.07
'Blake'	08.09	4.9 b^{z}	5.0 b^{z}	5.2 a^{z}	71.4 b^{z}	6.4 a^{z}	11.0 a^{z}	0.80 a^{z}	4.7	1.7±0.04	3.1±0.02	2.3±0.02	5.4±0.08
	11.09	5.1 b	5.1 ab	5.3 a	80.7 ab	4.8 a	11.4 a	0.85 a	4.3	1.6±0.02	3.1±0.04	2.1±0.06	5.6±0.04
	14.09	5.3 a	5.3 a	5.3 a	86.2 a	2.3 b	12.8 a	0.77 a	4.8	1.6±0.04	3.0±0.03	2.2±0.04	5.3±0.06

$^{k, l, m, n, x, v, w, y, z}$ Based on Duncan's Multiple Range Test ($P<0.05$) for mean separation in column represented by each cultivar.

significant differences between different harvest times were recorded (Table 2).

In 2000, the statistical analyses of characteristics of fruits from various harvest dates were repeated as shown in Table 3. Comparing with the results of the first year, no stable significance for the various fruit parameters and cultivars were observed. For more details see Table 3. On the other hand, the concentrations of reducing sugar, total sugar and sucrose differed significantly between the cultivars (Table 4).

Fruit weights varied to cultivars, harvest times and years. At the harvest time in 2000, 'J.H. Hale' (94.0 g), 'Blake' (86.2 g), 'Redhaven' (79.2 g) had the highest fruit weights. In 1999, fruit weights of the majority of cultivars were lower than those in 2000. Fruit length of cultivars were between 3.4 cm in 'June Gold' (7 August) and 5.6 cm in 'J.H. Hale' (19 September) in 1999, and between 4.3 cm in 'Earlyred' and 'Dixired' (6 August and 9 August) and 5.4 cm in 'J.H. Hale' (15 September) in 2000. Fruit height was between 3.3 cm in 'June Gold' (7 August) and 5.4 cm in 'Jeferson' (14 September) in 1999, and between 4.4 cm in 'June Gold' and 'Earlyred' (3 August) and 5.4 cm in 'J.H. Hale' (15 September) in 2000. Seed diameter in 1999 and 2000 had a range of 1.1–1.2 cm ('June Gold' on 12 August and 'Earlyred' on 6 August) and 2.1–1.7 cm ('J.H. Hale' on 19 September and 'June Gold' on 3 August). The range of seed length in 1999 and 2000 was 1.8–2.6 cm ('J.H. Hale' on 19 September and 'Dixired' on 3 August) and 3.4–3.2 cm ('Blake' on 6 September and 'J.H. Hale' on 15 September). Seed height was between 1.5 ('June Gold' on 7 August and 'Dixired' on 20 August)

Table 4. Some chemical characteristics of peach fruits at the end of the harvest period of the different cultivars grown in Van area in 2000.

Cultivars	Harvest dates	Reducing sugar (%)	Total sugar (%)	Sucrose (%)
'Halehaven'	01.09	5.7 ab[x]	11.1 b[x]	5.1 c[x]
'Dixired'	09.08	5.3 b	10.6 bc	5.1 c
'Glohaven'	04.09	5.3 b	10.9 bc	5.4 c
'Jeferson'	15.09	5.3 b	14.2 a	8.5 a
'J.H. Hale'	15.09	5.9 ab	13.9 ab	7.6 ab
'Redhaven'	01.09	7.0 a	11.4 b	4.2 d
'Earlyred'	06.08	5.4 b	13.5 ab	7.8 ab
'June Gold'	06.08	5.6 b	12.8 ab	6.9 b
'Blake'	14.09	6.0 ab	10.9 b	4.7 c

[x] Based on Duncan's multiple range test ($P<0.05$) for mean separation in column.

and 2.3 cm ('Jeferson' on 24 September) in 1999, and between 1.7 cm ('Earlyred' on 6 August) and 2.3 cm ('Jeferson' on 12 September) in 2000. Seed weight changed between 2.1 g ('June Gold' on 12 August) and 6.1 g ('Halehaven' on 17 August) in 1999, and between 3.1 g ('Earlyred' on 6 August) and 6.1 g ('J.H. Hale' on 12 September) in 2000. In the majority of cultivars, fruit weights, fruit and seed dimensions of the second year were higher (Table 2 and 3).

'Earlyred' in both years had the highest total soluble solid concentration with 17.2 % on 12 August 1999 and 19.2 % on 6 August 2000. This cultivar was followed by 'Redhaven' with 16.2 % and 'Dixired' with 16.2 % in 1999. The soluble solid contents were lower than those of the first year, depending from the cultivars and harvest times. Titratable acidity varied from 0.14 % ('Dixired', 25 August 1999) to 0.88 % ('Halehaven', 17 August 1999). In general, titratable acidity concentration and fruit flesh firmness were reduced with later harvest date. The value of pH depended on years and cultivar. It was between 3.6 in 'J.H. Hale' (19 September 1999) and 5.3 in 'Dixired' (25 August 1999). Fruit flesh firmness varied from 0.5 kg in 'Halehaven' (2 September 1999) to 11.5 kg in 'Halehaven' (17 August 1999) (Table 2 and 3).

The sugar amounts of the cultivars were analysed at the end of the harvesting period. It was found that the highest concentration of reducing sugar was 7.0 % in 'Redhaven', and the lowest concentration 5.3 % in 'Glohaven' and 'Jeferson'. The range of total sugar was 14.2 % in 'Jeferson' and 10.6 % in 'Dixired'. Sucrose was highest 7.8 % in 'Earlyred' and lowest 4.2 % in 'Redhaven' (Table 4).

Discussion

In this study that was carried out at 1725 m altitude under ecological conditions of Van province, it has been determined that flower bud development and blooming occurred later than under those conditions described by KÜDEN et al. (1995), BILGINER et al. (1995) and TOSUN et al. (2001). During both years of study, it has been observed that flower buds of peach cultivars were not damaged by late spring frosts. KÜDEN et al. (1995) reported that the blooming dates were 21 February for 'Flavorcrest' and 'Maygrand' cultivars, and 1 March for 'Springrest', 'Redcap', 'Redhaven' under ecological conditions of Adana. In another study carried out in Çarsamba lowland, the blooming period was approximately one week earlier because of high daily temperatures in March. The cultivars of 'Cardinal', 'Redhaven' and 'Glohaven', which normally full bloomed in the first week of April, bloomed in late March in a year with higher temperatures in springtime (BILGINER et al. 1995). TOSUN et al. (2001) reported that full flowering occurred in 'Glohaven', 'June Gold', 'Redhaven' and 'Dixired' cultivars along with other 14 peach cultivars in Şanlıurfa (GAP region, Southeast Anatolia) occurred between 16 and 26 March. As seen, peach flowering in Van region is later than described for other areas.

SON et al. (1995) studied the pomological properties of some peach cultivars grown under ecological conditions of Adana. They found 15.2 %, 11.2 %, 10.0 % TSS; 0.81 %, 0.50 %, 0.36 % acidity and 12.6 kg, 15.0 kg, 9.8 kg firmness in 'J.H. Hale', 'Dixired' and 'Earlyred' peach cultivars. When the data in Table 2 and 3 was compared with these values, some similarities can be noticed. KOYUNCU and ÇAVUŞOĞLU (2000) analysed reducing sugar, sucrose and total sugar from late harvested peach cultivars grown in Van area 2.65 %, 9.50 %, for 'Dixired', and 4.48 %, 5.44 % and 10.21 % for 'Halehaven', respectively.

As the result of this study, it has been recorded that all peach cultivars assessed had lower fruit weights but higher soluble solids than those of cultivars investigated under Çukurova growing conditions. Similar results for fruit weight and soluble solids have been reported by TOSUN et al. (2001), who studied pomological traits in Şanlıurfa (GAP region). In addition, KURNAZ and KAŞKA (1992) have also attributed lower fruit weights to high altitude for 'Earlyred', 'Cardinal' and 'J.H. Hale' which are grown at 1100 m altitude in Pozantı. TOSUN et al. (2001) stated that they determined 76.4 g fruit weight for 'June Gold', 59.0 g for 'Dixired', 51.5 g for 'Glohaven' and 49.0 g for 'Redhaven' under Şanlıurfa conditions, and attributed lower fruit weight to the in-

hibition of fruit growth due to higher summer temperatures. When compared to growing of peach at coastal areas, lower fruit sizes from this study can be attributed to high altitude and high summer temperatures along with clayey soil structure and cultural practices. Besides, higher soluble solid content contributes to well fruit aroma.

On the other hand, the soil of the experimental area was loam structure with lower organic matter and weak alkaline reaction. Therefore, it is necessary to improve the soil in terms of organic matter in order to get higher yield and quality of the fruits from peach cultivars, which were cultured. In addition, organic fertilizer and the fertilizers rich of N and P should be applied to enrich the soil. In addition, low precipitation (ANONYMOUS 2001) in the area is also another negative factor for the fruit growth and yield.

In both years, based on fruit characteristics such as fruit weight, flesh firmness, TSS, acidity, flesh colour and skin colour that varied according to harvest dates, suitable harvest times were determined for 'Halehaven', 'Dixired', 'Glohaven', 'Jeferson', 'J.H. Hale', 'Redhaven', 'Earlyred', 'June Gold' and 'Blake' in 1999 and 2000 as 25–27 August, 6–15 August, 4–5 September, 15–19 September, 15–19 September, 25–27 August, 2–3 August, 2–3 August and 6–11 September, respectively. Harvest time for 'Earlyred' was earlier than that of other cultivars.

References

ANONYMOUS 1998: Tarımsal Yapı ve Üretim. DİE, Ankara.

ANONYMOUS 2001: Meteoroloji İstasyonu Kayıtları, Van.

BILGINER, Ş. K., H. DEMIRSOY and L. KARADUVA 1995: The effects of unexpected climatic conditions on phenological development, fruit quality and fruit drop in Samsun in 1994 (in Turkish with English summary). Proc. of II. National Hort. Cong. of Turkey **I**, 116–121.

BURAK, M. and A. ERIŞ 1992: Relationships between frost resistance and carbonhydrate, protein and lipid contents in bud of some peach cultivars. Acta Hort. **315,** 61–71.

DEMIRÖREN, S. 1995: Şeftali Yetiştiriciliği. Atatürk Bah. Kült. Merkez Araş. Enst., Yalova.

DEMIRSOY, H. and Ş. BILGENER 1996: A research on determination of suitability to Çarsamba plain climatical condition of the peach (in Turkish with English summary). Jour. O.M.U Agr.Fac. **11,** 27–39.

DÜZGÜNEŞ, O. 1963: Bilimsel Araştırmalarda İstatistik Prensipler ve Metodları. Ege Üniv. Matbaası, İzmir.

ERTAN, Ü., S. ÖZELKÖK, M. YÜREKTÜRK and S. DEMIRÖREN 1982: Marmara Bölgesinin Muhtelif Yörelerinde Yetiştirilen Bazı Standart Şeftali Çeşitlerinin Hasat Sonrası Fizyolojisi Üzerinde Araştırmalar. Sert Çekirdekli Meyveler Araştirma Projesi Sonuç Raporu. Atatürk Bah. Kült. Merkez Araş. Enst., Yalova.

HESSE, C.O. 1975: Peaches. In: JANICK, J. and J.N. MOORE (eds.). Advances in Fruit Breeding. Purdue Univ. Press, 285–336, W.Lafayette, Indiana.

KACAR, B. 1984: Bitki Besleme Klavuzu. Ankara Üniv. Ziraat Fak. Yay. No. 900, Ankara.

KARAÇALI, İ. 1990: Bahçe Ürünlerinin Muhafazası ve Pazarlanması. Ege Üniv. Basımevi, İzmir.

KAŞKA, N. 2001: Recommendations on the production strategies os stone fruits in Turkey (in Turkish with English summary). Proc. of Symp. on stone fruits-**I,** 1–16.

KOYUNCU, M.A. and Ş. ÇAVUŞOĞLU: A study on preharvest and postharvest physiology of 'Dixired' and 'Hale Haven' peach cultivars grown in Van (in Turkish with English summary). S.D.U. J. Grad. Sch. Sci. **5**, 147–157.

KURNAZ, S., and N. KASKA 1992: Comparison of the physical and chemical characteristics of peachs fruits in low and high elevations. Acta Hort. **315,** 117–123.

KÜDEN, A.B., F. ÖZMETLI, N. KAŞKA and A. KÜDEN 1995: Determination of yield and quality characteristics of some peach and nectarine cultivars (in Turkish with English summary). Proc.of II. National Hort. Cong. of Turkey **I**, 111–116.

ÖZBEK, S. 1978: Özel Meyvecilik. Ç.Ü. Zir. Fak. Yay. No. 128, Adana.

SCORZA, R. and W.R. OKIE 1991: Peach. In: MOORE, J.N and J.R. BALLINTON (eds.): Genetic Resources of Fruit and Nut Crops. Acta Hort. **290,** 175–233.

SON, L., N. KAŞKA, A. KÜDEN and A.B. KÜDEN 1995: Pomological characteristics of some peach cultivars in Adana ecological conditions (in Turkish with English summary). Proc.of II. National Hort. Cong. of Turkey **I**, 106–110.

TOSUN, İ., B.E. AK and İ. ACAR 2001: An investigation on phenological and pomological traits of some peach cultivars grown at GAP region (in Turkish with English summary). Proc. of Symp. on stone fruits-**I,** 423–434.

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