Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

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Asian Journal of Plant Sciences 6 (2): 298-303, 2007
ISSN 1682-3974

Fruit Sets and Fruit Drops in Turkish Apricot (*Prunus armeniaca* L.) Varieties Grown under Ecological Conditions of Van, Turkey

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Abstract: This research was conducted to determine fruit sets and fruit drops from full bloom to harvest in Turkish apricot varieties for two years. In the study, changes in fruit sets and fruit drops following full bloom period in apricot varieties were assessed in eight different dates in the first year and in eleven different dates in the second year. In 2004, the final fruit sets were determined a few days before harvest time (13 July) as 24.5% in Soganci, 34.9% in Hasanbey, 41.3% in Alyanak, 45.5% in Tokaloglu, 31.1% in Salak and 35.1% in Sekerpare. The final fruit sets at the harvest time of 2005 were found as 4.5% in Soganci, 19.8% in Hasanbey, 15.6% in Alyanak, 31.1% in Tokaloglu, 20.1% in Salak, 20.4% in Sekerpare, 7.1% in Hacihaliloglu, 12.6% in Kabaasi and 21.7% in Sakit.

Key words: Apricot, fruit set, fruit drop, Van

INTRODUCTION

Turkish apricot varieties are included in the Irano-Caucasian group (Mehlenbacher *et al*., 1990). Turkey is one of the native spreading areas of apricot in the Near East of Central Asia (Bailey and Hough, 1975). Turkey is the leading country in fresh apricot production and dried apricot export in the world. İn Turkey, annual apricot production is highly influenced by late spring frosts in some years and the production frequently fluctuates (Askin *et al*., 1990; Cangi, 1991; Gulcan and Askin, 1991; Bostan, 1993; Akca and Sen, 1993; Akca and Asthma, 1995; Guleryuz, 1995). For example, Turkey's fresh apricot production is 383 000 tons in 1999 and 609 000 tons in 2000 (Asthma, 2000). Temperature fluctuations in late winter and in early spring also affect the yield by causing the flower buds to soften. Turkish apricot trees, which are self-fertile (Asthma, 2000), need to satisfy fruit set to get regular bearing, but late spring frosts do not make possible high fruit set every year. Thus, adverse weather conditions, frosts, winds and low temperatures, rain, hailing, water stress, irrigation treatments, high relative humidity affecting pollination and bee activity in the spring can lead to decreasing the number of buds, flowers and fruits and pollination failures during bloom (Gradziel and Weinbaum; 1999; Viti and Monteleone, 1991; Torricalles *et al*., 2000; Alburquerque *et al*., 2003). In additon, fruit set, fruit drops and yield in apricots can be affected a large number of environmental and physiological factors (Gulcan *et al*., 1995; Torricalles *et al*., 2000; Alburquerque *et al*., 2003; Alburquerque *et al*., 2004). Thus, causes of poor yield in many apricot varieties are currently unclear (Alburquerque *et al*., 2003).

Located in eastern Turkey, Van city has suitable climatic conditions for apricot growing, but the yield is highly influenced by late spring frosts and undesired environmental conditions, unsatisfied technical and cultural applications. Late spring frost in Van sometimes occur in late April and in early May in some years. The yield in apricot production is closely related to fruit set and fruit drops. Regular high fruit set and low fruit drops is desired for apricot growing. There exists a limited information on fruit set and drops in apricots in the references although they affect the yield. This study tried determining the percentages of fruit set and fruit drops in Turkish apricot varieties grown in Van city.

MATERIALS AND METHODS

The study was conducted on 15-year-old trees belonging to Turkish apricot (*Prunus armeniaca* L.) varieties Soganci, Hasanbey, Alyanak, Tokaloglu, Salak, Sekerpare, Hacihaliloglu, Kabaasi and Sakit during 2004-2005. At full bloom period of apricot trees, when 70-75% of the flower buds were opened, the open flowers were separately counted in three different branches for each variety both in 2004 and 2005. Flower numbers per branch were recorded in 01 May (full bloom stage) in the first year and in 28 April (full bloom stage) in

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the second year. Flower numbers were determined in three different branches of each variety. After full bloom period, the numbers of fruitlets or fruits were recorded in 8 different dates from 13 May to 13 July in 2004 and in 11 different dates from 12 May to 22 July in 2005. Subsequent fruit set after flowering period and fruit drops proceeded under orchard conditions. The three single-tree replicates of each variety were used to determine flower numbers, fruit sets and fruitlets/fruit drops. The final fruit set was expressed as the percentage of fruits per total open flowers (Williams, 1970; Alburquerque *et al*., 2003).

RESULTS AND DISCUSSION

In full bloom period of the first year, the mean flower numbers counted per branch in Soganci, Hasanbey, Alyanak, Tokaloglu, Salak and Sekerpare apricot varieties were 104.0, 123.8, 410.5, 403.8, 273.4 and 262.3, respectively (Table 1). In this period of the second year, the mean flower numbers per branch Soganci, Hasanbey, Alyanak, Tokaloglu, Salak, Sekerpare, Hacihaliloglu, Kabaasi and Sakit varieties were counted as 248.5, 212.8, 89.8, 113.9, 230.6, 194.7, 327.0, 344.7 and 378.2 (Table 3). Therefore, Alyanak and Tokaloglu varieties in the first year and Sakit and Kabaasi varieties produced more flowers. In addition, full bloom period in the second year was observed a few days earlier than that of the first year.

In the study, changes in fruit set and fruit drops following full bloom period in apricot varieties were assessed in eight different dates in the first year and in eleven different dates in the second year.

In 2004, the numbers of fruitlets per branch in the first observation date (12 May) after the fruit set were recorded as 87.4 in Soganci, 108.6 in Hasanbey, 323.3 in Alyanak, 331.0 in Tokaloglu, 204.3 in Salak and 215.3 in Sekerpare. In this date, fruit set percentages by flower numbers counted in full bloom period were 84.0% in Soganci, 87.7% in Hasanbey, 78.6% in Alyanak, 81.9% in Tokaloglu, 74.7% in Salak and 82.0% in Sekerpare. In addition, the date of 25 May was remarkable period with respect to droppings. On 25 May, great numbers of fruitlets were determined to have been dropped in all apricot varieties. Therefore, fruit set percentages highly decreased in this date. Although fruit set percentages continued to decrease in all varieties from 08 June to 13 July, reductions in fruit number had lower percentages during this period. Thus, final fruit sets determined a few days before harvest time of 2004 (13 July) were determined as 24.5% in Soganci, 34.9% in Hasanbey, 41.3% in Alyanak, 45.5% in Tokaloglu, 31.1% in Salak and 35.1% in Sekerpare (Table 2).

In 2005, the numbers of fruitlets per branch in the first observation date (12 May) were recorded as 200.3 in Soganci, 183.7 in Hasanbey, 64.9 in Alyanak, 87.8 in Tokaloglu, 151.7 in Salak, 152.1 in Sekerpare, 180.8 in Hacihaliloglu, 173.9 in Kabaasi and 313.9 in Sakit. In the same date, fruit set percentages were recorded as 81.8% in Soganci, 86.3% in Hasanbey, 72.3% in Alyanak, 77.0% in Tokaloglu, 65.8% in Salak, 78.1% in Sekerpare, 55.3% in Hacihaliloglu, 50.4% in Kabaasi and 83.0% in Sakit. As observed on 25 May of the first year, 20 May of 2005 was remarkable period regarding fruitlet droppings. In this date, a great number of fruitlets was dropped in all varieties. Therefore, fruit set percentages highly decreased on 20 May. Also, the date of the second largest fruitlet dropping was 27 May in all varieties. After this date, the drops were usually diminished, but did not all stop. Although fruit drops continued in all varieties from

Table 1: In the first year (2004), the mean flower number per branch in full blooming period in Soganci, Hasanbey, Alyanak, Tokaloglu, Salak and Sekerpare apricot varieties grown under ecological conditions of Van, Turkey

		The mean number of flower per branch					
Date	Period	Soganci	Hasanbey	Alyanak	Tokaloglu	Salak	Sekerpare
01 May	Full bloom	104.0	123.8	410.5	403.8	273.4	262.3

Table 2: In the first year (2004), changes in fruit set and fruit drops after full bloom period in Soganci, Hasanbey, Alyanak, Tokaloglu, Salak and Sekerpare apricot varieties grown under ecological conditions of Van, Turkey

		The mean number and mean percent per branch in each variety											
		Soganci		Hasanbey		Alyanak		Tokaloglu		Salak		Sekerpare	
Dates	Period	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB
12 May	FL	87.4	84.0	108.6	87.7	323.3	78.6	331.0	81.9	204.3	74.7	215.3	82.0
25 May	SF	53.6	51.5	79.3	64.0	219.6	53.4	251.0	62.1	143.0	52.3	139.3	53.1
08 June	SF	32.8	31.5	48.6	39.2	184.0	44.8	199.0	49.2	94.3	34.4	98.3	37.4
15 June	F	27.4	26.3	45.0	36.3	180.0	43.8	195.3	48.3	91.6	33.5	96.0	36.5
22 June	F	25.5	24.5	43.6	35.2	177.0	43.1	189.6	46.9	90.6	33.1	95.3	36.3
29 June	F	25.5	24.5	43.6	35.2	175.6	42.7	187.6	46.4	90.6	33.1	94.3	35.9
06 July	F	25.5	24.5	43.6	35.2	171.6	41.8	184.3	45.6	85.6	31.3	92.6	35.3
13 July	F	25.5	24.5	43.3	34.9	169.6	41.3	184.0	45.5	85.3	31.1	92.3	35.1

FL: Fruitlets after fertilisation; SF: Small fruit period; F: Fruit period; NFS: The mean number of fruit set per branch; FB: Full bloom period; FS: Fruit set

Table 3: In the second year (2005), the mean flower number per branch in full blooming period in Soganci, Hasanbey, Alyanak, Tokaloglu, Salak and Sekerpare apricot varieties grown under ecological conditions of Van, Turkey

		The mean number of flower per branch								
Date	Period	Soganci	Hasanbey	Alyanak	Tokaloglu	Salak	Sekerpare	Hacihaliloglu	Kabaasi	Sakit
28 April	Full bloom	248.5	212.8	89.8	113.9	230.6	194.7	327.0	344.7	378.2

Table 4: In the second year (2005), changes in fruit set and fruit drops after full bloom period in Soganci, Hasanbey, Alyanak, Tokaloglu and. Salak apricot varieties grown under ecological conditions of Van, Turkey

		The mean number and mean percent per branch in each variety									
		Soganci		Hasanbey		Alyanak		Tokaloglu		Salak	
Dates	Period	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB
12 May	FL	200.3	81.8	183.7	86.3	64.9	72.3	87.8	77.0	151.7	65.8
20 May	SF	35.7	14.3	94.3	44.3	28.7	31.9	61.6	54.1	127.2	55.2
27 May	SF	19.0	7.6	68.2	32.1	24.4	27.2	60.6	53.2	81.6	35.4
03 June	F	15.5	6.2	58.6	27.5	22.9	25.5	58.3	51.2	74.9	32.5
10 June	F	14.5	5.8	56.3	26.5	22.9	25.5	54.7	48.0	64.2	27.9
17 June	F	14.3	5.7	54.0	25.4	20.4	22.7	51.0	44.8	58.8	25.5
24 June	F	13.8	5.5	52.9	24.9	18.3	20.3	48.9	42.9	56.1	24.3
01 July	F	13.8	5.5	52.0	24.4	17.5	19.5	45.0	39.5	53.8	23.3
08 July	F	13.5	5.4	50.1	23.5	17.3	19.2	44.6	39.1	51.3	22.3
15 July	F	13.0	5.2	47.2	22.2	16.3	18.1	43.1	37.9	47.8	20.7
22 July	F	11.3	4.5	42.1	19.8	14.0	15.6	35.4	31.1	46.3	20.1

FL: Fruitlets after fertilisation; SF: Small fruit period; F: Fruit period; NFS: The mean number of fruit set per branch; FB: Full bloom period; FS: Fruit set

Table 5: In the second year (2005), changes in fruit set and fruit drops after full bloom period in Sekerpare, Hacihaliloglu, Kabaasi and Sakit apricot varieties grown under ecological conditions of Van, Turkey

		The mean number and mean percent per branch in each variety							
		Sekerpare		Hacihaliloglu		Kabaasi		Sakit	
Dates	Period	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB	NFS	FS% by FB
12 May	FL	152.1	78.1	180.8	55.3	173.9	50.4	313.9	83.0
20 May	SF	90.4	46.5	78.3	24.0	82.4	23.9	133.2	35.2
27 May	SF	68.2	35.0	34.8	10.6	69.1	20.0	111.3	29.4
03 June	F	57.9	29.7	28.3	8.7	61.7	17.9	107.7	28.5
10 June	F	52.4	26.9	27.4	8.4	57.9	16.8	103.9	27.5
17 June	F	50.1	25.7	27.0	8.3	55.2	16.0	100.9	26.7
24 June	F	48.0	24.7	25.9	7.9	51.8	15.0	95.8	25.3
01 July	F	46.9	24.1	23.4	7.2	49.1	14.2	93.8	24.8
08 July	F	44.1	22.7	25.8	7.9	47.3	13.7	90.7	24.0
15 July	F	40.7	20.9	25.3	7.7	46.2	13.4	85.6	22.6
22 July	F	39.7	20.4	23.3	7.1	43.3	12.6	82.2	21.7

FL: Fruitlets after fertilisation; SF: Small fruit period; F: Fruit period; NFS: The mean number of fruit set per branch; FB: Full bloom period; FS: Fruit set

03 June to 22 July, they were low as percentage during this period. Thus, final fruit sets at the harvest time of 2005 were found as 4.5% in Soganci, 19.8% in Hasanbey, 15.6% in Alyanak, 31.1% in Tokaloglu, 20.1% in Salak, 20.4% in Sekerpare, 7.1% in Hacihaliloglu, 12.6% in Kabaasi and 21.7% in Sakit (Table 4 and 5).

Asthma (2000) reported that fruit set percentages of apricot flower buds range from 31.6 to 46.9% and fruit set percents in bearing shoots are higher in the flowers close to the tip than those close to the base. McLaren *et al.* (1996) obtained fruit set between 0.4 and 46% in Sundrop apricot variety and between 1 and 54% in Moorpark apricot variety in New Zealand. Rodrigo and Herrero (2002a) recorded 36-49% fruit set in 8-year-old trees of Moniqui apricot cultivar and they suggested that pre-blossom temperatures affect subsequent fruit set in apricots. Alburquerque *et al.* (2003) recorded that Guillermo, a Spanish apricot variety, shows fruit set between 2.00 and 24.7%, depending on growing place, irrigation treatment and shoot type. Also, some chemicals were reported to be effective on the fruit set in apricots. Alburquerque *et al.* (2004) determined fruit set percentage 6.5-28% in Bebeco, 23.2-30.7% in Palstein, 36.5-61.4% in Beliana, 1.1-5.4% in Goldrich, 22.1-66.4% in Priana, 4.7-18.6% in Bergeron, 3.8-10.4% in Colorao, 9.3-15.1% in Guillermo and 1.4-8.7% Pepioto apricot variety, depending on the years in Spain. Reporting that fruit set percentages was affected by different irrigation treatments depending on years, Torricalles *et al.* (2000) observed fruit sets 18-25% in 1994, 9-19% in 1995, 10-26% in 1996

and 9-19% in 1997 in the 9-year-old trees belonging to Bulida variety in Spain and they stated that water stress induced young fruit drop which led to lower fruit final fruit set and significantly decreased the yield. Son and Kuden (2005) stated that Dormex (49% hydrogen cyanamide) and Promalin influenced fruit set in Tokaloglu and Karacabey apricot (*Prunus armeniaca*) varieties and 1 and 2% concentrations of Dormex improved fruit set percentage.

When the findings of this study were considered collectively, it seems that fruit set percentages in the first year are higher than those of the second year. Fruit sets of the first and second year were 4.5-24.5% in Soganci, 19.8-34.8% in Hasanbey, 15.6-41.3% in Alyanak, 31.1-45.5% in Tokaloglu, 20.1-31.1% in Salak and 20.4-35.1 in Sekerpare, respectively. Therefore, Soganci and Alyanak varieties had greater fluctuations in fruit set than Hasanbey, Tokaloglu, Salak and Sekerpare.

In addition, Rodrigo and Herrero (2002b) stated that the majority of flowers and fruitlets dropped within the first 4 weeks after pollination and the biggest drop wave occurred 3-4 weeks after pollination. With respect to fruit drops, findings belonging to the first and second years of this study are in parallel with those of Rodrigo and Herrero (2002a). In this study, the biggest fruitlets drops in all varieties were observed 3-4 weeks after full bloom period.

On the other hand, the honeybee pollination in the garden affects the fertilization (Langridge and Goodman, 1981; Ozbek and Calmasur, 2001). Examining honeybee pollination in apricot variety Trevatt, Langridge and Goodman (1981) reported that the majority (97.6%) of insects visiting the flowers are honeybees, 84% of the bees are pollen gatherers visiting newly opened flowers and pollen gatherer bees are more important pollinators than nectar collecting bees. Also, temperatures in the days following anthesis can affect pollen tube growth. The first pollen tubes in apricots reach the base of the style in 3-4 days after pollination and fertilisation is completed by 7 days following pollination (Rodrigo and Herrero, 2002b). Therefore, climate conditions during this period can be effective on the fruit set and fruitlet drops.

Rodrigo and Herrero (2002b) suggested that other factors along with pollination or fertilisation may be involved in fruit set and fruit drops. In apricot varieties, fruit sets and fruitlet drops after fertilisation can be negatively influenced by adverse climate conditions during the period of pollination and fertilisation beside insufficient technical and cultural practices (Guleryuz *et al*., 1996) to trees.

Van city has suitable climatic conditions for apricot growing, but the yield is highly affected by late spring frosts and insufficient technical and cultural applications. In Van city, late spring frosts occur in late April-early May. Figure 1 and 3 show fluctuations of minimum temperatures observed in April of 2004 and 2005. Before flowering period, 2004 was colder than 2005. In 2004, the lowest minimum temperatures continued from 4 April to 9 April and thus flowering was later. Whereas, minimum temperatures recorded in the same dates of the second year were higher and thus flowering was later as well. Figure 2 and 4 display fluctuations of minimum temperatures observed in May of 2004 and 2005. In May, the minimum temperatures were not a serious threat for flowering or fruitlets drops of apricot. Therefore, apricot varieties were not seriously affected by late frosts in both years. However, severe hailing occurred just before the third observation date (20 May) in 2005 and let to severe drops of fruitlets. Accordingly, lower fruit sets and higher fruit/fruitlets drops in the second year might be attributed to severe hailing conditions in middle May rather than frosts and also water deficiencies or unsatisfied supply of water. Fruit/fruitlets drops and yield in apricot was reported to have been affected by water stress conditions and irrigation treatments (Torricalles *et al*., 2000; Alburquerque *et al*., 2004).

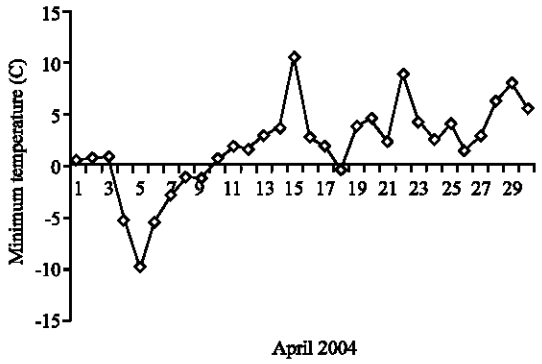

Fig. 1: Minimum temperatures of April 2004

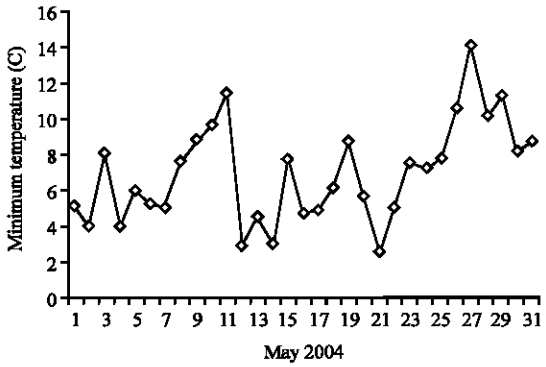

Fig. 2: Minimum temperatures of May 2004

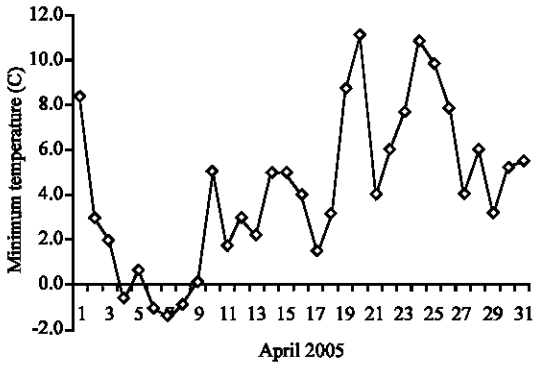

Fig. 3: Minimum temperatures of April 2005

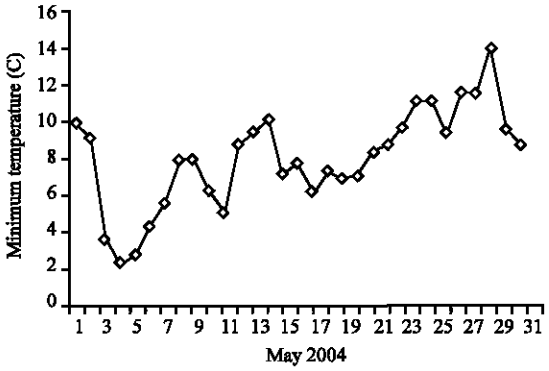

Fig. 4: Minimum temperatures of May 2004

At the end of this study, low final fruit sets were not recorded for Turkish apricot cultivars grown in Van. However, results also suggested that fruit set and fruit drops in apricots should be assessed together with total yield amounts by years.

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