

## Population density and damage ratios of Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) on pomegranate orchards in Turkey

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### ABSTRACT

The Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is a serious pest on pomegranate in Turkey. The objective of this study was to determine of the population density and damage ratios of the medfly on pomegranate in Antakya district of Hatay province of Turkey. The eostrap® invaginada traps baited with % 95 Trimedlure impregnated in a polymeric plug-type dispenser were used. After two years of the study, the medfly was recorded in ten sampled sites. The population density of this pest varied over the sampling periods. The largest percentages of total catches per traps were recorded in November (53.68) and October (44.2) in 2012, and November (73.6) and October (22.2) in 2014. In addition, the highest mean catches per traps were recorded in November and October, while the lowest mean catches per traps were recorded in August, September and December in both years. In the first year, the largest percentages of damage ratios were recorded at orchard II (14), followed by orchard VI (12), orchard I (11), orchard IV (9), orchard III (7), orchard V (7). In the second year, the highest percentages of damage ratios were recorded at orchard IV (25), followed by orchard III (22), orchard II (15) and orchard I (12). In conclusion, the population density of medfly on pomegranate increased in October and November due to ripening and harvesting time of fruits. The medfly caused significantly more damage on Katıbaşı pomegranate than Hicaz pomegranate in Hatay province of Turkey.

**Key words:** Medfly, trimedlure, traps, pomegranate, Turkey.

### INTRODUCTION

The Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is one of the most important fruit pests throughout the world [6,8]. The Medfly is a polyphagous species attacking over three hundred and fifty different hosts [18,26]. The pest can overwinter as pupa in the soil under the host plant and they appear on apricot and peach from June to July [2], on pomegranate from late July to August, if they are available [3,4,5]. The females puncture the fruits and lay eggs below the skin of the host fruits, which are destroyed by larval feeding [2,18,24]. Insecticidal protection from medfly is possible by using a cover spray or a bait spray [22,23]. Malathion is the usual choice of insecticide for fruit fly control and this is usually combined with protein hydrolysate to form a bait spray [3,21]. Traps baited with trimedlure are important tools for detection, monitoring and controlling of the medfly [5,12,17]. The trimedlure contained in Jackson traps, and McPhail traps baited with hydrolyzed protein were the primary detection tools used in medfly detection programmes [5,25]. Traps baited with lures are also used to monitor population size and spread continuously [4,16,20]. The purpose of the current study was to determine the population density and damage ratios of medfly *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) on pomegranate orchards in Hatay province of Turkey.

### MATERIALS AND METHODS

The study was conducted in 2012 and 2014 at ten pomegranate orchards in Antakya district of Hatay province of Turkey. The study was carried out using the Eostrap® invaginada traps (Sanidad Agricola Econex, Santomera,

Murcia, Spain) baited with % 95 Trimedlure, (formulated in a polymeric plug-type dispenser) (Sanidad Agricola Econex, Santomera, Murcia, Spain) and dichlorvos or 2,2-dichlorovinyl dimethyl phosphate (DDVP) tablet (Sanidad Agricola Econex, Santomera, Murcia, Spain). The first experiment was conducted at six different pomegranate orchards which contain 'Hicaz' variety from 29 July to 25 December 2012. The second experiment was carried out at four different pomegranate orchards two of which contain 'Hicaz' variety (orchard I, II) and the other two 'Katrbaşı' variety (orchard III, IV) from 10 August to 20 December 2014. In both years, one trap for each orchard was used. The traps were placed 1.5 m above ground and checked weekly, trapped medfly were counted and removed from the traps. The trimedlure and DDVP tablet in traps were replaced with the new ones in every 90 days.

The fruit damage assessment was measured by the percentage of medfly punctures during the harvest. For this purpose, during the harvest time, except from the trap baited with trimedlure hanging tree, two-hundred fruits were chosen randomly from twenty trees in each of the orchards and checked for medfly punctures and infested fruits were counted. The percentage of fruit damage was calculated by dividing the number of infested fruits by the total number of sampled fruits in each orchards to evaluate the percentage of the damaged fruits in each of the orchard.

## RESULTS

The population density of *C. capitata* were recorded all pomegranates orchards, in which the studies were conducted in 2012 and 2014. A six pomegranate orchards in Antakya district were sampled in 2012 and a total of 2634 medfly adults were caught by traps (Figure 1). The first adults were caught by traps on 26 August. The population density of this pest was low from 26 August through 7 October, while it increased from 14 October to 18 November. The largest mean of catches per traps were recorded on 4 November (127.50), followed by 28 October (122.33), 18 November (59.67), 11 November (45.0), 14 October (39.67) and 21 October (29.83).

A four pomegranate orchards in Antakya district were sampled in 2014 and a total of 1325 medfly adults were caught by traps (Figure 2). The first adults were caught by traps on 20 September. The population density of this pest was gradually low in late September, while it increased from October to mid-November. The largest mean of catches per traps were recorded on 8 November (69.5), followed by 15 November (67.25), 1 November (53.0), 22 November (33.75), 26 October (32.25), 29 November (20.25) and 19 October (19.0).

The percentage of the total caught over this period varied for each of the sampling month in both years. The distribution of the total caught of this pest according to the months as percentages were August (0.11), September (1.1), October (44.2), November (53.68) and December (0.91) in 2012 (Figure 3). These percentages were August (0.0), September (1.4), October (22.2), November (73.6) and December (2.8) in 2014 (Figure 4).

The percentages of damage rates of medfly were observed in each of the sampled orchard in both years. In 2012, the study was conducted on Hicaz pomegranate and the highest damage ratios of medfly were observed at orchard II (14), followed by orchard VI (12), orchard I (11), orchard IV (9), orchard III (7) and orchard V (7) (Figure 5). In 2014, the study was carried out on Hicaz and Katırbaşı pomegranate and the highest damage ratios of medfly were observed at orchard IV (Katırbaşı) (25), followed by orchard III (Katırbaşı) (22), orchard II (Hicaz) (15) and orchard I (Hicaz) (12) (Figure 6).

## DISCUSSION

Detection and monitoring systems are critical components to control medfly in the world [12,25]. The trimedlure (tert-butyl 4-(and 5) chloro-2-methylcyclohexane 1-carboxylate) contained in Jackson traps and McPhail traps baited with hydrolyzed protein were the primary detection and monitoring tools used for medfly [5,9,17,25]. The trimedlure and ceralure are widely used as synthetic male medfly attractant [12,13,17,25]. Traps baited with protein-based baits and lures are also used for capture of male and female medfly [11,12,14,15]. An ammonium acetate (AA) + trimethylamine (TMA) + putrescine (PT), a food-based synthetic attractant, were tested and found to be synergistic in capturing pest fruit flies that are attracted to liquid protein-baited traps [11]. Field trials were conducted in seven countries (Greece, Honduras, Mauritius, Morocco, Portugal, Spain and Turkey) mostly in citrus orchards and traps baited with the three component attractant were found to capture equal or greater numbers of female medfly than McPhail-type traps baited with NuLure/borax solution [7]. In Greece and Morocco, Epsky et al. [7] reported that multilure traps baited with NuLure was the least effective for medfly females compared with trap baited with AA+TMA+PT. In Spain, the multilure traps baited with NuLure captured more *C. capitata* females than wet or dry trap baited with AA+TMA+PT [19].

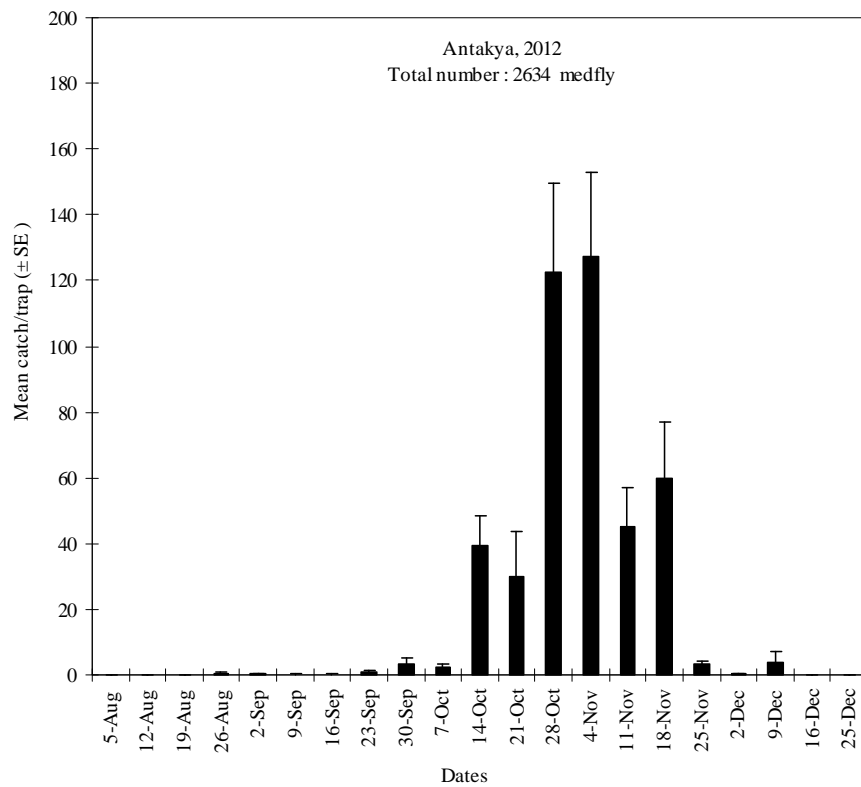


Figure 1. Mean (±SE) catches of medfly adults in traps baited with trimedlure (29 July–25 December, 2012) at pomegranate orchards in Antakya district.

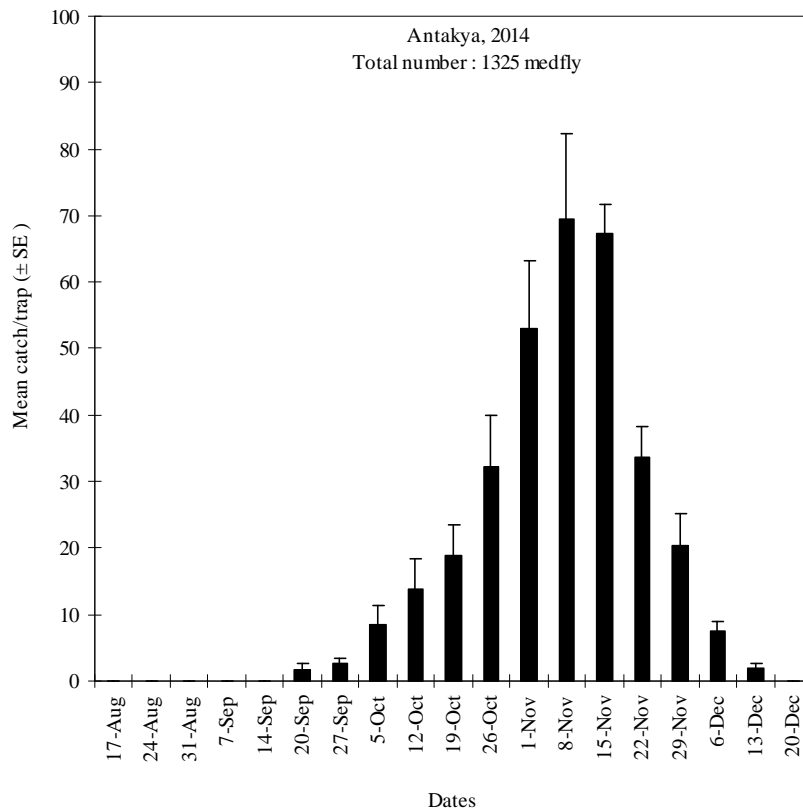


Figure 2. Mean (±SE) catches of medfly adults in traps baited with trimedlure (10 August–20 December, 2014) at pomegranate orchards in Antakya district.

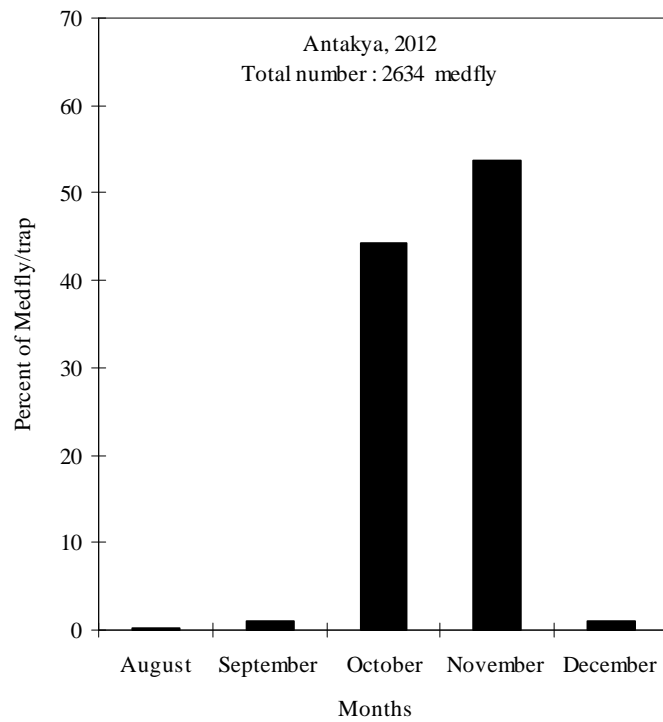


Figure 3. Percentage of the total medfly adults caught over the sampling period at the pomegranate orchards in Antakya district in 2012.

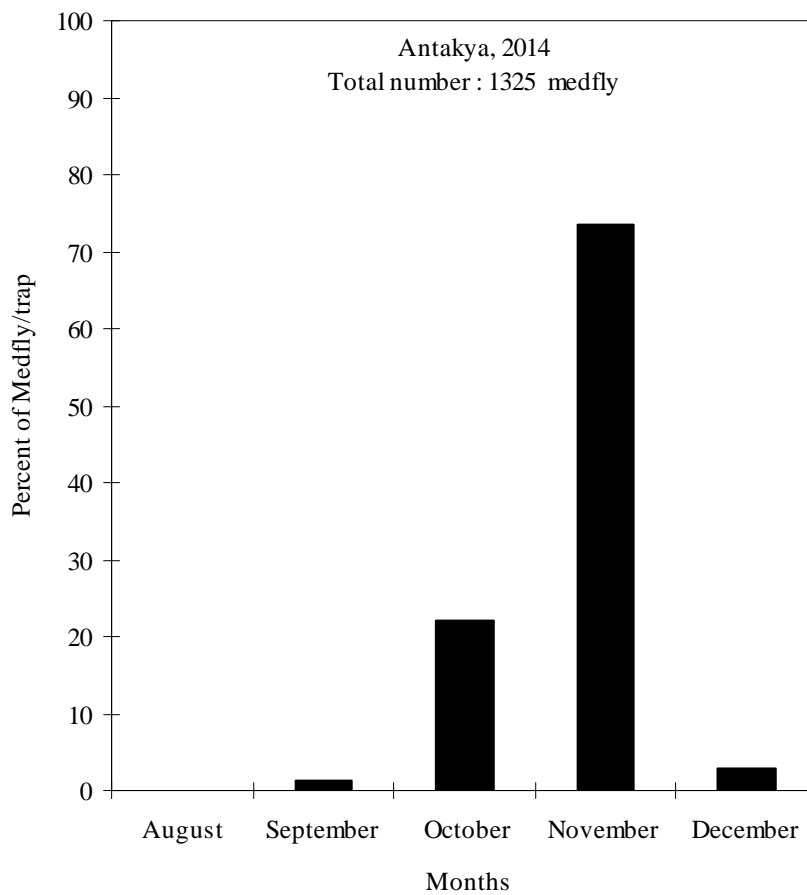


Figure 4. Percentage of the total medfly adults caught over the sampling period at the pomegranate orchards in Antakya district in 2014.

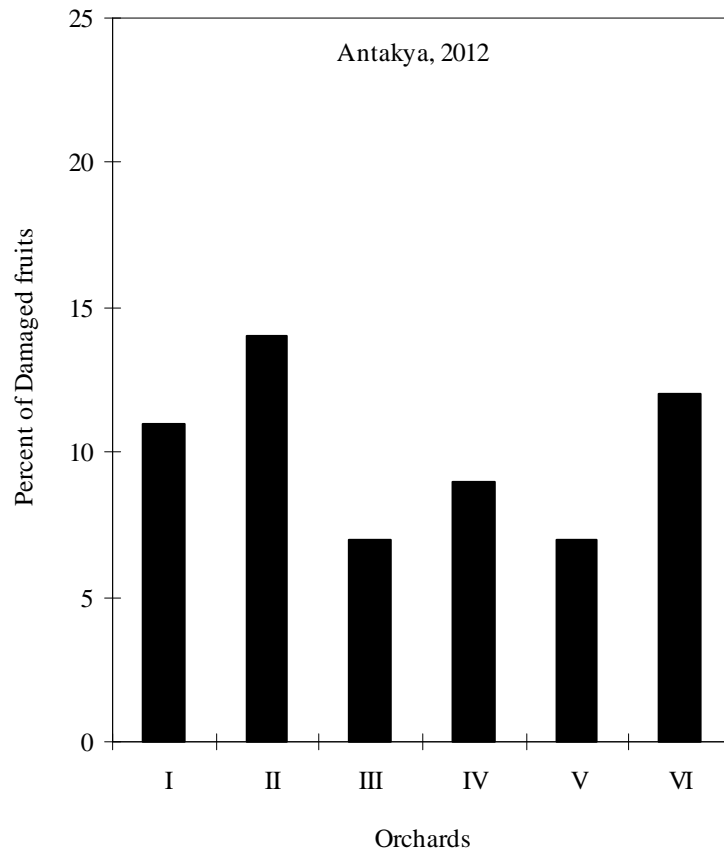


Figure 5. Percentage of the damaged fruits by medfly in pomegranate orchards in Antakya district in 2012.

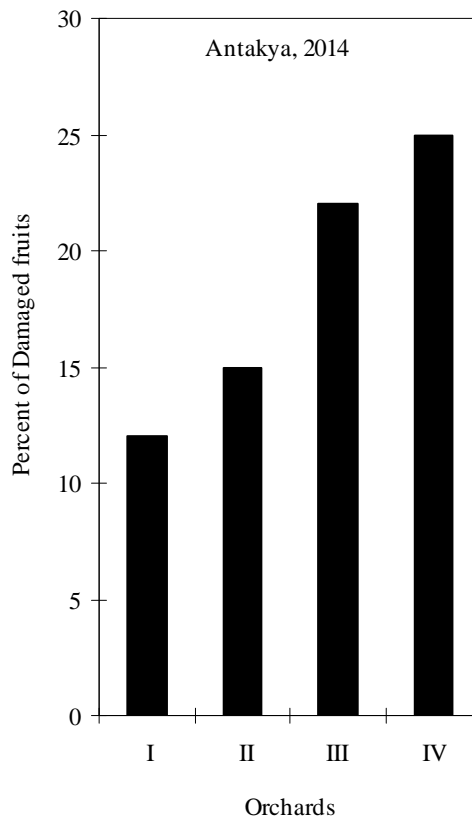


Figure 6. Percentage of the damaged fruits by medfly in pomegranate orchards in Antakya district in 2014.

The population density of *C. capitata* varied for hosts plants and sampling periods. Hashem et al. [10] studied the population fluctuations of *C. capitata* in the north of Egypt, two population peaks occurred, the first in October–November, mainly on *Citrus*, and the second in May–June on apricot and some early varieties of peaches. In addition, Demirel [5] studied the population density of medfly on pomegranate in Hatay province of Turkey in 2010-2011. In the first year, the studies were conducted by trap baited with trimedlure in Kırıkhan and Soguksu districts. A total of 2380 medfly adults were caught by traps in Kırıkhan district. The highest mean of catches were recorded on 13 October (236.5), followed by 6 October (166.5), 29 September (145.5), 20 October (145.0), 22 September (110.0), 1 September (95.0), 15 September (78.0) and 8 September (75.5). A total of 257 medfly adults were caught by traps in Soguksu district. The highest mean of the medfly adults were recorded on 6 October (38), followed by 13 October (33.8), 20 October (17), and 29 September (16). In the second year, the study was conducted in Serinyol district, and a total of the 1228 medfly adults were caught by traps during the sampling period. The highest mean of catches were recorded on 7 November (240.0), followed by 14 November (162.5), 31 October (100.5), 24 October (58.0) and 21 November (32.0). Moreover, Çardak [4] studied the population density of medfly on Hicaz pomegranate in Osmaniye province of Turkey in 2012-2013. The population density of medfly was different in each of the pomegranate orchard and sampling periods in both years. In the first year, a total of 168 medfly adults were caught by traps baited with trimedlure during the sampling period. The highest mean of catches were recorded on 26 October (11.0), followed by 9 November (11.0), 23 November (10.5) and 15 September (8.5). In the second year, a total of 274 medfly adults were caught by traps and the highest mean of catches were recorded on 10 November (8.75), followed by 3 November (7.75) and 22 September (6.25).

Many studies were conducted by many researchers to evaluate the population density of medfly on various host plants. Akyol [1] reported that the population density of medfly were significantly different in each of sampling periods on satsuma mandarin in 2011-2012. A total of 8,968 medfly adults were caught by traps baited with trimedlure and the percentages of the medfly were recorded in October (71.32), followed by November (10.13), September (6.54) and August (1.17) in 2011. A total of 1,307 medfly adults were caught by traps and the percentages of the medfly were recorded in September (32.13), followed by November (26.70), October (16.37) and August (3.67) in 2012. In addition, Demirel [5] reported the population density of medfly on pomegranate in Antakya and Soguksu districts in 2010 and in Serinyol district in 2011. The distribution of the total caught of this pest as percentages were July (0.04), August (7.90), September (42.40), October (48.99) and November (0.71) in Kırıkhan district, and July (0.0), August (0.39), September (21.79), October (74.32) and November (0.78) in Soguksu district. These percentages were recorded in August (0.0), September (3.25), October (28.91), and November (70.76) in Serinyol district. Moreover, Çardak [4] also reported the population density of medfly on Hicaz pomegranate in Osmaniye province in 2012-2013. The percentages of this pest were recorded in August (8.24), September (17.65), October (21.76) and November (45.29) in 2012, and August (2.92), September (32.85), October (28.83) and November (35.40) in 2013. Furthermore, Kılıç [16] studied the population density of medfly on persimmon in 2013-2014. A total of 3061 medfly adults were caught by traps baited with trimedlure during the sampling period, and the distribution of the total caught of this pest as percentages were recorded in July (6.76), August (28.06), September (36.56), October (22.74) and November (5.88) in 2013. A total of 4227 medfly adults were caught by traps, and the distribution of the this pest as percentages were recorded in August (66.12), September (12.86), October (16.30), and November (4.99) in 2014.

Many studies were also conducted to evaluate the percentages damage ratios of medfly on different host plants. Fimiani [8] reported that the damage to fruit crops is frequently high and may reach 100 percent. Hashem et al. [10] reported that infestation levels of medfly as percentages were different in on apricots (74), grapefruits (49.5), sour oranges (42.5), guavas (36.5), peaches (24), mandarins (16), baladi oranges (13.3), navel oranges (8.5), mangoes (8.6) and valencia oranges (7.5). In addition, Akyol [1] reported that the damage rates of medfly on satsuma mandarin were 10.91% in 2011 and 8.56 % in 2012. The medfly also cause significant damage on pomegranate fruits in Turkey, where the damage rates as percentages were observed on Karamehmet + Katurbaşı (37-42) and Katurbaşı (3-7) in 2010, and Katurbaşı (43.5) and Hicaz (8) in 2011[5]. In addition, Çardak [4] reported that the damage ratio of medfly on Hicaz pomegranate in 2012-2013. The highest damage rates of medfly as percentages were observed at orchard II (7.33), followed by orchard I (5.66) in 2012. The highest damage rates of medfly as percentages were observed at orchard I (10.3), followed by orchard IV (10), orchard III (6.7) and orchard II (5.7) in 2013.

## CONCLUSION

The present study was conducted by traps baited with trimedlure to determine the population density and damage ratios of medfly on pomegranate orchards in Hatay province of Turkey. As a result of two-year investigations, this pest was found in ten sites, which is located in Antakya district of Hatay province. The results also indicated that the population density of this pest was low in August, September and December, while it increased in October and

November in both years. The percentage damage of the medfly was different in each of the sampling orchard and variety. In the first year, the highest percentage of the damage was observed at orchard (II) (Hicaz) with 14 percent, while in the second year, the highest percentage of the damage was observed at orchard IV (Katırbaşı) with 25 percent.

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