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Adult population fluctuations and damage ratio of *Pandemis cerasana* (Hübner, 1786) (Lepidoptera: Tortricidae) in cherry orchards

Kiraz bahçelerinde *Pandemis cerasana* (Hübner, 1786) (Lepidoptera: Tortricidae)'nın popülasyon dalgalanması ve zarar oranı

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ABSTRACT

This study was carried out in the cherry orchards of Afyonkarahisar province in order to determine the population fluctuation of *Pandemis cerasana* (Hübner, 1786) (Lepidoptera: Tortricidae) and the damage rate in bouquets and fruits. The larvae of *P. cerasana* damage the buds, flowers, leaves and fruits of the cherry tree. In this study, adult population fluctuation of *P. cerasana* and the damage rate were determined in five different cherry orchards in Afyonkarahisar province. The first adult emergence in cherry orchards took place in the third week of May in 2007 and 2008 and the adult population peaked twice. The end of the adult flights differed according to years and cherry orchards and took place between August - October. Similarly, the damage rate of *P. cerasana* in bouquets and fruits changed according to years and cherry orchards. The damage rate in the bouquet varied between 15.40 % to 56.30% and the damage rate in the fruit varied between 2.80% to 9.80% in 2007 and the damage rate in the bouquet varied between 13.70 - 54.00% and the damage rate in the fruit ranged between 2.00% and 8.10% in 2008. According to the statistical evaluation, the difference between years was not found significant with regard to the damage rate. However, the difference between the orchards in terms of the damage rate was found significant.

INTRODUCTION

Cherry (*Prunus avium* L.) (Rosales: Rosaceae) is known as the native fruit between South Caucasus, Caspian Sea and Northeast Anatolia (Özbek 1978). Turkey is one of the origin centers of cherries and cherry cultivation is done in almost every region. Cherry is one of the fruit produced economically for domestic consumption and export. According to 2018 data, cherry production was 639.564 tons (Anonymous 2018) and 161.674 tons of total cherry production of Turkey was exported (UİB 2019).

There are harmful organisms that cause economic damage in cherry orchards. Apple leafroller *Archips rosanus* L. (Lepidoptera: Tortricidae) is generally present in cherry orchards and causes significant damage when no control

measures are taken (Anonymous 2017). In apple orchards in Erzincan province *A. rosana* was found as an intensive and determined as an important species (Canbay and Tozlu 2013). *Pandemis cerasana* (Hübner, 1786) (Lep: Tortricidae) was rarely present in cherry orchards in our country. *P. cerasana* larvae give damage by feeding on buds, flowers, leaves and fruits of the cherry tree. Larvae damage the ripened cherry fruits by gnawing and by wrapping the leaf bouquet with silky yarns secreted by the larvae inside the leaves during the harvesting period of cherry fruit. It is found in orchards, other woodland areas and many kinds of deciduous trees, especially fruit-trees (Anonymous 2019). *Betula*, *Corylus avellana*, *Fagus*, *Quercus*, *Acer*, *Ulmus*, *Salix*, *Larix*, *Pinus*, *Abies*, *Tilia*, *Rosa*, *Rhamnus*, *Sorbus*, *Prunus*, *Pyrus* and fruit trees are hosts of *P. cerasana* (Balachowsky 1966, Özdemir et al. 2005, Razowski 2001).

Its biology is very similar to the other leafroller species but it has more economic importance than the other species. Especially damage is seen during harvesting and farmers feel weak in control of *P. cerasana*. Its damage is seen on leaves and bouquets as well as the fruits and cause directly loss of yield and leads to economic losses.

In this study, population changes of *P. cerasana* adults was observed and damage rate in cherry orchards was evaluated in five cherry orchards in two different districts in Afyonkarahisar province of Central Anatolia Region where cherry is produced especially for export. In this study, it was aimed to give information about damage status of *P. cerasana* in important cherry production areas and obtained some data for timing the control of this insect.

MATERIALS AND METHODS

The main material of the research was *Pandemis cerasana* (Hübner, 1786) and the other materials were *P. cerasana* infested cherry orchards, *P. cerasana* Pherocon IC pheromone traps and various laboratory materials. Dr. Mustafa Özdemir as an expert identified *P. cerasana* adults.

This study was conducted in five cherry orchards in Sultandağı and Çay districts of Afyonkarahisar in 2007-2008. The cherry orchards were established with 0 900 Ziraat varieties and the number of trees in the orchards varied between 125-210. In the study, the adult population fluctuation of *P. cerasana* was observed by using pheromone traps and the damage rate was determined in bouquet and fruit. Pheromone traps were hung to a height of 1.5-2 m from the ground and to the prevailing wind direction. The traps were checked twice a week until the first adult was caught, they were checked every week after the first adult was captured and the number of adults trapped was recorded. The traps were monitored for another three weeks after the last adult was caught. Pheromone capsules were changed every 4-6 weeks; the sticky plates were replaced with new ones when they became dirty.

In order to determine the damage rate of *P. cerasana* in the bouquet, 100 bouquets were checked every week on the sample trees starting from April. The number of damaged bouquets recorded and the damage ratio was determined. Even if there was only one leaf infested by the larva in a bouquet, that bouquet was considered damaged. In addition, 1000 cherry fruit samples were taken randomly from different directions and heights of sample trees during the harvesting period to determine the fruit damage of *P. cerasana* and the number of damaged fruit was recorded. Percentage of damage rate was calculated on the bouquets and fruits. The counts in the bouquets and fruits were made separately in each trial orchard and the damage ratio of the cherry bouquet and fruit was calculated. The variance analysis was performed with the obtained data and was analyzed by using Tukey multiple comparison test. Statistical analyzes were performed with the help of MINITAB Release 18 (McKenzie & Goldman 2005).

RESULTS AND DISCUSSION

In 2007, pheromone traps were hung on May 1 in five different cherry orchards in Sultandağı and Çay districts of Afyonkarahisar province. Except for the second cherry orchard in Sultandağı, the first adults were caught on May 21 in both districts. Twice adult population peaks occurred in each of five orchards (Figure 1). The peak date of the *P. cerasana* population varied according to the orchards. The adult population reached its peak in the orchard I, II and IV on May 30 and August 1; in the orchard III on June 6 and July 25 in Sultandağı district; and in the orchard V on May 30 and August 8 in Çay district.

Dates of the adult flights varied according to the orchards. The adult flight ended on October 17 in the orchard I, on August 22 in the orchard II; on September 12 in the orchard III and IV and on August 29 in the orchard V. According to the results, the adult flight duration period in the first, second, third, fourth and fifth orchards in 2007 were 149, 93, 114, 114 and 100 days, respectively.

P. cerasana pheromone traps were hung in cherry orchards in Sultandağı and Çay districts of Afyonkarahisar province on May 6, 2008. In both districts, the first *P. cerasana* adults

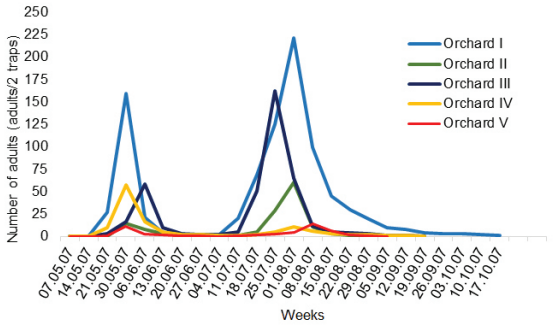

Figure 1. Adult population fluctuations of *Pandemis cerasana* (Hübner, 1786) (Lepidoptera: Tortricidae) in different cherry orchards in Sultandağı and Çay districts of Afyonkarahisar in 2007

were caught on 20 May (Figure 2). The peak of the adult population of *P. cerasana* varied according to the orchards. According to the obtained data, adult population reached its peak in the first orchard in Sultandağı and in the orchard III on May 27 and August 5, in the orchard II on May 27 and August 12. In other orchards such as orchard IV on May 20 and August 12 and in the orchard V on May 30 and August 5, the adult population reached its peak.

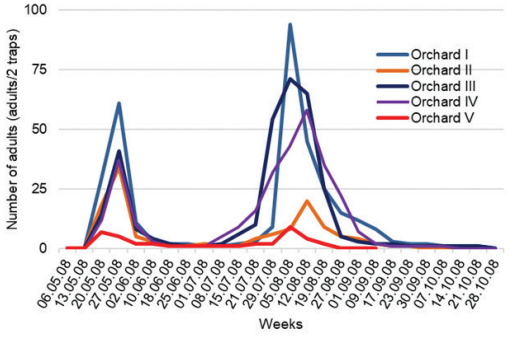

Figure 2. Adult population fluctuations of *Pandemis cerasana* (Hübner, 1786) (Lepidoptera: Tortricidae) in different cherry orchards in Sultandağı and Çay districts of Afyonkarahisar in 2008

The dates of the end of adult flights differed according to the orchards. In Sultandağı I and III orchards adult flight ended on October 21, in the orchard II on September 23, in the orchard IV on October 7 and in the orchard V on August 19. In 2008 adult flight duration in the Sultandağı I and III orchard was 154 days while it was 126, 140 and 91 days in the orchard II, IV and V respectively. The average adult flight duration of both two years was determined as 151.5 ± 2.5 (149-154) in the first orchard; 137.5 ± 11.5 (126-149) days in the orchard II; 151.5 ± 2.5 (149-154) days in the orchard III; 127 ± 12.9 (114-140) days in the orchard IV and 95.5 ± 4.5 (91-100) days in the orchard V.

According to a study conducted in 2010 in Üzümlü and Central districts of Erzincan province, *Archips rosana* has an adult flight period of 43 days and *A. podana*'s adult flight period is 118 days. This study mentions that *A. rosana*'s adult flight period is 35 days in Central district. *A. podana*'s adult flight period has been determined as 102 days. Parallel to our study, the duration of the adult flight period of leafroller species in the same group changed according to districts.

In 2007, the number of adults caught by pheromone traps varied according to the orchards (Figure 2). It can be seen from Figure 2 that the pest density in the II, IV and V orchards was lower than the other two orchards. Average number of adults caught by pheromone traps was 438 ± 13.03 (1-221); 62.5 ± 4.41 (1-60); 201.5 ± 10.05 (1-162); (1-162), 60 ± 3.26 (1-57) and 21 ± 0.79 (0-11) in the orchards I, II, III, IV and V respectively. According to these results, it is seen that the pest population was the highest in the orchard I. Orchard III, II, IV. and V. followed orchard I (Figure 2). It can be seen from the results that the density of *P. cerasana* in cherry orchards in Sultandağı district was found higher than the density in Çay district.

In 2008, the number of adults caught by pheromone traps varied according to the orchards (Figure 3). It can be seen from Figure 3, the second orchard in Sultandağı district and the third orchard had higher pest density than the other three orchards. The number of adults caught by traps in Sultandağı district was determined as 166.5 ± 5.00 (1-94); 63 ± 1.97 (1-34); 160.5 ± 4.55 (1-71) in the orchard I, II and III respectively while the district of **Çay** orchards IV. and V. were 149 ± 3.70 (1-58) and 20 ± 0.67 (1-9), respectively (Figure 3). According to Figure 3 the most intense population was seen

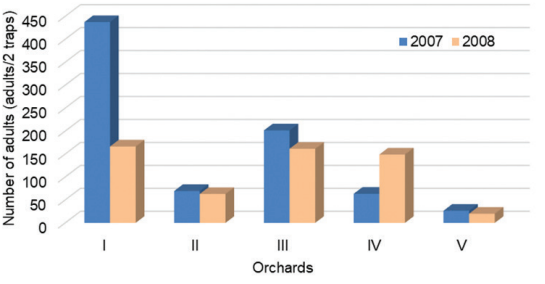

Figure 3. Adult numbers of *Pandemis cerasana* (Hübner, 1786) caught in pheromone traps in 2007-2008 cherry orchards in Sultandağı and Çay districts of Afyonkarahisar province

in the first orchard, followed by orchards III., IV., II. and V. In general, *P. cerasana* density in cherry orchards in Sultandağı district was higher than the pest density in cherry orchards in Çay district.

Damage ratio of P. cerasana

P. cerasana population that overwintered in 2007 started to feed under the actively opened buds starting from the second week of April. The larvae emerged and fed beneath the opened buds in early April. As the larva develops, it fed with the epidermis of the leaf by gluing the leaves together, and it fed with leaves, flowers and buds by tying the bouquets together with the secreted threads. It consumes a large portion of the fruits in the bouquet in the early period and feeds with fruit flesh superficially or head towards the core of the ripe or about to ripe fruits and pollutes it with secretion and excreta. *P. cerasana* damaged to leaves and fruits known as in a group of leafroller (Zangheri et al. 1992). In addition, secreted silky yarns and faeces were reported to spoil the fruit quality (LaGasa 1996). Evans (1970) stated that the pest fed with various broad-leaved trees and shrubs, but do damage to Garry oak trees (*Quercus garryana*) and cause leaf fall in North America. Doganlar (2007) stated that the young larvae of *Archips rosanus* move to opening buds and feed on both sides of new leaves. Percentage of damaged bouquets determined in the cherry orchards with the counts of the bouquet in 2007 and 2008 years. The loss percentage rate of *P. cerasana* in bouquets during the season is given in Table 1.

When Table 1 is analyzed, the damage rate in the bouquet in the first orchard was 56.30% in 2007 and 54.00% in 2008 and the difference was not statistically significant (F = 0.17; p>0.05). In 2007 the damage rate in the orchard II was 28.00, while it was 26.20 in 2008 and the difference was not statistically significant (F = 0.17; p>0.05).

In 2007, the damage rate in the orchard III was 48.80, while it was 44.90 in 2008 and the difference was not statistically significant (F = 0.45; p>0.05). In 2007, the damage rate in the orchard IV was 39.20 while it was 40.20 in 2008 and the difference was not statistically significant (F = 0.03; p>0.05). While the damage rate in the bouquet in the orchard V in 2007 was 15.40 ± 6.06, it was 13.70 in 2008 and the difference was not statistically significant (F = 0.03; p>0.05). As a result, the difference between the years in terms of the damage rate of the bouquet in the orchards was not found statistically significant between 2007-2008 years. When Table 1 is examined the rate of the damaged bouquet in 2007 was the highest (56.30%) in the orchard I. It was 48.80% in orchard III. Damage rates were 39.20% in orchard IV, 28.00% in orchard II and 15.40% in orchard V. The difference between the orchards was found to be statistically significant (F = 22.21; p<0.05).

The rate of bouquet that was damaged in 2008 was again the highest in the first orchard (54.00%). Damage rate of orchard III was 44.90% while it was 40.20% in the orchard IV and 28.00% in the orchard II and 15.40% in the orchard V. The difference between orchards was statistically significant (F= 21.70; p<0.05) (Table 1). According to the counts during harvesting, the damage rate of *P. cerasana* in the fruit varied according to the orchards. In 2007, the number of damaged fruit was 9.8% in the first orchard and followed by orchard III (6.2%). Fruit damage was 5.1% in orchard IV while it was 4.3% in orchard II and 2.8% in orchard V (Figure 4). When the Figure 4 is examined, the number of damaged fruits in 2008 was parallel to 2007. According to this, the ratio of

Table 1. Damage ratio of *Pandemis cerasana* (Hübner 1786) in different cherry orchards in Sultandağı and Çay districts of Afyonkarahisar province in 2007- 2008

Years	% Damage± SD (%95 CI)				
	Orchard I	Orchard II	Orchard III	Orchard IV	Orchard V
2007	56.30±12.49 a*A** (47.90-64.70)	28.00±9.19 aCD (21.57-34.43)	48.80±11.47 aAB (40.12-57.48)	39.20±13.76 aBC (31.21- 47.19)	15.40±6.06 aD (12.27-18.53)
2008	54.00±12.80 aA (45.60-62.40)	26.20±10.13 aC (19.77-32.63)	44.90±14.49 aAB (36.22-53.58)	40.20±10,00 aB (32.21-48.19)	13.70±2.75 aC (10.57-16.82)

* Different letters in the same column indicate statistically different from each other (Anova P<0.05. Tukey test).

** Different letters in the same line indicate statistically different from each other (Anova P<0.05. Tukey test).

damaged fruit was highest in the first orchard with 8.1%. It was followed by orchard III (5.3%), orchard IV (4.2%), orchard II (3.5%) and orchard V (2.8%). The damage rate in the bouquet and the damage rate in the fruit were parallel in the orchards. Only in 2008, orchard II and orchard V did not differ as to the damage rate in the bouquet and belonged to the same group statistically.

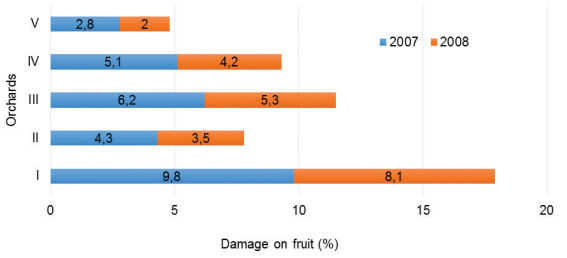

Figure 4. Fruit damage percentage rates of *Pandemis cerasana* (Hübner, 1786) in different cherry orchards in Sultandağı and Çay districts of Afyonkarahisar province in 2007-2008

Ulu and Önuçar (1999) stated that the damage rate of *Archips rosana* larvae in cherry fruits changed between 2% and 9%. Fruit damage caused by other leafroller species that is found out by various researchers was similar to our findings. In addition, Ercan and Özpınar (2014) stated that in their study in the province of Çanakkale *A. rosana* and *P. cerasana* did not do damage to cherry and apple orchards, but they found that they do damage both leaves and fruits in peach orchards. The adult flight duration and the rate of damaged bouquet and fruit in the orchards III and I were higher than the other orchards in both years. Vicinity of the both orchards was cherry orchards infected with this pest and they were the source of infection. In the orchard V, where the least damage was seen, the adult flight duration was realized in a short period in both years and damage rates were lower in this orchard. It is thought that being located in an isolated area, the population level and damage rate of this pest was low in orchard V.

P. cerasana caused significant damage in cherry bouquets and fruits due to population density in cherry orchards, which are important source of income in our country. Uncontrolled spraying against *P. cerasana* can result in residual risk on the fruit. Adult population density can be decreased by using alternative control methods such as cultural and biotechnical methods in this pest control and thus the loss of yield rate can be reduced. According to the data obtained from this study, it is thought that it is important to take necessary measures in these areas by monitoring the orchards, which prevent the increase of the pest population by taking precautions in time. In cherry orchards destruction of infected fruits at harvest as a cultural control method is important in terms of decreasing pest population.

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ÖZET

Bu çalışma Afyonkarahisar ili kiraz bahçelerinde *Pandemis cerasana* (Hübner, 1786) (Lepidoptera: Tortricidae)'nın popülasyon dalgalanması ile buket ve meyvelerindeki zarar oranını belirlemek amacıyla yapılmıştır. *P. cerasana*'nın larvaları kiraz ağacının tomurcuk, çiçek, yaprak ve meyvelerinde zarar yapmaktadır. Bu çalışmada, Afyonkarahisar ilinde beş farklı kiraz bahçesinde *P cerasana*'nın ergin popülasyon dalgalanması izlenmiş ve zarar oranı belirlenmiştir. Kiraz bahçelerinde ilk erginler her iki yılda da mayıs ayının üçüncü haftasında gerçekleşmiş ve ergin popülasyonu iki kez zirveye ulaşmıştır. Ergin uçuşlarının sona ermesi yıllara ve kiraz bahçelerine göre değişmiş olup, ergin uçuşları ağustos - ekim ayları arasında gerçekleşmiştir. *P. cerasana*'nın buketlerde ve meyvelerdeki zarar oranı yıllara ve kiraz bahçelerine göre değişmiştir. 2007 yılında buketteki zarar oranı %15.40 ile %56.30 arasında değişirken meyvedeki zarar oranı %2.80-%9.8 arasında değişmiştir. 2008 yılında buketdeki zarar oranının %13.70 -%54.00 arasında değişirken meyvede zarar oranı %2.00-%8.10 arasında değişmiştir. Yapılan istatistiki değerlendirme sonucunda zarar oranı bakımından yıllar arasındaki fark anlamlı bulunmamıştır. Bununla birlikte, meyve bahçeleri arasındaki zarar oranı arasındaki fark anlamlı bulunmuştur.

Anahtar kelimeler: *Pandemis cerasana*, kiraz, popülasyon dalgalanması, zarar oranı

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