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Adult emergence course of *Kermania pistaciella* Amsel (Lepidoptera:Tineidae) in Culture Cages and Population Change on Pheromone Traps at Three Different Altitudes of Gaziantep

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ABSTRACT

Pistachio twig borer moth [*Kermania pistaciella* Ams. (Lep: Tineidae)] is the economically damaging species where pistachio is grown. As a result of the feeding of the larvae of the pest, the fruit buds fall off, the damaged shoots remain short. During the fruit formation period, the larvae enter the clusters and feed on the cluster stems, so the fruits fail to develop or fall off. With this work, adult emergence of *K. pistaciella* in culture cages and pheromone traps placed at three different altitudes (705 m, 531 m and 856 m) between 2015 and 2017 has been followed. Between 2015 and 2017, population monitoring in pheromone traps started on average between the last week of March and the first week of April in all locations, peaked in the third week of April, and ended between the last week of April and the last week of May. Adult emergence in culture cages in all locations in 2015 and 2017 started in the second week of April on average, and in the last week of March in all locations in 2016. Adult emergence peaked in the third week of April in all locations between 2015 and 2017 and ended between the last week of April and the first week of May. This work is the first study in which population follow-up of pistachio twig borer in pheromone traps and culture cages was carried out together.

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Population dynamics

Antepfıstığı Dalgüvesi *Kermania pistaciella* Amsel (Lepidoptera:Tinediae) 'nın Gaziantep İlinde Üç Farklı Rakımda Kültür Kafeslerinde Ergin Çıkış Seyri ve Feromon Tuzaklardaki Popülasyon Değişimi

ÖZET

Antepfıstığı dalgüvesi [*Kermania pistaciella* Ams. (Lep: Tineidae)] antepfıstığının yetiştirildiği alanlarda ekonomik anlamda zarar yapan türler arasındadır. Zararlının larvalarının beslenmesi sonucu meyve gözleri dökülmekte, zarar gören ve sürgünler kısa kalmaktadır. Meyve oluştuğu dönemde ise salkımlardan içeri giren larvalar salkım saplarında beslenmekte, bu nedenle meyveler gelişememekte veya dökülmektedir. Bu çalışma ile; 2015-2017 yılları arasında üç farklı rakımda (705 m, 531 m ve 856 m) yerleştirilen kültür kafeslerinde ve feromon tuzaklarda antepfıstığı dalgüvesi (*K. pistaciella*) 'nın ergin çıkış seyri takip edilmiştir. 2015-2017 yılları arasında feromon tuzaklardaki popülasyon takibi bütün lokasyonlarda ortalama Mart ayının son haftası ile Nisan ayının ilk haftası arasında başlamış, Nisan ayının üçüncü haftası pik yapmış ve Nisan ayının son haftası ile Mayıs ayının son haftası arasında sona ermiştir. 2015 ve 2017 yıllarında tüm lokasyonlarda kültür kafeslerinde ergin çıkışları ortalama Nisan ayının ikinci haftasında, 2016 yılında ise farklı olarak bütün lokasyonlarda Mart ayının son haftasında başlamıştır. Ergin çıkışları 2015-2017 yılları arasında bütün lokasyonlarda Nisan ayının üçüncü haftasından itibaren pik yapmış ve Nisan ayının son haftası ile Mayıs ayının ilk haftası arasında sona ermiştir. Bu çalışma; Antepfıstığı dalgüvesinin feromon tuzak ve kültür kafeslerinde popülasyon takibinin birlikte yapıldığı ilk çalışma özelliğini taşımaktadır.

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Anahtar Kelimeler
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INTRODUCTION

Pistachio fruit, which has been cultivated by the people of the Southeastern Anatolia region since ancient times, provides a significant economic contribution to the producers of the region by increasing the quality and taste of every food item it is used with, together with the richness of protein, antioxidants, aroma, vitamins and minerals it contains. In addition, in this region, pistachio cultivation is a great gain for both the country and the farmer's economy in lands with limited irrigation water, low rainfall (300-500 mm) and which cannot be used economically by many cultivated plants (Eldoğan and Şahin,2015). Pistachio production provides the people living in the region with the opportunity to earn a living and additional income (Arpacı, 2010).

The world's major pistachio producing countries were examined between 2020 and 2023, and it was seen that the USA ranked first with 433,521 tons of production (USDA 2024), Turkey ranked second with 207,755 tons of production (TUİK 2024), and Iran ranked third with 162,500 tons (IPA 2024).There are 4.087.086 da pistachio production is carried out in the area of Türkiye (TUIK 2024c). The majority of pistachio production is obtained from the provinces in the Southeastern Anatolia and Eastern Anatolia regions. Among the provinces in Southeastern Anatolia, where pistachios are grown intensively in Turkey, the number of fruit bearing pistachio trees is 18.681.133 in Gaziantep, 22.446.288 in Şanlıurfa, 5.129.726 in Adıyaman, 943.400 and 7.285.643 in Kahramanmaraş and Siirt, respectively (TUIK, 2024a). Moreover, as of 2022, there are 25.469.721 pistachio trees that have not yet produced fruit (TUIK 2024b), and with the increase in new pistachio plantations, it is expected that fruit yield and economic gain will increase in the future.

In pistachios, which make a significant contribution to the country's economy, there are different types of insects that damage both the crop produced in the same year and the crop of the next year (Karagöz). At the same time, they reduce the yield and quality of the product. Özer (1958) in the wild pistachio fields of Balıkesir and Kütahya provinces, Ulu et al. (1972) in the Aegean Region, Çelik (1975) in Gaziantep; Günaydın (1978), Bolu, (2002) found more than 40 pest and mite species in their studies on pistachio fields in the Southeastern Anatolia Region.

Among these important pests, pistachio moth is concentrated in Gaziantep, Şanlıurfa and Siirt; it has been determined by preliminary studies that fruit clusters and leaves fall as a result of feeding the larvae in the shoot, and that the larvae in the clusters cause damage to the cluster stems, leaving the fruits small and at the same time causing losses such as fruit drop (Şahan and Tunaz 2021).

Mehrnejad (2001, 2003), Van Achterberg and Mehrnejad (2002), Emami et al., (2004), Bassirat (2005), Manickavasagam et al., (2008), Abbaszadeh et al. (2006, 2011), Tezerji, (2011), Izadi et al. (2011) Arbabtafti et al. (2012), Gries et al. (2006, 2007), Mollaei et al. (2017) conducted various studies on the biology, development threshold, damage threshold, population dynamics, some morphological features, parasitoids and control of *K. pistaciella*. In Türkiye, Küçükarslan (1966), Bolu (2002), Mart et al. (1995), Yanık and Yücel (2001), Özgen et al. (2012), Şimşek and Bolu (2016), Yanık and Yıldırım (2016) obtained important data on some biological and morphological characteristics, population dynamics, parasitoids and control of *K. pistaciella*.

In this study, which was carried out to prepare the groundwork for studies on controlling pistachio twig borer (*K. pistaciella*), the pest was monitored both in culture cages and pheromone traps at three different altitudes of Gaziantep which were Alahacı (705 m) and Yağmuralan locations (531 m) in Nizip district and Institute orchard (856 m) in Şahinbey district.

MATERIAL and METHOD

The main material of the study, Pistachio orchards infested with pests in Gaziantep (Nizip district Alahacı and Yağmuralan locations and Şahinbey district Pistachio Research Institute Directorate orchard) one-year pistachio shoots obtained from these orchards, adults and pupae of the pest were formed. Stereo binocular microscope (Leica EZ4D brand), forceps, scalpel, mouth aspirator, ethyl acetate, 70% ethyl alcohol, insect needles (000 and 2 size), camera, vineyard scissors, petri dishes (9x1cm), ice bowl, culture cages with wooden frames and insect net (70x70x100 cm), eppendorf tubes, culture dishes, soft-tipped brushes (number 00, 0, 1, 2 and 3), transparent polyethylene bags, paper bags, plastic jars, culture containers and other laboratory materials, delta type pheromone trap [(2S,12Z)-2-Acetoxy-heptadecene] and climate data logger (Hobo and Metos brand) were used as materials. Additionally, data such as the highest-lowest temperature values and the daily average humidity values were used.

Sampling Method:

Two delta type sexual attractive traps were hung in the orchards of Şahinbey location and Yağmuralan and Alahacı locations of Nizip District selected for the experiment in mid-March between 2015 and 2017 and were checked twice a week. Sexual attractive traps were hung at a height of 1–1.5 m from the ground and in the prevailing wind direction to represent the orchard. The traps were counted daily in the parcel located in the orchard of the Institute Şahinbey location after the first butterfly was caught, and once a week in Alahacı (705 m) and Yağmuralan locations (531 m), and the numbers of the caught butterflies were recorded and removed from the traps. Trap capsules were changed every 4 weeks in line with the company's recommendation, and the sticky tray was changed when it became dirty.

In order to monitor the adult emergence of the pest from the culture cages, two culture cages were left at the same locations at the end of February in the same years. One or two-year-old shoots on which pupae were detected, collected in February-March, were placed in each of the cages. In the study, 100 shoots with pupae were placed in the culture cages in all locations in 2015. However, since the number of adults collected from the experimental area in Şahinbey location in 2015 was found insufficient to be used in other studies, 600 shoots with pupae were placed in cages in Şahinbey location and 100 shoots with pupae were placed in cages in Yağmuralan and Alahacı locations in 2016 and 2017.

RESULTS

Adult population changes of *Kermania pistaciella* in pheromone traps at different altitudes

Adult population changes of *Kermania pistaciella* in pheromone traps and culture cages in Şahinbey Location of Gaziantep Province.

In order to monitor the adult population change, pheromone traps were set up in the orchard of the Institute in Şahinbey location of Gaziantep province.

The adult emergence course of *K. pistaciella* in pheromone traps between 2015 and 2017 at the location Şahinbey is given in Figure 1. According to Figure 1. In 2015, the adult emergence in the orchard in Şahinbey location started on 17 April, reached the highest number on 28 April, and ended on 9 May. The adult emergence took 22 days. When the temperature values started to reach a minimum of 18 ºC, a maximum of 22 ºC and the average proportional humidity value was about 36%, the first adult emergences were seen. The highest temperature was 26ºC, the lowest temperature was 19ºC, and the daily average proportional humidity was around 42% at the time when the adult emergence reached its highest level. In 2016, as can be seen from the examination of Figure 1.B. the adult emergence in pheromone traps started on April 4, reached the highest number on April 16, and ended on April 26. The adult emergence took 22 days in traps. When the temperature values started to reach a minimum of 16 ºC, a maximum of 22 ºC and the average proportional humidity value was about 20%, the first adult emergences were seen. The highest temperature was measured at 25 ºC, the lowest temperature was 19 ºC and the daily average proportional humidity was around 25% at the time when the adult emergence reached its highest level. When Figure 1.C. of 2017 is examined, the adult emergence in the orchard in Şahinbey location started on 18 April in pheromone traps, reached the highest number on 29 April and ended on 12 May. The adult emergence took 24 days in traps. When the temperature values started to reach a minimum of 7 ºC, a maximum of 20 ºC and the average proportional humidity value was about 64%, the first adult emergences were seen. The highest temperature was 29 ºC, the lowest temperature was 10 ºC and the daily average proportional humidity was around 38% on the date when the adult emergence reached its highest level.

Adult population change of *Kermania pistaciella* in pheromone traps in Gaziantep Province Nizip District Yağmuralan Location

In order to monitor the adult population change, pheromone traps were set up in the farmer's orchard in the Yağmuralan location of the Nizip District of Gaziantep.

The data of the study in which the adult emergence course of *K. pistaciella* in pheromone traps was determined between the years 2015-2017 in the farmer's orchard of Gaziantep province Nizip district Yağmuralan location are given in Figure 2 A.B.C. According to Figure 2.A, in 2015, the adult emergence in the orchard in Yağmuralan location started on 7 April, reached the highest number on 28 April and ended on 12 May. The adult emergence took 35 days. When the temperature values started to reach a minimum of 8 ºC, a maximum of 25 ºC and an average proportional humidity was about 53%, the first adult emergences were observed. The highest temperature was 31ºC, the lowest temperature was 11ºC, and the daily average proportional humidity was around 38% at the time when the adult emergence reached its highest level. In 2016, as can be seen from the examination of Figure 2.B, the adult emergence in pheromone traps started on March 23, reached the highest number on April 12, and

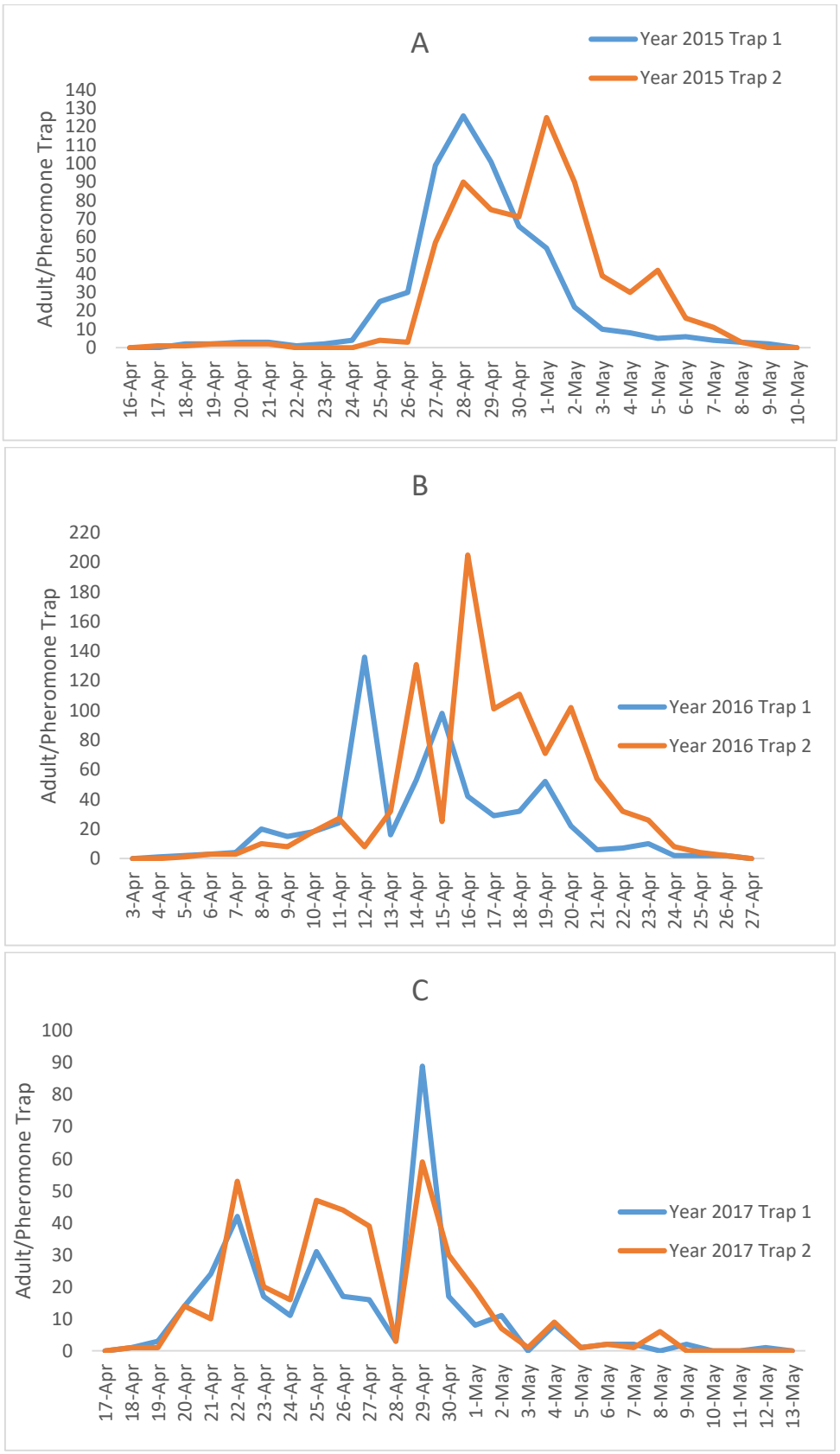


Figure 1. Population change of *Kermania pistaciella* in pheromone traps in Gaziantep Şahinbey Pistachio Research Institute Directorate orchard in 2015 (A), 2016 (B) and 2017 (C)

Şekil 1. Kermania pistaciella'nın Gaziantep Şahinbey antepfıstığı Araştırma Enstitü Müdürlüğü bahçesindeki feromon tuzaklarda 2015 (A), 2016 (B) ve 2017 (C) yılı populasyon değişimi

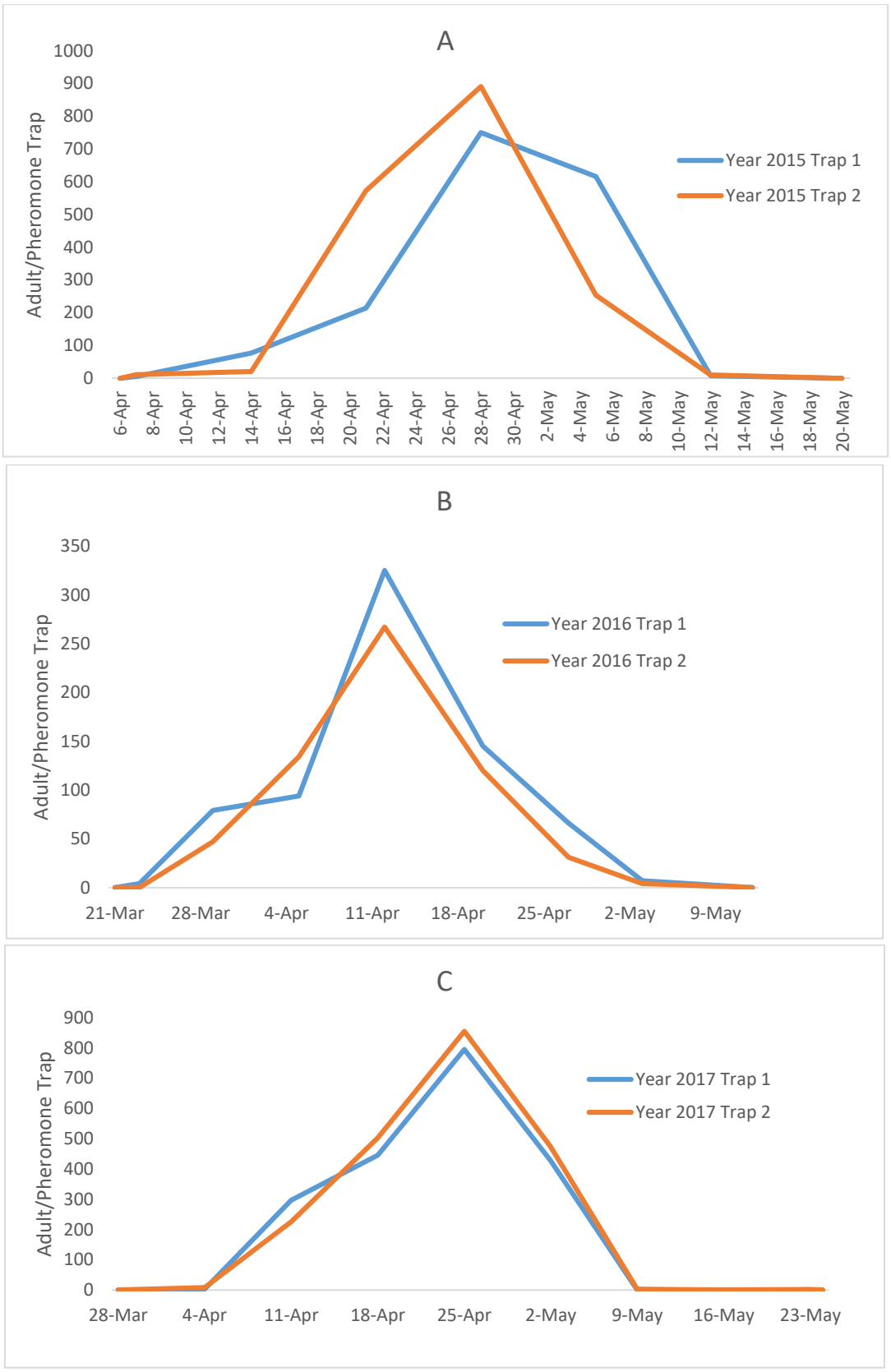


Figure 2. Population change of *Kermania pistaciella* in 2015 (A), 2016 (B) and 2017 (C) years in the farmer's orchard in Gaziantep Nizip district Yağmuralan location

Şekil 2. Kermania pistaciella'nın Gaziantep Nizip ilçesi Yağmuralan lokasyonu çiftçi bahçesindeki 2015 (A), 2016 (B) ve 2017 (C) yılı populasyon değişimi

ended on May 3. The adult emergence took 42 days in traps. When the temperature values started to reach a minimum of 9 ºC, a maximum of 22 ºC and the average proportional humidity value was around 43%, the first adult emergences were seen. The highest temperature was 18 ºC, the lowest temperature was 10 ºC and the daily average proportional humidity was about 64% on the date when the adult emergence reached its highest level.

When Figure 2.C of 2017 is examined, it is seen that the adult emergence in the orchard in Yağmuralan location started on 4 April in pheromone traps, reached the highest number on 25 April and ended on 23 May. Adult emergence took 50 days in traps. When the temperature values started to reach a minimum of 13 ºC, a maximum of 16 ºC and the average proportional humidity value was about 83%, the first adult emergences were seen. The highest temperature was 23 ºC, the lowest temperature was 12 ºC and the daily average proportional humidity was around 25% at the time when the adult emergence reached its highest level.

Adult population change of *Kermania pistaciella* in pheromone traps in Gaziantep Province Nizip District Alahacı Location.

In order to monitor the adult population change, pheromone traps were set up in the farmer's orchard in the Alahacı location of Nizip District of Gaziantep.

The data of the study in which the adult emergence course of *K. pistaciella* in pheromone traps was determined between 2015-2017 in the farmer's orchard of Alahacı location. According to Figure 3.A, in 2015, the adult emergence in the orchard in Alahacı location started on 7 April, reached the highest number on 28 April and ended on 28 May. The adult emergence lasted 51 days. When the temperature values started to reach a minimum of 11 ºC, a maximum of 22 ºC and the average proportional humidity value was around 55%, the first adult emergences were seen. The highest temperature was 26 ºC, the lowest temperature was 14 ºC and the daily average proportional humidity was around 39% on the date when the adult emergence reached its highest level. In 2016, as can be seen from the examination of Figure 3.B, the first adult emergence started on March 24, reached the highest number on April 20 and ended on May 12. The adult emergence lasted 50 days. When the temperature values started to reach a minimum of 9ºC, a maximum of 22ºC and the average proportional humidity value was about 47%, the first adult emergences were seen. The highest temperature was 19 ºC, the lowest temperature was 11 ºC and the daily average proportional humidity was around 63% on the date when the adult emergence reached its highest level. When Figure 3.C of 2017 is examined, the adult emergence in the orchard in Alahacı location started on 3 April in pheromone traps, reached the highest number on 19 April and ended on 24 May. Adult emergence took 51 days in traps. When the temperature values reached a minimum of 10 ºC, a maximum of 18 ºC, and the average proportional humidity value was around 39%, the first adult emergences were seen. The highest temperature was 20 ºC, the lowest temperature was 11 ºC and the daily average proportional humidity was around 80% on the date when the adult emergence reached its highest level.

Adult population variation of *Kermania pistaciella* in culture cages at different altitudes

From the areas where the experiment was established, two culture cages were placed in the orchard in the Şahinbey District of Gaziantep and the Yağmuralan and Alahacı neighborhoods of the Nizip District, and the population of the pest was monitored at three different altitudes between 2015 and 2017.

Adult population change of *Kermania pistaciella* in culture cages in Şahinbey District of Gaziantep Province

In order to monitor the adult population change, two culture cages were placed in the Institute orchard in Şahinbey District of Gaziantep province. In order to monitor adult emergence, shoots with pupae over 100 in 2015 and 600 each in 2016 and 2017 due to insufficient number of adults to be used in other studies were placed in culture cages.

The adult emergence course of *K. pistaciella* in culture cages between 2015-2017 at the Şahinbey location is given in Figure 4.A.B.. According to Figure 4.A, in 2015, the adult emergence in culture cages in the orchard in Şahinbey location started on April 27, reached the highest number on April 29 and ended on May 7. The adult emergence took 10 days. When the temperature values started to reach a minimum of 15 ºC, a maximum of 22 ºC and the average proportional humidity value was around 46%, the first adult emergences were seen. The highest temperature was 27 ºC, the lowest temperature was 21 ºC and the daily average proportional humidity was around 36% on the date when the adult emergence reached its highest level. In 2016, as can be seen from the examination of Figure 4.B., the adult emergence in the culture cages started on 25 March, reached the highest number on 15 April and ended on 25 April. Adult emergence took 22 days in culture cages. When the temperature values started to reach a minimum of 12 ºC, a maximum of 14 ºC and the average proportional humidity value was around 52%, the first adult emergences were seen in the culture cages. The highest temperature was 19 ºC, the lowest temperature was 18 ºC and the daily average proportional humidity was around 52% when the adult emergence reached the highest level in the culture cages. When Figure 4.C. of 2017 is examined, the adult emergence in the orchard in Şahinbey location started on 18 April in the culture cages, reached the highest number on 22 April and

ended on 9 May. The adult emergence took 22 days in culture cages. When the temperature values started to reach a minimum of 7 ºC, a maximum of 20 ºC and an average proportional humidity was around 63%, the first adult emergences were observed. The highest temperature was 26 ºC, the lowest temperature was 10 ºC and the daily average proportional humidity was around 40% at the time when the adult emergence reached its highest level.

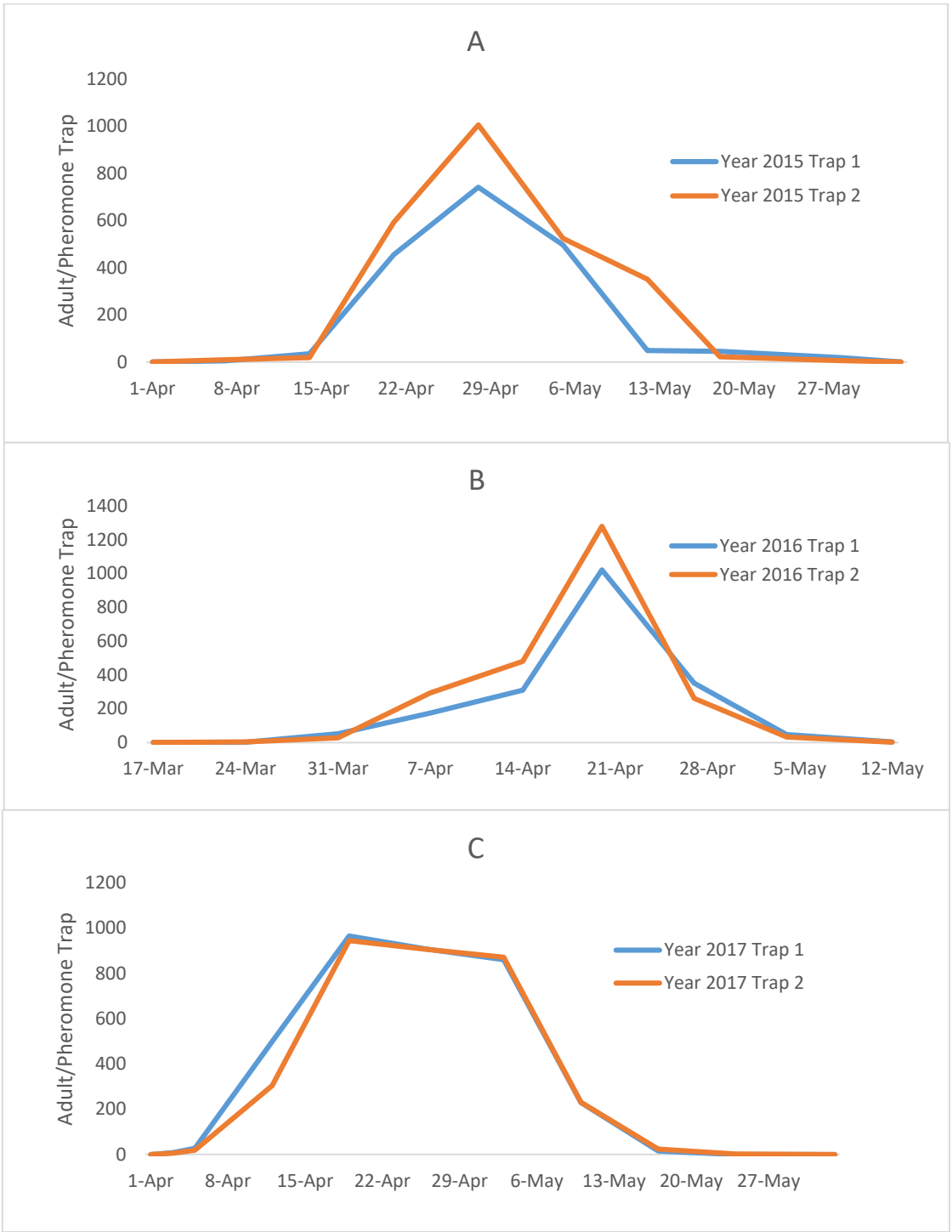


Figure 3. Population change of *Kermania pistaciella* in the farmer's orchard in Gaziantep Nizip district Alahacı location in 2015 (A), 2016 (B) and 2017 (C) years

Şekil 3. Kermania pistaciella'nın Gaziantep Nizip ilçesi Alahacı lokasyonu çiftçi bahçesindeki 2015 (A), 2016 (B) ve 2017 (C) yılı populasyon değişimi

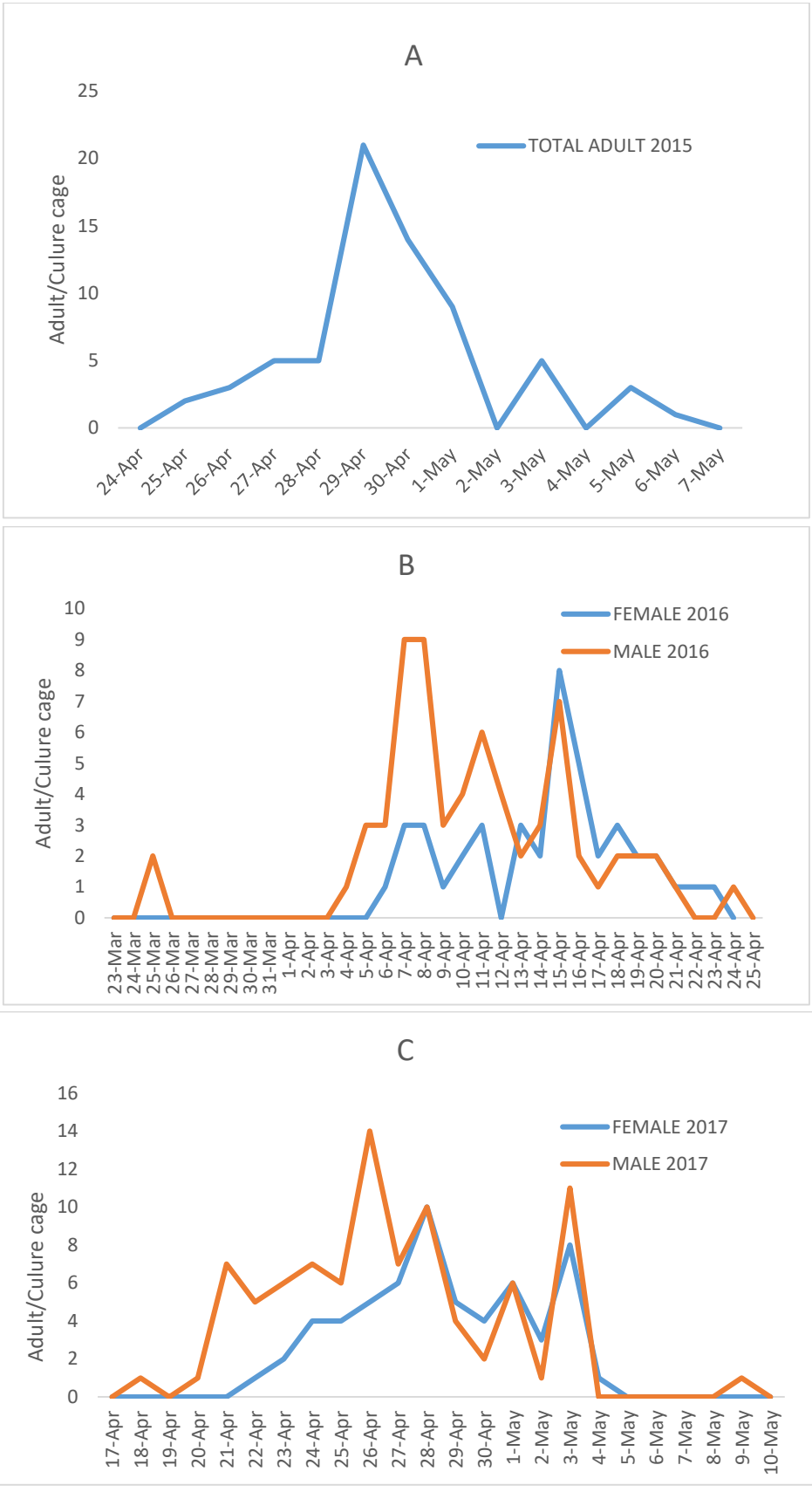


Figure 4. Population change of *Kermania pistaciella* in culture cages in the orchard of Gaziantep Şahinbey Pistachio Research Institute Directorate in 2015 (A), 2016 (B) and 2017 (C)

Şekil 4. Kermania pistaciella 'nın Gaziantep Şahinbey Antepfıstığı Araştırma Enstitü Müdürlüğü bahçesindeki 2015 (A), 2016 (B) ve 2017 (C) yılı kültür kafeslerinde ergin populasyon değişimi

Adult population change of *Kermania pistaciella* in culture cages in Gaziantep Province Nizip District Yağmuralan Location

In order to monitor the adult population change, two culture cages were placed in the farmer's orchard in Yağmuralan location. In order to monitor the adult emergence, shoots with more than 100 pupae were placed in culture cages between 2015 and 2017.

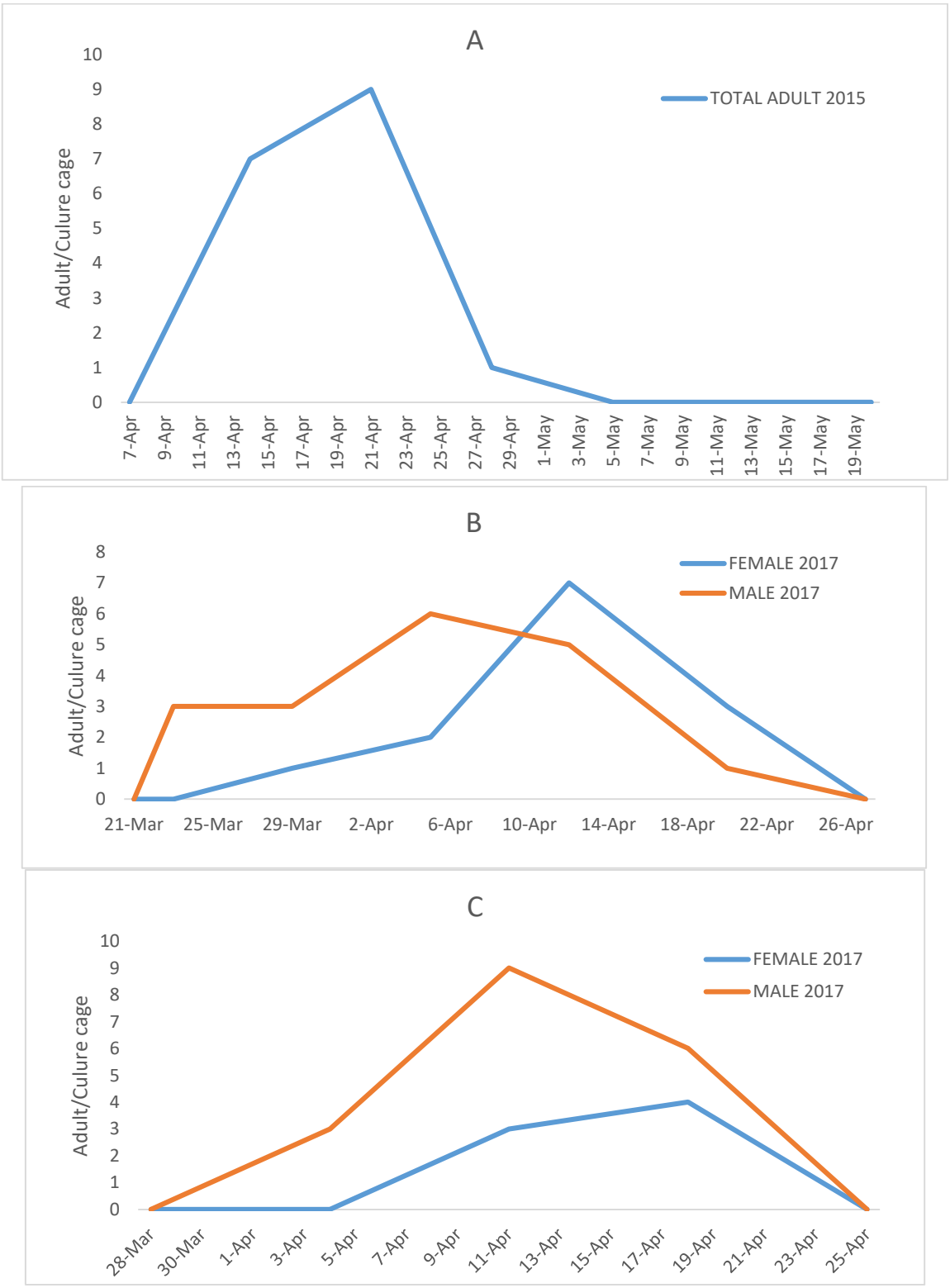


Figure 5. Adult population change of *Kermania pistaciella* in 2015 (A), 2016 (B) and 2017 (C) culture cages in Gaziantep Province Nizip District Yagmuralan neighborhood farmer's orchard

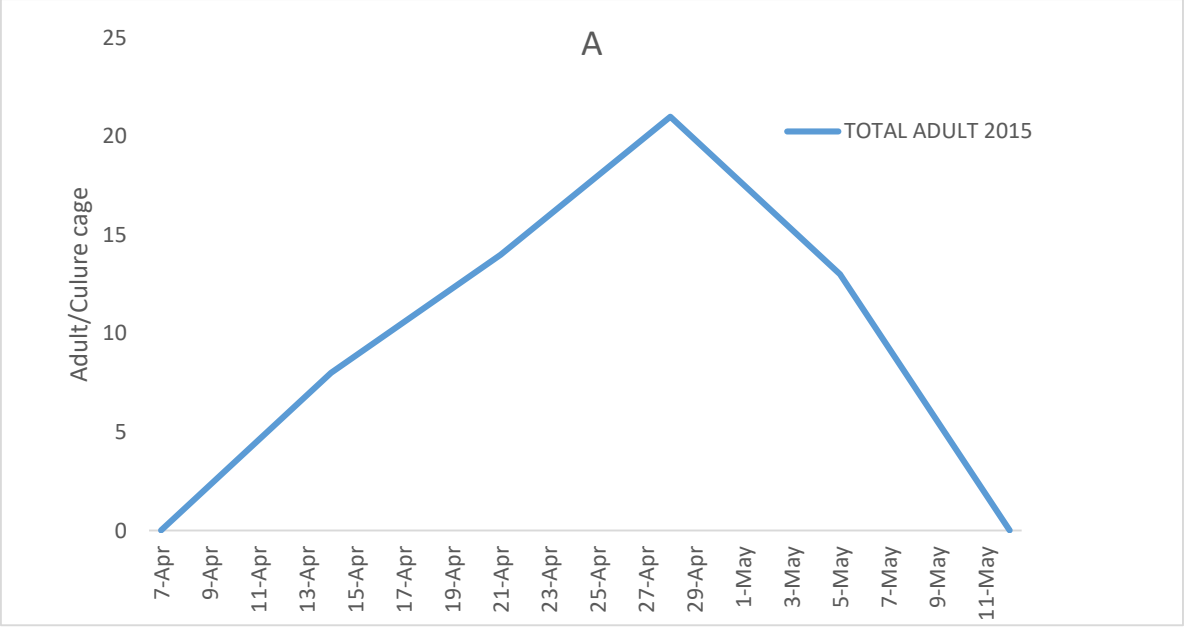
Şekil 5. Kermania pistaciella'nın Gaziantep İli Nizip İlçesi Yağmuralan lokasyonu çiftçi bahçesindeki 2015 (A), 2016 (B) ve 2017 (C) yılı kültür kafeslerinde ergin populasyon değişimi

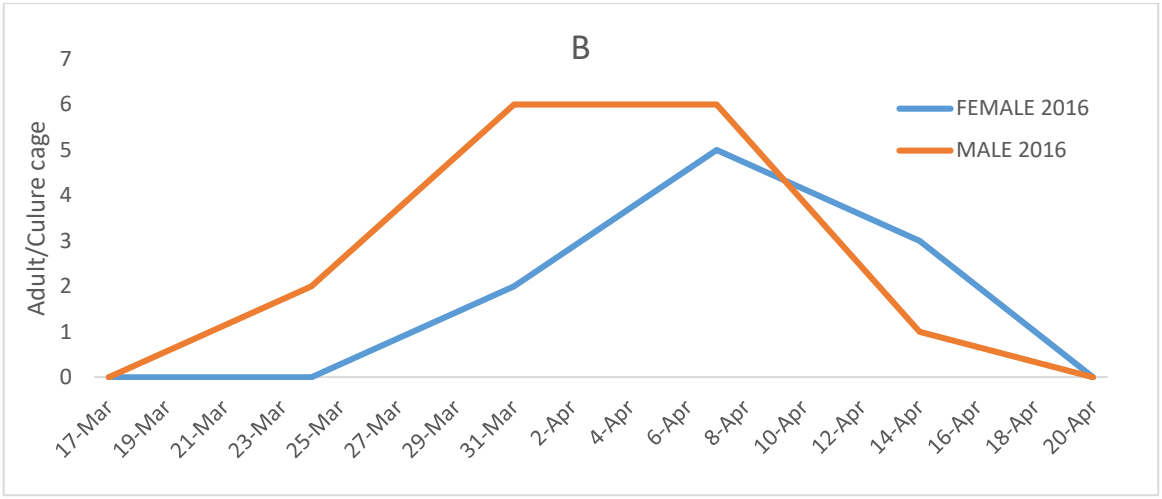
According to Figure 5.A., in 2015, the adult emergence in culture cages in the orchard in Yağmuralan location started on 14 April, reached the highest number on 21 April and ended on 28 April. The adult emergence took 14 days in culture cages. When the temperature values started to reach a minimum of 5 ºC, a maximum of 19 ºC and the average proportional humidity value was around 46%, the first adult emergences were seen. The highest temperature was 23 ºC, the lowest temperature was 7 ºC and the daily average proportional humidity was around 59% on the date when the adult emergence reached its highest level. In 2016, as can be seen from the examination of Figure 5.B., the adult emergence in the culture cages started on March 23, reached the highest number on April 12 and ended on April 20. The adult emergence took 27 days in culture cages. When the temperature values reached a minimum of 9 ºC, a maximum of 22 ºC, and the average proportional humidity value was around 56%, the first adult emergences were seen in the culture cages. At the time when the adult emergence reached the highest level in the culture cages, the highest temperature was 18 ºC, the lowest temperature was 10 ºC, and the daily average proportional humidity was around 64%. When Figure 5.C of 2017 is examined, the adult emergence in the same orchard started on April 4 in the culture cages, reached the highest number on April 11 and ended on April 25. Adult emergence took 21 days in culture cages. When the temperature values started to reach a minimum of 10 ºC, a maximum of 22 ºC and the average proportional humidity value was around 46%, the first adult emergences were seen. The highest temperature was 18 ºC, the lowest temperature was 8 ºC and the daily average proportional humidity was around 41% on the date when the adult emergence reached its highest level.

Adult population change of *Kermania pistaciella* in culture cages in Gaziantep Province Nizip District Alahacı Location

In order to monitor the adult population change, two culture cages were placed in the farmer's orchard in Nizip District of Gaziantep province. In order to monitor the adult emergence, shoots with more than 100 pupae were placed in culture cages between 2015 and 2017.

The adult emergence course of *K. pistaciella* in culture cages between 2015-2017 at the Alahacı location was shown in figure 6. According to figure 6.A., in 2015, adult emergence in the culture cages in the farmer's orchard in Alahacı location started on 14 April, reached the highest number on 28 April, and ended on 12 May. Adult emergence took 28 days in culture cages. When the temperature values start to reach a minimum of 7 ºC, a maximum of 16 ºC and the average proportional humidity value of around 44%, the first adult emergences were seen. The highest temperature was 26 ºC, the lowest temperature was 14 ºC and the daily average proportional humidity was around 39% on the date when the adult emergence reached its highest level. In 2016, as can be seen from the examination of Figure 6.B., the adult emergence in the culture cages started on March 24, reached the highest number on April 7 and ended on April 20. Adult emergence took 26 days in culture cages. When the temperature values started to reach a minimum of 9 ºC, a maximum of 23 ºC and the average proportional humidity value of around 47%, the first adult emergences were seen in the culture cages. The highest temperature was measured at 26 ºC, the lowest temperature was 15 ºC and the daily average proportional humidity was around 39% at the time when the adult emergence reached the highest level in the culture cages. When Figure 6.C. of 2017 is examined, the adult





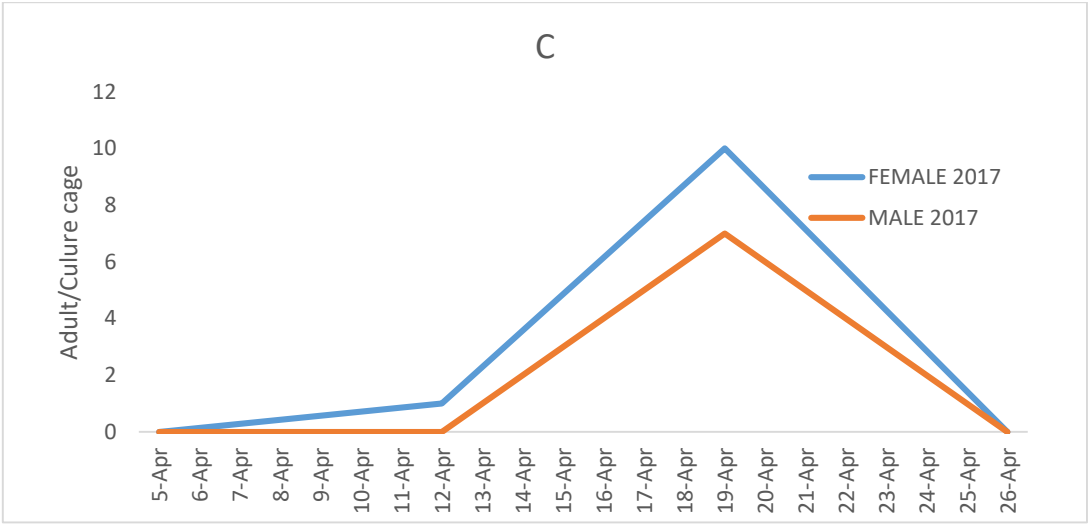


Figure 6. Adult population change of *Kermania pistaciella* in 2015 (A), 2016 (B) and 2017 (C) culture cages in Gaziantep Province Nizip District Alahacı location farmer's orchard

Şekil 6. Kermania pistaciella'nın Gaziantep İli Nizip İlçesi Alahacı lokasyonu çiftçi bahçesindeki 2015 (A), 2016 (B) ve 2017 (C) yılı kültür kafeslerinde ergin populasyon değişimi

emergence in the same orchard started on 12 April in the culture cages, reached the highest number on 19 April and ended on 26 April. Adult emergence took 26 days in culture cages. When the temperature values start to reach a minimum of 9 ºC, a maximum of 18 ºC and the average proportional humidity value of around 50%, the first adult emergences were seen. The highest temperature was 20 ºC, the lowest temperature was 11 ºC and the daily average proportional humidity was around 80% on the date when the adult emergence reached its highest level.

DISCUSSION

Küçükarslan (1966) states that *K. pistaciella* gives offspring once a year and its butterflies fly in a month between mid-April and mid-May.

Table 1 Date of first adult observation and adult emergence time in pheromone traps in three different locations

Çizelge 1. Üç farklı lokasyonda feromon tuzaklarda ilk ergin görüldüğü tarih ve ergin çıkış süresi

Pheromone Traps	First Adult Monitoring Date/Adult Monitoring Time		
Location-Altitude	2015	2016	2017
Yağmuralan (531 m)	7 April 35 days	23 March 42 days	4 April 50 days
Alahacı (705 m)	7 April 51 days	24 March 50 days	3 April 51 days
Şahinbey (856 m)	17 April 20 days	4 April 33 days	18 April 26 days

Adult emergence of *K. pistaciella* in pheromone traps in Şahinbey district of Gaziantep province between 2015-2017 started between April 4-17, reached the highest number on April 16-29 and ended between April 26 and May 12. Adult emergence lasted between 20-33 days. Also, Zamani et al. (2012) reported that the first adults to be caught, the peak and the last adult to be caught by pheromone traps of *K. pistaciella* in pistachio orchards in the Isfahan region of Iran were on 8 April, 28 April and 19 May, respectively. Similarly, Mart et al. (2003) reported that the first adult was caught on 12 April in the pheromone trap in Gaziantep Center in 2001, it reached its peak on 23 April, and no adults were caught after 15 May.

Adult emergence of *K. pistaciella* in pheromone traps in Gaziantep province Nizip district Yağmuralan location, between 2015-2017, started between 23 March-7 April, reached the highest number on 12-28 April and ended between 3-23 May. Adult emergence lasted between 35-50 days.

Adult emergence of *K. pistaciella* in pheromone traps in Gaziantep province Nizip district Alahacı location, between 2015-2017, started between 24 March-7 April, reached the highest number on 19-28 April, and ended between 12-28 May. Adult emergence lasted an average of 50 days. Similarly, Abbaszadeh et al. (2006), conducted in five different geographical regions of Iran, determined the emergence, peak and last adult capture dates of the adults of *K. pistaciella* as 18 April, 20 April and the second half of May, respectively.

Table 2 Date of first adult observation and adult emergence time in culture cages at three different locations
Çizelge 2. Üç farklı lokasyonda kültür kafeslerinde ilk ergin görüldüğü tarih ve ergin çıkış süresi

Culture Cages	First Adult Monitoring Date/Adult Monitoring Time		
Location-Altitude	2015	2016	2017
Yağmuralan (531 m)	14 April 14 days	23 March 27 days	11 April 21 days
Alahacı (705 m)	21 April 28 days	24 March 26 days	12 April 26 days
Şahinbey (856 m)	25 April 10 days	25 March 22 days	18 April 22 days

For pheromone traps and culture cages, the shortest adult emergence time occurred in the Şahinbey location, which is at the highest altitude. The longest emergence time was observed in the Alahacı location, while the emergence time in the Yağmuralan location, which has a similar altitude, is similar to Alahacı. The shortest adult emergence time occurred in the highest altitude. However, the slowest adult emergence time was observed in the Alahacı location. These data refute the hypothesis that adult emergence time will increase as altitude decreases.

Mart et al. (1995) reported that the first adult of *K. pistaciella* pupae collected in Gaziantep province in 1992 emerged on 24 April. In this study, adult emergence of *K. pistaciella* in culture cages in Şahinbey district of Gaziantep province between 2015-2017 started between 18-25 April, reached the highest number on 15-29 April and ended between 25 April and 9 May. Adult emergence lasted between 10-22 days. Mart et al. (2003), again in Gaziantep Merkez, Oğuzeli and Nizip districts, stated that the first adults of *K. pistaciella* emerged on 17-18 April in culture cages in 2000, reached the peak of the population on 24-27 April, and that the adult emergence started from 1-4 May. They report that they have not been seen since.

Adult emergence of *K. pistaciella* in culture cages in Gaziantep province Nizip district Yağmuralan location, between 2015-2017, started between 23 March-14 April, reached the highest number on 11-21 April and ended between 20-28 April. Adult emergence lasted between 14-27 days.

Adult emergence of *K. pistaciella* in culture cages in Gaziantep province Nizip district Alahacı location between 2015-2017, started between 24 March-14 April, reached the highest number between 7-28 April and ended between 14 April 5 May. Adult emergence lasted an average of 27 days. Mart et al. (2003) found that the first adults of *K. pistaciella* emerged on April 2-9 in culture cages in Gaziantep Center and Nizip districts in 2001, reached the peak on April 17-25, and adult emergence was not seen after April 20-May 6, which In the study, the results obtained between 2015-2017 are similar, but it was determined that the adult emergence in Alahacı location took one week longer in 2015.

CONCLUSION

When the adult emergences in culture cages and pheromone traps were compared, it was concluded that pheromone traps gave clearer information while monitoring the population of the pest. The reason for this is that the shoots placed in the culture cage and the air temperature inside the cage may slightly deviate from the natural ambient temperature. With this, Population follow-up in both pheromone traps and culture cages helped to determine whether male individuals were monitoring earlier. The advantage of using culture cages as an

alternative for population follow-up is to obtain new species of parasitoids and new registered parasitoids for our country, and to follow-up the emergence of female butterflies. In this way, important data on female butterflies of control against this pest has been obtained.

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Contribution Rate Statement Summary of Researchers

The authors declare that they have contributed equally to the article.

Conflict of Interest

The authors declare that there are no conflicts of interest.

REFERENCES

Abbaszadeh, G., Seiedoleslami, H., Samih, M.A., & Hatami, B., 2006. Bioecology of Pistachio Twig Borer Moth *Kermania pistaciella* Amsel, in Rafsanjan and Isfahan-Iran. *Communications in Agricultural and Applied Biological Sciences, 71(2), 563-569.*

Abbaszadeh, G., Seiedoleslami, H., & Hatami, B., 2011. Ecological, Cultural and Pheromonal Studies on Pistachio Wood Borer, *Kermania pistaciella* A. *Annals of Plant Protection Sciences, 19(1), 25-28.*

Arbabtafti, R., Sheikhigarjan, A., Mahmoudvand, M., & Mohammadipour, A., 2012. Cost–Benefit Analysis of Pistachio Twig Borer, *Kermania pistaciella* Amsel (Lepidoptera: Oinophylidae) Chemical Control. *Archives of Phytopathology and Plant Protection, 45(16), 1972-1979.* https://doi.org/10.1080/03235408.2012.718690

Arpacı S., 2010. Antepfıstığı ve Geleceği, TMMOB Kent Sempozyumu

Bassirat, M., 2005. Determination of Heat Requirements for Pistachio Twig Borer Moth, *Kermania pistaciella*. IV International Symposium on Pistachios and Almonds, ISHS Acta Horticulturae *726*; 519-524. https://doi.org/10.17660/ActaHortic.2006.726.86

Bolu, H., 2002. Güneydoğu Anadolu Bölgesi Antepfıstığı Alanlarındaki Böcek ve Akar Faunasının Saptanması. *Türkiye Entomoloji Dergisi, 26(3), 197-208.* (in Turkish with English summary).

Çelik, M.Y., 1975. *Gaziantep İli'nde Antepfıstığının zararlıları ve Bunların Faydalı Böcekleri Üzerinde Çalışmalar.* Zirai Mücadele Araştırma Yıllığı, *9*, 43-44 (in Turkish).

Eldoğan, Ü., & Şahin, A. (2015). Gaziantep İlinde Antepfıstığı Üretim Ekonomisi Araştırması. *KSÜ Doğa Bilimleri Dergisi, 18*(3), 29-36. https://doi.org/10.18016/ksujns.22332

Emami, Y., Aliakbar, A., Farivar Mehin, H., Rajabi, A., Hajabdollahi, M., 2004. Study on Possibility of Extraction and Identification of Pistachio Twig Borer Sexual Pheromone (*Kermania pistaciella*). https://agris.fao.org/search/en/providers/122649/records/64724a6f53aa8c8963055329 (in Persian with Farsi and English summary)

Gries, R., Khaskin, G., Daroogheh, H., Mart, C., Karadag, S., Er, M. K., 2006. (2S, 12Z)-2-Acetoxy-12-heptadecene: Major Sex Pheromone Component of Pistachio Twig Borer, *Kermania pistaciella*. *Journal of Chemical Ecology, 32(12), 2667-2677.* https://doi.org/10.1007/s10886-006-9190-0

Gries, G., Sasaerila, Y., Darougheh, H., Sheykhi Garjan, A., & Yazdani, A., 2007. Field Testing of A Pheromone-Based Attracticide for Control of Pistachio Twig Borer Moth, *Kermania pistaciella* Amsel (Lep.: Oinophylidae). https://agris.fao.org/search/en/providers/122649/records/647356d1e17b74d2224ff6cb (Persian with Farsi and English summary)

Günaydın, T., 1978. *Güneydoğu Anadolu Bölgesi'nde Antepfıstıklarında Zarar Yapan Böcek Türleri, Tanımları, Yayılışları ve Ekonomik Önemleri Üzerinde Araştırmalar.* Diyarbakır Zirai Mücadele Araştırma Enstitüsü (Yayınlanmamış Uzmanlık Tezi, 106 s.) (in Turkish)

IPA., 2024, Iran Pistachio Association, URL: https://iranpistachio.org/en/images/stat/ ARCHIVE/ Analytic Comparative Data/4 Iran US Annual Pistachio Production Comparison.pdf (erişim tarihi 22.02.2024)

Izadi, H., Samih, M.A., Behroozy, E., Hadavi, F., Mahdian, K., 2011. Energy Allocation Changes During Diapause in Overwintering Larvae of Pistachio Twig Borer, *Kermania pistaciella* Amsel (Lepidoptera: Tineidae) in Rafsanjan. *Arpn Journal of Agricultural and Biological Science, 6(5), 12-17.*

Küçükarslan, N., 1966. *Antepfıstıklarında Zarar Yapan Fıstık Dalgüvesi (Kermania pistaciella Amsel, Lep. – Oinophilidae)'nin Biyoloji ve Savaşı Üzerinde Bazı İncelemeler*, Sabri A.Ş. Basımevi, İstanbul, 64s. (in Turkish)

Manickavasagam, S., Mehrnejad, M.R., Noyes, J.S., 2008. *Cheiloneurus pistaciae* sp. nov. (Hymenoptera:

Encyrtidae) A Facultative Hyperparasitoid of *Kermania pistaciella* Amsel (Lepidoptera: Tineidae), A Pest of Pistachio Trees in Iran. *Zootaxa, 1958, 61–64.* https://doi.org/10.11646/zootaxa.1958.1.6

Mart, C., Yigit, A., & Çelik, M.Y., 1995. Biological Observations and Chemical Control of Pistachio Twig Borer, *Kermania pistaciella*, Injurious in Pistachio Orchards in Turkey. ISHS Acta Horticulturae 419: I International Symposium on Pistachio; 373-378. https://doi.org/10.17660/ActaHortic.1995.419.62

Mart, C., Karadağ, S., Aslan, M.M. & Eroğlu, N., 2003. *Antepfıstığı Alanlarında Entegre Mücadeleye Veri Tabanı Oluşturacak Bazı Konularda Araştırmalar,* TÜBİTAK Tarp-2076 Nolu proje raporu, 315 s. (in Turkish)

Mehrnejad, M. R., 2001. The Natural Parasitism Ratio of The Pistachio Twig Borer Moth, *Kermania pistaciella*, in Iran. III International Symposium on Pistachios and Almonds. *ISHS Acta Horticulturae* 591; (541-544). https://doi.org/10.17660/ActaHortic.2002.591.83

Mehrnejad, M. R., 2003. The Influence of Host Species on Some Biological and Behavioural Aspects of *Dibrachys boarmiae* (Hymenoptera: Pteromalidae), Parasitoid of *Kermania pistaciella* (Lepidoptera:Tineidae). *Biocontrol Science and Technology, 13(2), 219-229.* https://doi.org/10.1080/0958315021000073484

Mollaei, M., Izadi, H., Moharramipour, S., Moghadam, E. B., 2017. Physiology of Hibernating Larvae of the Pistachio Twig Borer, *Kermania pistaciella* Amsel (Lepidoptera: Tineidae), Collected From Akbari Cultivar of *Pistacia vera* L. *Neotropical Entomology, 46(1), 58-65.* https://doi.org/10.1007/s13744-016-0438-2

Özer, M., 1958. *Balıkesir ve Kütahya Vilayetlerindeki Yabani Antepfıstıklarında Rastlanan Bazı zararlılar üzerinde incelemeler.* Atatürk Üniversitesi Ziraat Fakültesi Yıllığı, *8*(2), 111-120 (in Turkish)

Özgen, İ., Bolu, H., Beyarslan, A., 2012. *Chelonus flavipalpis* Szépligeti, 1896 and *Mirax rufilabris* Haliday, 1833 (Hymenoptera: Braconidae): Two New Larva-Pupa Parasitoids of Pistachio Twig Borer *Kermania pistaciella* Amsel, 1964 (Lepidoptera: Oinophilidae) With the Parasitization Ratios From Turkey. *Munis Entomology and Zoology, 7(1), 238-242.*

Şahan, Y. B., & Tunaz, H. (2021). Antepfıstığı Dalgüvesi Kermania pistaciella AMSEL (LEPIDOPTERA: TINEIDAE)'nın Braconidae ve Ichnemonidae Familyasından Yeni Kayıt Parazitoitleri. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi, 24(6), 1230-1236.* https://doi.org/10.18016/ksutarimdoga.vi.803418

Şimşek, A., & Bolu, H., 2016. Determination of The Beneficial Insect Fauna in Pistachio (*Pistacia vera* L.) Areas in Diyarbakır Province. *Bitki Koruma Bülteni, 56(3), 267-282.* https://doi.org/10.16955/bkb.56653

Tezerji, Z. S., 2011. Determination of Damages of Pistachio Twig Borer Moth *Kermania pistaciella* Amsel, to Fruit Clusters of Pistachio Trees. V. International Symposium on Pistachios and Almonds, ISHS Acta Horticulturae, 912, 701-707. https://doi.org/10.17660/ActaHortic.2011.912.105

TUİK, 2022., Türkiye İstatistik Kurumu URL: https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr (erişim tarihi: 04.01.2022)

TUIK, 2024a., Türkiye İstatistik Kurumu, Ağaç sayıları il bazında URL: https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr (erişim tarihi 20.02.2024)

TUIK, 2024b., Türkiye İstatistik Kurumu, Meyve vermeyen ağaç sayısı URL: https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr (erişim tarihi 20.02.2024)

TUIK, 2024c., Türkiye İstatistik Kurumu, 2022-2023 Yılları Antepfıstığı üretim miktarı URL: https://data.tuik.gov.tr/Bulten/Index?p=Bitkisel-Uretim-Istatistikleri-2023-49535 (erişim tarihi 22.02.2024)

Ulu, O., Zümreoğlu, A. ve San, S., 1972. *Ege Bölgesi'nde Antepfıstığı Zararlıları İle Bunların Parazit ve Predatörleri Üzerinde Ön Çalışmalar*. Zirai Mücadele Araştırma Yıllığı, *6*, 55 (in Turkish)

USDA., 2024, Foreign Agricultural Service, URL: https://apps.fas.usda.gov/psdonline/circulars/TreeNuts.pdf (erişim tarihi 22.02.2024)

Van Achterberg, C., & Mehrnejad, M. R., 2002. The Braconid Parasitoids (Hymenoptera: Braconidae) of *Kermania pistaciella* Amsel (Lepidoptera: Tineidae: Hieroxestinae) in Iran. *Zoologische Mededelingen, 76: 27-39.*

Yanık, E., & Yücel, A., 2001. The Pistachio (*P. vera* L.) Pests, Their Population Development and Damage State in Şanlıurfa Province. C*ahiers Options Mediterraneenes, 56*, 301-309.

Yanık, E., & Yildirim, Y., 2016. Effectiveness of Mass Trapping for Control of The Pistachio Twig Borer, *Kermania pistaciella. Bulletin of Insectology, 69(1), 35-40.*

Zamani, Z., Khajehali, J., Sabrazalian, M. R., 2012. Influence of Trap Type, Trapping Location and Cardinal Direction on the Capture of the Pistachio Twig Borer Moth, *Kermania pistaciella* Amsel. (Lepidoptera: Tineidae)'in Isfahan. *Plant Pest Research*, *2(2), 59-61.*