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Research Article

The Population Fluctuation of *Prays oleae* Bern (Lepidoptera: Praydidae, Yponomeutidae*)* in Three Different Olive Orchards

Gülsevim TİRİNG*[1], Medine ADA[2], Murat ADA[2], Rocheyln DONA[2], Çağlar KALKAN[2], Serdar SATAR[1,2]

ABSTRACT
The olive moth, *Prays oleae Bern* (Lepidoptera: Praydidae, Yponomeutidae) is a significant pest of olive trees in Turkey. This study aimed to investigate the monitoring of the population fluctuation of *P. oleae* at different time intervals. The study was conducted in 3 different olive orchards located in the Mersin province between 2020 and 2022 years. Traps were inspected weekly, and the numbers of captured *P. oleae* individuals were recorded separately. The results of the study revealed that the first adults of *P. oleae* in 2022 were caught in the first week of April. In the second year of the study, in all three orchards, the population was lower due to the effects of insecticide applications and increased precipitation compared to other years. In the study found that the highest population peak occurred in the third week of September. Recording the population peaks and understanding of the timing of *P. oleae* population fluctuations can provide valuable information for implementing Integrated Pest Management (IPM) strategies in olive orchards. By considering these population dynamics, informed decisions can be made to effectively manage and control *P. oleae* populations, ultimately aiding in the protection of olive crops.
Keywords: Mersin, trap, Olive moth, population change

Prays oleae Bern (Lepidoptera: Praydidae, Yponomeutidae)'nın Üç Farklı Zeytin Bahçesindeki Popülasyon Dalgalanması

ÖZ
Zeytin güvesi, *Prays oleae* Bern (Lepidoptera: Praydidae, Yponomeutidae), Türkiye'deki zeytin ağaçlarının önemli bir zararlısıdır. Bu çalışma, *P. oleae*'nin popülasyon dalgalanmasının farklı zaman aralıklarında takip etmeyi amaçlamıştır. Denemeler 2020-2022 yılları arasında Mersin ilinde bulunan 3 farklı zeytin bahçesinde yürütülmüştür. Tuzaklar haftalık olarak kontrol edilmiş ve yakalanan *P. oleae* bireylerinin sayısı ayrı ayrı kaydedilmiştir. Çalışmada, *P. oleae*'nın ilk erginleri 2022'de nisan ayının ilk haftasında yakalanmıştır. Çalışmanın ikinci yılında ise her üç bahçede de insektisit uygulamalarının etkisi ve yağışların fazla olması nedeniyle diğer yıllara göre popülasyon daha düşük olmuştur. Genel olarak, çalışmada en yüksek popülasyon eylül ayının üçüncü haftasında gözlemlenmiştir. Popülasyon piklerini belirlemek ve *P. oleae* popülasyon dalgalanmalarının tespit etmek, zeytin bahçelerinde Entegre Zararlı Yönetimi (IPM) stratejilerinin uygulanması için değerli bilgiler sağlayabilir. Bu popülasyon dinamikleri dikkate alınara*k, P. oleae* popülasyonlarının etkili bir şekilde yönetilmesi ve zararlı ile etkin bir şekilde mücadele edilmesi için bilinçli kararlar alınabilir ve sonuç olarak zeytin bitkilerinin korunmasına yardımcı olunabilir.
Anahtar kelimeler: Mersin, popülasyon değişimi, tuzak, Zeytin güvesi.

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[1] BIOTEK Scientific Services, Agricultural R&D and Consultancy Company, Çukurova Technocity, Adana
[2] Department of Plant Protection, Faculty of Agriculture, Çukurova University, Adana
*E-posta: glsvm.trng@gmail.com

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Introduction

The olive moth *Prays oleae* (Bern) (Lepidoptera: Praydidae, Yponomeutidae) is a widespread pest that affects olive trees (*Olea europaea L.*) in various regions, including the Mediterranean, Black Sea, Middle East, and Canary Islands (Tzanakakis, 2003; Kumral et al., 2005). The infestation caused by this moth can result in substantial losses in olive oil production, with potential reductions ranging from 50 to 60% (Arambourg and Pralavorio, 1986, Tzanakakis 2003; Ortiz et al., 2021). *Prays oleae* is a monophagous species, meaning it feeds exclusively on a single host plant, which in this case is the olive tree. *P. oleae* has a life cycle that typically consists of three generations per year (Kovancı and Kumral, 2004; Kaçar and Ulusoy, 2007; Kaplan and Alaserhat, 2020, Ortiz et al., 2021). Each generation represents a distinct period of development and reproduction within the population. The first generation appears from females of the overwintered generation, which lay their eggs in flower buds during April. The newly hatched larvae subsequently feed on the buds and flowers losses (Kovancı and Kumral, 2004; Kumral and Kovancı, 2004; Kumral et al., 2005; Kaçar and Ulusoy, 2007). The second generation emerges in early June, with females depositing their eggs near the stem of small fruits. The larvae then tunnel into the stone of the olive fruit, causing notable damage (Çakıllar, 1959; Çetin and Alaoğlu, 2005; Kumral and Kovancı, 2004; Kumral et al. 2005). By September, when the larvae complete their development and leave the fruit, they trigger substantial fruit drop, leading to significant crop losses (Kovancı and Kumral, 2004; Kumral and Kovancı, 2004; Kumral et al. 2005).

To manage *P. oleae* populations, olive growers often implement integrated pest management strategies. These strategies may include biological control (using natural enemies of the pest) (Alves et al., 2021; Martínez-Núnez˜ et al., 2021), and targeted pesticide applications when necessary (Wiesman, 2009). Regular monitoring of population levels and pest damage can help determine the appropriate timing and intensity of control measures (Kumral et al., 2005; Tiring and Satar, 2017; 2021).

Several studies have been conducted in Türkiye to investigate the population dynamics of *P. oleae*. Çakıllar (1959), inspected the biology of *P. oleae* in the Marmara Region, while Bozan et al. (1994) focused on the population changes and damage rates in the Black Sea Region. Güçlü et al. (1995), studied the infestation rates in the Artvin, while Yayla et al. (1995), inspected the first egg-laying period, infestation rates, and natural enemies of *P. oleae* in Antalya. Çetin and Alaoğlu (2005), provided information on damage and population density in the Mut district. Turanlı et al. (2011), investigated the population dynamics and damage ratio of *P. oleae* in olive-growing regions of İzmir and Manisa provinces while Kaplan and Alaserhat (2020), conducted a study on the population of *P. oleae* in the region of Mardin.

It is worth noting that specific population data for *P. oleae* may vary depending on the region and available research studies. In this particular study, the population density rate of *P. oleae* was monitored in various olive orchards located in the Toroslar district of Mersin, Türkiye.

Material and Method

Field area

The study was conducted in the neighborhoods of Işıktepe, Doruklu, and Musalı situated in Mersin, a coastal city in southern Türkiye along the Mediterranean coast. The experimental fields consisted of olive orchards planted with the Gemlik cultivar, and the trees in these orchards were approximately 10-15 years old.

Trapping

Between 2020 and 2022, the flight activity of male *P. oleae* was monitored using three Delta traps (Trece Inc., Salinas, CA, USA) equipped with sticky inserts. These inserts were baited with synthetic sex pheromone [(Z)-7-14:Ald]. The pheromone traps were hung on the trees in orchards in the third week of May in 2020 and 2021 whereas in 2022 were installed the last week of March. Traps were hung at a height of 1.5-2.0 m from the soil and to the south of the trees. In traps, pheromone capsules were changed every five weeks. The traps were checked once a week, and the numbers *of P. oleae* caught were recorded separately. Following each count, the traps were thoroughly

cleaned and replaced to prevent any mixing with previously captured specimens from different counting periods.

Climate data

Daily climate data, including relative humidity, precipitation, mean temperature, minimum temperature, and maximum temperature, were acquired from the Türkiye State Meteorological Service for the duration of the study.

Results And Discussion

Figure 1 shows the population density of *P. oleae* in various olive orchards located in neighborhoods of Işıktepe, Doruklu, and Musalı, the Toroslar district of Mersin between 2020 and 2022. In 2020, the first adults (4 adults/trap) were detected in the olive orchard in Işıktepe in the first week of June. The highest number of adults was 14 adults/trap in the third week of September 2020 during the study in this orchard. Also, the last adults of 2020 were detected in November. The first adults in Doruklu were observed in the second week of June. The number of moths detected in this orchard is generally low. However, in the third week of September, the number of moths caught in traps increased to 12 adults/trap. In this orchard, the last adults were caught in the last week of September. The first adults in Musalı were observed in the second week of June. The highest population (8 adults/trap) was detected in the third week of September. The last moths were caught in the third week of October.

In 2021, the first adults were detected in the olive orchard in Işıktepe in the first week of June. The last moths were caught in second week of August. There is no moths in Doruklu were caught during the second year of study. The first adults (4 adults/trap) in Musalı were observed in the first week of June. The last moths were caught in the third week of August. The lower population observed in the second year of the study compared to other years can be attributed to the application of insecticides. Specifically, insecticides were applied twice in Işıktepe and Musalı, and three times in Doruklu during that year. The repeated application of insecticides likely played a role in suppressing the population of the target insect pest, resulting in reduced numbers observed during the second year of the study. Furthermore, the higher precipitation experienced in the second year compared to the other years resulted in a decrease in the population of *P.oleae* (Figure 2). The increased precipitation had a significant impact on the population dynamics of the pest.

During the third year of the study, the first adults of the *P. oleae* were captured in the first week of April in three orchards. The early hanging of the traps in the third year enabled the earlier capture of the moths. However, in Doruklu, where repeated insecticide applications were carried out, no moths were caught in the traps after the first adults. In Işıktepe (6 adults/trap) and Musalı (15 adults/trap), the highest population in the leaf generation of *P. oleae* was observed during the first week of May. On the other hand, the highest population of the fruit generation of *P. oleae* was observed in the third week of September (Işıktepe 11 adults/trap; Musalı: 12 adults/trap). This suggests that during this time, the *P. oleae* population was predominantly in the stage of infesting and causing damage to the fruit.

To ensure effective control and successful management of the *P. oleae*, it is crucial to select the timing of pesticide applications. During the course of this research, traps were utilized to assess the population dynamics of *P. oleae*. In a separate study conducted in Northern Greece, Andreadis et al. (2011), employed pheromone traps to determine the optimal timing for spraying against *P. oleae*. These findings emphasize the significance of accurately timing pesticide applications to target critical periods in the life cycle of *P. oleae.* By aligning pesticide use with the appropriate stages of the population of pests, more effective control measures can be implemented, contributing to successful pest management in olive orchards. Furthermore, the use of pheromone traps and other monitoring tools can provide valuable data on the population dynamics of *P. oleae*, allowing for a more targeted and strategic approach to pest management. By understanding the specific timing of peak activity or reproduction periods for *P. oleae*, farmers and pest management professionals can more effectively plan and execute pesticide applications to maximize their

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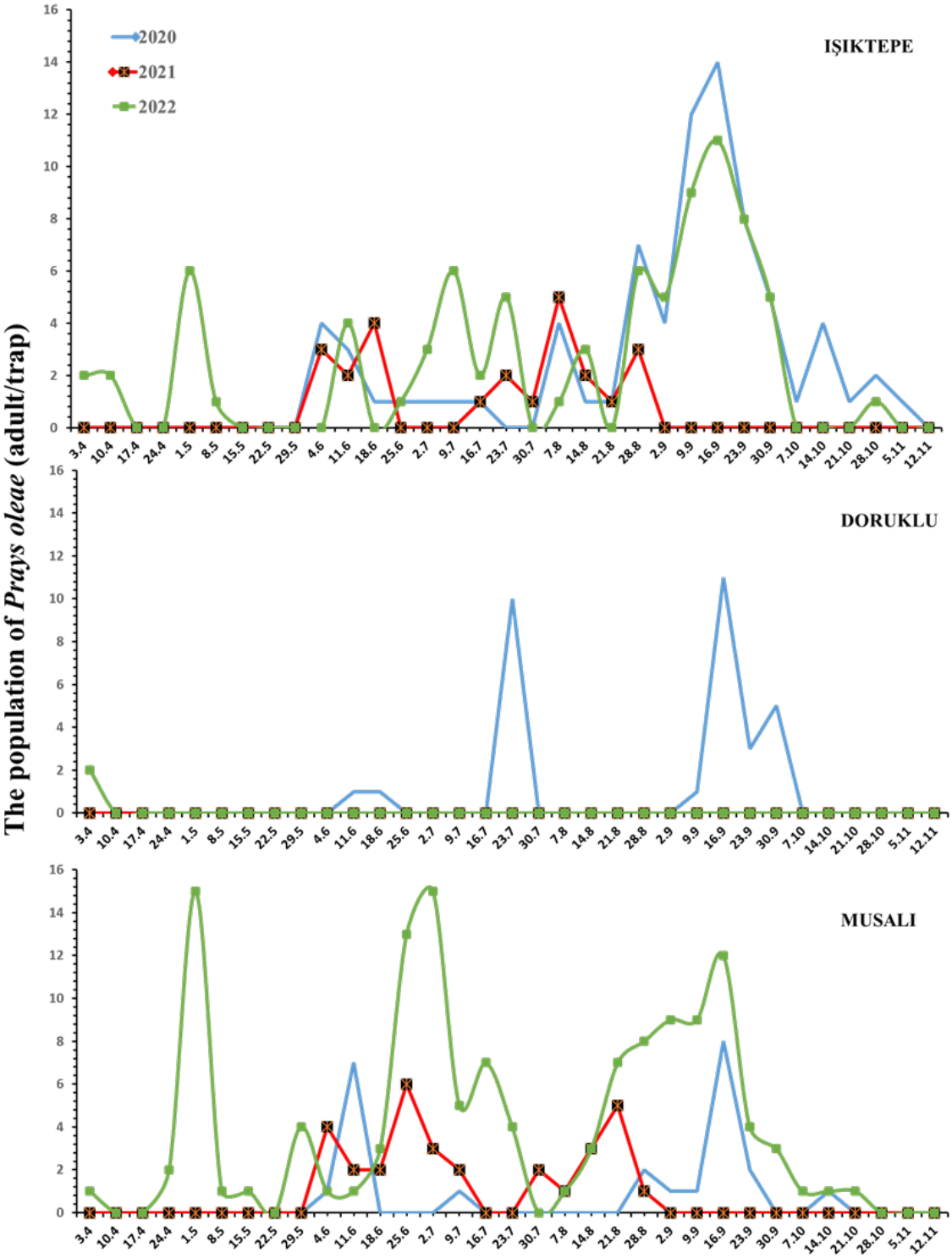

Figure 1. The population development of *Prays oleae* in Mersin province between 2020 and 2022.

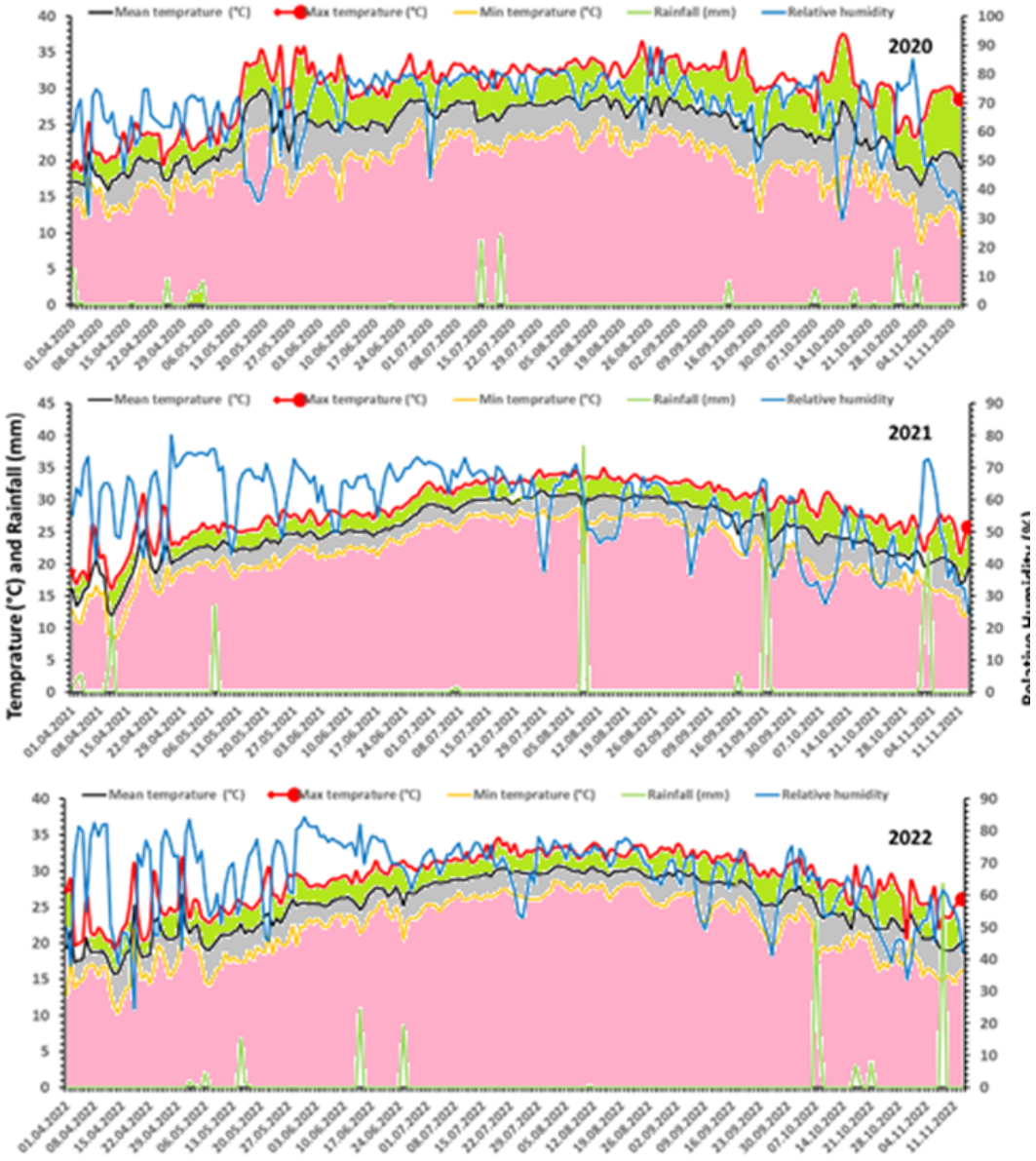

Figure 2. The climate data in Mersin province between 2020 and 2022.

impact on reducing pest populations. This integrated approach not only ensures more efficient use of pesticides but also minimizes environmental impact and promotes sustainable agricultural practices in olive orchards. Since our study includes population data, it provides valuable information for the pest control.

Kaçar and Ulusoy (2007), conducted research in Adana and detected that *P. oleae* produced three generations. The leaf-generation adults emerged from the first half of April to the end of May, the flower-generation adults emerged in the last ten days of May until early July, and the fruit-generation adults emerged from late September to mid-December. In our research conducted in Işıktepe, we observed that the leaf-generation adults appeared from the beginning of April to the end of May, the flower-generation adults emerged from the first week of June until the last week of July, and the fruit-generation adults emerged from the first week of August to November in 2022. During our study in Musalı in 2022, we noted that leaf-generation adults were present from early April to the second week of May, flower-generation adults emerged from the third week of May to the end of July, and fruit-generation adults appeared from early August to November. The data obtained were consistent with the study conducted by Kaçar and Ulusoy (2007), due to the similarity in climate conditions where the studies were carried out. Additionally, our research revealed that the abundance and distribution of leaf, flower, and fruit-generation adults were influenced by temperature and precipitation patterns. This suggests that climate conditions play a significant role in shaping the life cycle of these insects in Mersin. Further studies are needed to explore the specific environmental factors driving the observed patterns and to assess potential implications for agricultural practices in the region. Helvacı and Özden (2020) conducted a research in Kıbrıs and found that the highest population of *P. oleae* occurred between August and November. Our study similarly determined a high population in September. Our findings are consistent with the research conducted by Helvacı and Özden (2020), indicating that September is a critical period for *P. oleae* population. Özpınar et al. (2011), observed wintering progeny adults of *P. oleae* in Çanakkale, noting population peaks on May 5, May 13, and May 4. Kaplan et al. (2015), observed that adult moth activity of *P. oleae* was initiated in early April, and the presence of adults from the first and second generations overlapped until mid-June. The differences observed in other study may be attributed to regional variations and different pest management practices. These factors can influence the population dynamics of *P. oleae,* highlighting the importance of considering local conditions and management strategies while studying and monitoring pest populations. It is crucial for researchers and pest management professionals to take into account the specific environmental and agricultural conditions of each region in order to develop effective strategies for controlling *P. oleae* populations. By understanding the unique life cycle and population dynamics of this pest in different areas, targeted and sustainable management practices can be implemented to minimize its impact on olive crops. Additionally, continued monitoring and research are essential for staying ahead of potential shifts in *P. oleae* populations and behavior, especially in light of changing climate patterns and evolving agricultural practices.

Conclusion

P. oleae is a significant pest that poses a direct threat to olive trees, particularly through damage to flowers and fruits, which are crucial for income generation in our country. It is important to note that uncontrolled spraying practices against *P. oleae* can result in potential residue risks on the fruit, which can further impact marketability.

Implementing alternative control methods, such as biological and biotechnical approaches, can help decrease the density of the adult population of *P. oleae*. These methods offer effective pest control while reducing the risk of yield loss. It is crucial to monitor orchards regularly and take

timely precautions to prevent the population of the pest from increasing. By implementing necessary measures and interventions based on proper monitoring, the risk of yield loss and economic impact can be minimized. Moreover, educating and training farmers on integrated pest management practices can also play a vital role in controlling *P. oleae* infestations. By promoting sustainable and environmentally friendly approaches, we can ensure the long-term health and productivity of olive orchards. Collaboration between scientists, agricultural experts, and farmers is essential to develop comprehensive strategies that address the challenge of *P. oleae* infestations while minimizing the use of chemical pesticides. Through collective efforts and proactive measures, we can safeguard our olive trees and preserve the economic stability of our olive industry for future generations.

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