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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Infestation rates of Mediterranean fruit fly [*Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)] on common guava (*Psidium guajava* L.) fruits

Guava (*Psidium guajava* L.) meyvelerinde Akdeniz meyve sineği [*Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)]'nin bulaşma oranları

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ABSTRACT

The study was conducted to determine infestation rates of medfly on common guava, *Psidium guajava* L. (Myrtaceae), fruits in Hatay province of Türkiye. During the study, a different number of the common guava fruits were collected at University of Hatay Mustafa Kemal Research Center in Field 49. They were brought to the laboratory, placed in three plastic container, and each container put into three different mesh screen cages at room temperature. For each of the sampling year, the adults of medfly emerging from the infested fruits were counted in a three-mesh screen cages. Additionally, medfly infestation rates were evaluated as percentage by examining all fruits in plastic cups in each of the cages. As a result of four-year investigations, this pest was found on *P. guajava* fruits in all sampling years. Totals of 3240 medfly adults in 2016, 4161 medfly adults in 2017, 4621 medfly adults in 2019, and 2982 medfly adults in 2020 were counted in three mesh screen cages. In 2016, a total of 600 guava fruit samples were collected during the study period, of which 255 fruits (42.5%) were infested by medfly. In 2017, a total of 450 guava fruit samples were collected during the study period, of which 352 fruits (78.22%) were infested by medfly. In 2019, a total of 870 guava fruit samples were collected during the study period, of which 625 fruits (71.84%) were infested by medfly. In 2020, a total of 689 guava fruit samples were collected during the study period, of which 554 fruits (81.41%) were infested by medfly. The highest percentage infested rates was recorded as 81.41 in 2020, followed by 78.22 in 2017, 71.84 in 2019 and 42.5 in 2016.

ÖZET

Bu çalışma, Türkiye'nin Hatay ilinde guava, *Psidium guajava* L. (Myrtaceae) meyvelerinde akdeniz meyve sineğinin bulaşıklık oranlarını belirlemek amacıyla yapılmıştır. Çalışma sırasında Hatay Mustafa Kemal Üniversitesi Araştırma Merkezi 49 nolu tarladan farklı sayıda guava meyvesi toplanmıştır. Laboratuvara getirilerek üç plastik kab ile üç farklı tel kafese oda sıcaklığında konulmuştur. Örnekleme yılının her biri için, bulaşık meyvelerden çıkan Akdeniz meyve sineklerinin erginleri üç farklı tel kafesin içinde sayılmıştır. Ayrıca kafeslerin her birindeki plastik kaplardaki tüm meyveler incelenerek akdeniz meyve sineklerinin bulaşıklık oranları yüzde olarak değerlendirilmiştir. Dört yıllık araştırmalar sonucunda, tüm örnekleme yıllarında *P. guajava* meyvelerinde bu zararlıya rastlanmıştır. Üç farklı tel kafes içinden 2016'da toplam 3240, 2017'de toplam 4161, 2019'da toplam 4621 ve 2020'de toplam 2982 adet Akdeniz meyve sineği sayılmıştır. Çalışma döneminde, 2016 yılında toplanan 600 guava meyvesinin 255 (%42.5)'i, 2017 yılında toplanan 450 guava meyvesinin 352 (%78.22)'si, 2019 yılında toplanan 870 guava meyvesinin 625 (%71,84)'i ve 2020 yılında toplanan 689 guava meyvesinin 554 (%81.41)'ü Akdeniz meyve sineği ile bulaşık olduğu tespit edilmiştir. En fazla bulaşma yüzdesine 2020'de 81.41 olarak kaydedilirken, bunu sırasıyla 2017'de 78.22, 2019'da 71.84 ve 2016'da 42.5 izlemiştir.

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INTRODUCTION

The common guava, yellow guava, or lemon guava, *Psidium guajava* L. (Myrtaceae) is considered to be native to Mexico and grown in all the tropical and subtropical areas of the world (Stone, 1970; Wilson, 1980; Yadava, 1996; Le et al., 1998; Tate, 2000; Gould & Raga, 2002; Dolinski, 2016; Adak et al., 2019). Guava is a well-known cultivated tropical fruit known for its food and nutritional values throughout the world (Morton, 1987). Several insect species feed on its fruits, leaves, trunk, causing damage depending on the region or country (Gundappa et al., 2018). Major insect pests of guava which can cause considerable economic damage are fruit flies, *Anastrepha bistrigata* Bezzi (Diptera: Tephritidae), *A. fraterculus* (Wiedemann), *A. obliqua* (Macquart), *A. sororcula* Zucchi, *A. zenildae* Zucchi, *A. suspensa* Loew, *A. serpentina* (Wiedemann), *A. ludens* (Loew), and *A. striata* Schiner (Zucchi, 2008; White & Elson-Harris, 1994), *Bactrocera zonata* Saunders, *B. dorsalis* (Hendel), *B. correcta* (Bezzi), (Diptera: Tephritidae) (Kapoor, 2000; Jalaluddin et al., 2001; Reddy & Vasuki, 2002; EPPO, 2014; CABI, 2015), medfly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) (Liquido et al., 1990; Canal et al., 1998; Weems, 2001; De Meyer et al., 2002; Souza-Filho et al., 2009; Souza-Filho & Costa, 2003; Mwatawala et al., 2009), *C. anonae* (Graham), *C. cosyra* (Walker), *C. fasciventris* (Bezzi), and *C. rosa* on fruits Karsch (Coperland et al., 2006), bark-ating caterpillar, *Indarbela quadrinotata* Walker and *I. tetraonis* Moore (Lepidoptera: Metarbelidae) (Srivastava, 1997; Haseeb, 2007), pomegranate butterfly, *Deudorix* (=*Virachola*) *isocrates* Fab. (Lepidoptera: Lycaenidae), castor capsule Borer, *Conogethes punctiferalis* (Guenée) (Lepidoptera: Crambidae), guava weevil, *Conotrachelus psidii* Marshall (Coleoptera: Curculionidae) (Souza-Filho & Costa, 2003), leaf twisting weevil, *Apoderus transquebaricus* Fab. (Coleoptera: Curculionidae) on foliage (Singh, 1996), Stem borer, *Aristobia testudo* Voet (Coleoptera: Cerambycidae), trunk borer, *Batocera rufomaculata* (Coleoptera: Cerambycidae), spiralling whitefly, *Aleurodicus dispersus* Russel (Mani & Krishnamoorthy, 1996), tea mosquito bug, *Helopeltis antonii* Signoret (Hemiptera: Miridae), redbanded thrips, *Selenothrips rubrocinctus* Giard (Thysanoptera: Thripidae), grapevine thrips, *Rhipiphorothrips cruentatus* Hood (Thysanoptera: Thripidae), the guava thrips, *Liothrips anonae* Moulton, 1933 (Thysanoptera: Phlaeothripidae) are secondary pests on guava plantations damaging leaves and shoots, and fruits (Gould & Raga, 2002, Picanço et al., 2003), mango mealybug, *Rastrococcus iceryoides* Green (Hemiptera: Pseudococcidae) on vegetative as well as reproductive parts (Mani and Krishnamoorthy, 1998), green shield scale, *Chloropulvinaria psidii* Maskell and wax scale, *Drepanococcus chiton* Green (Hemiptera: Coccidae), the leaf-footed bug, *Leptoglossus zonatus* Dallas (Hemiptera: Coreidae) (Souza-Filho & Costa, 2003), *Paradasynus rostratus* Dist.(Hemiptera: Coreidae) on fruit (Beevi et al., 1989), psyllid, *Triozoida limbata* (Hemiptera: Triozidae) (Souza-Filho & Costa, 2003), aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae) have been reported on guava (Pena et al., 2002; Gould & Raga, 2002; Uhammad Sarwar, 2006; Haseeb, 2007; Muniappan et al*.,* 2012; Gundappa et al., 2018). The Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is one of the most important fruit pests throughout the world (White & Elson-Haris, 1994; Demirel, 2016; Demirel & Akyol, 2017; Demirel et al., 2018; Demirel, 2019a,b). The Medfly is a polyphagous species attacking over 350 different hosts plant (Weems, 1981; Liquido et al., 1991). The females lay eggs below the skin of the host fruits, which are destroyed by larval feeding (Krainacker et al., 1987; Fimiani, 1989; Zucoloto, 1993; Papadopoulos et al., 2002; Ovruski et al., 2003; White & Elson-Haris, 1994; Medeiros et al., 2007; Mwatawala *et al*., 2009). The purpose of the current study was to determine infestation rates of Medfly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) on common guava, *Psidium guajava* L. (Myrtaceae) fruits in Hatay province of Türkiye.

MATERIALS and METHODS

The studies were conducted over four years (2016, 2017, 2019 and 2020) to determine infestation rates of medfly, *Ceratitis capitata* (Wiedemann), on common guava, *Psidium guajava* L. (Myrtaceae) fruits in Hatay province of Türkiye. During the study, 600 fruits on 9 October 2016, 450 fruits on 4 November 2017, 870 fruits on 31 October 2019, and

689 fruits on 12 November 2020 common guava fruits were collected at University of Hatay Mustafa Kemal Research Center in Field 49. They were brought to the laboratory, placed in plastic containers (43x28x7cm), and then put into three different mesh screen cages (100x50x50cm) at room temperature. After approximately 45 days, the total numbers of emerged Medfly adults (♀,♂) into mesh screen cages were counted. In addition, all fruits in plastic containers into each of the cages were examined one by one, and the percentage of the damage rates of Medfly larvae was calculated to express percentage infestation.

RESULTS and DISCUSSIONS

Total numbers of medfly adults counted in mesh screen cages varied in each of the sampled years. A total of 3240 medfly adults in 2016, a total of 4161 medfly adults in 2017, a total of 4621 medfly adults in 2019 and a total of 2982 medfly adults in 2020 were counted in three mesh screen cages (Figure 1).

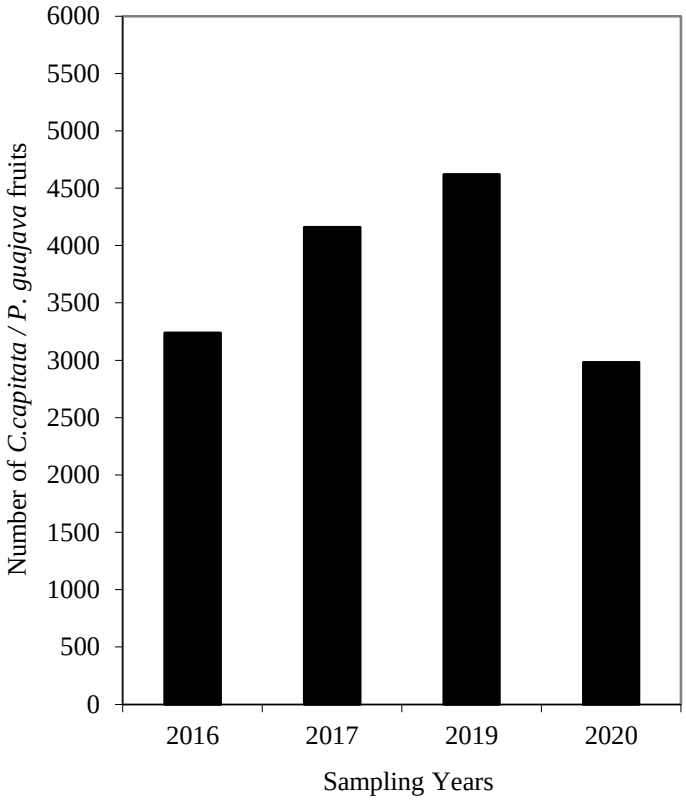

Figure 1. Number of medfly adults emerged from damaged fruits during the sampling years
Şekil 1. Örnekleme yıllarında zarar görmüş meyvelerden çıkan Akdeniz meyve sineği ergin sayısı

Total number of sampled fruits and the number of infested fruits by medfly varied in each of the sampled years. The total of 600 guava fruit samples were collected on 9 October 2016, of which 255 fruits were infested by medfly (Figure 2). The total of 450 guava fruit samples were collected on 04 November 2017, of which 352 fruits were infested by medfly. The total of 870 guava fruit samples were collected on 31 October 2019, of which 625 fruits were infested by medfly. The total of 689 guava fruit samples were collected on 12 November 2020, of which 554 fruits were infested by medfly.

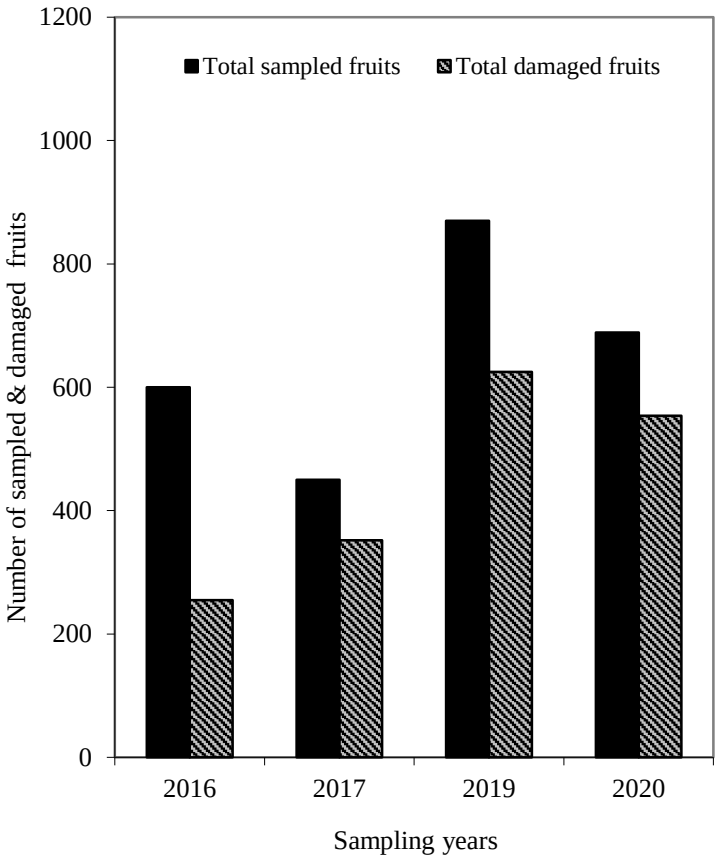

Figure 2. Number of sampled and damaged fruits during the sampling years
Şekil 2. Örnekleme yıllarında örneklenen ve zarar görmüş meyve sayısı

The current study indicated that percent of infestation rates by medfly were significantly different in each of the sampling years. The highest percent of infested rates was recorded as 81.41 in 2020, followed by 78.22 in 2017, 71.84 in 2019 and 42.5 in 2016, respectively (Figure 3).

A total of 116 guava fruit samples were collected by Hussain et al. (2015) during the study period, of which 36 fruits (31 %) were infested by *Bactrocera dorsalis* (syn. *B. invadens*) and *Ceratitis capitata.* The highest percent of infestation rates was recorded in guava fruits in Keren regions with 69%, followed by Adi Naamen (45 %), Dekemhare (40 %) and Hamelmalo (27 %) regions of Eritrea. Therefore, the infestation of invasive *B. dorsalis* was prevalent in guava fruits of Hamelmalo (100 %) and Adi Naamen (86 %) regions of Eritrea; whereas *C. capitata* was predominant in Dekemhare (79 %) and Keren (54 %) regions of Eritrea (Hussain et al., 2015). Several studies were also conducted to evaluate the percentage infestation rates of medfly on various host plants. In Egypt, The Egyptian Ministry of Agriculture (MOA) stated that the percent of medfly infestation was the highest in grapefruit (28.13%), following in guava (27.1%), apricot (24.41%), peach (23.22%), fig (8.67%), orange (7%) and mango (6%) (Lysandrou, 2009). In addition, the rates of infestation with the medfly reported as Clementine (31.1%), Navel orange (23.8%), and Valencia orange (14.12%) (Saleh & El-Hamalawii, 2004). Moreover, the rates of infestation with the medfly recorded as apricot (34.5%), summer pear (39.5%), clementine (77%), and yellow figs (65%) in Iraq (Al-Jabouri, 2009). Furthermore, infestation levels of medfly 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) (Hashem et al., 1987). In addition, Demirel & Akyol (2017) reported that percentages of infestation rates with medfly on satsuma mandarin were 10.91 in 2011 and 8.56 in 2012. Moreover, Yıldırım & Başpınar (2011) found that infestation rate of

pomegranate orchards during the harvest was 2.20 percent. Furthermore, Kasap & Aslan (2016) reported that the infestation rates of medfly on Acco pomegranate was 5.2% in Adana province.

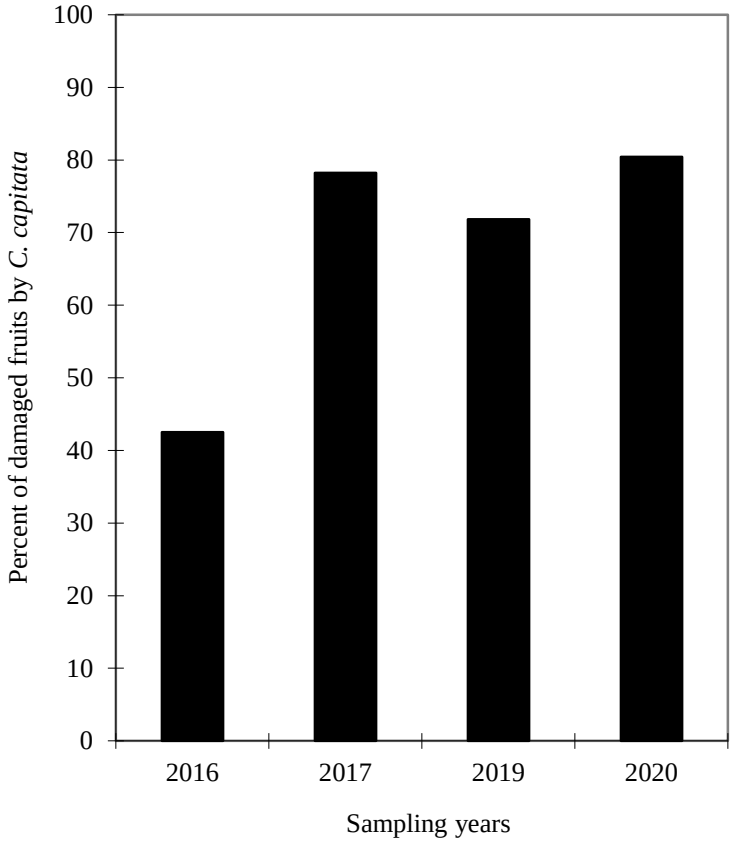

Figure 3. Percent of damaged fruits by medfly larvae during the sampling years
Şekil 3. Örnekleme yıllarında Akdeniz meyve sineğinin larvaları tarafından zarar görmüş meyvelerin yüzdesi

Fruit fly infests guava heavily during the winter season. Infestation level of *B. dorsalis* on guava has been reported as in the range of 19-42% in Punjab (Arora et al., 1998), while *B. zonata* infestation level has been reported as it varies from less than 10 to more than 20% on various cultivars in the state of Haryana (Rana et al., 1990). A damage of 25-50% has been reported to guava fruit by *Dacus zonatus* alone particularly in summer season (Syed et al., 1970). The highest level of fruit fly damage and percentage of infestation (92.5%) on guava fruit were observed due to the most abundant species *Bactrocera invadens* (Jose et al., 2013). In peninsular India, the infestation level of *B. dorsalis* varies from 10 to 41% on different cultivars of guava (Reddy & Vasuki, 2002), whereas the infestation level of *B. correcta* has been reported from 4.8 to 49.38% (Jalaluddin et al., 2001). It has been reported that on average *B. zonata* incurs crop loss on guava up to 75% in severe cases (Kapoor, 2000). The guava fruit fly, *Bactrocera correcta* (Bezzi) (Diptera: Tephritidae) was responsible for 60-80% of the loss. Guava and oriental fruit fly, *B. dorsalis* (Hendel) (Diptera: Tephritidae) caused 5-100% (Kafi, 1986), the Ber fruit fly, *Carpomya vesuviana* Costa, (Diptera: Tephritidae) causes 90-100% and the peach fruit fly, *B. zonata*, causes 30-80% damage (Mwatawala et al., 2006) on guava.

In conclusion, the current study was conducted in 2016, 2017, 2019 and 2020 to determine infestation rates of Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) on common guava, *Psidium guajava* L. (Myrtaceae) plant in Hatay province of Türkiye. As a result of four-year investigations, this pest was found on common guava fruits in all sampling years in Hatay province of Türkiye. Totals of 3240 medfly adults in 2016, 4161 medfly adults in 2017, 4621 medfly adults in 2019, and 2982 medfly adults in 2020 were counted. The highest percent of infested rates was recorded as 81.41 in 2020, followed by 78.22 in 2017, 71.84 in 2019 and 42.5 in 2016, respectively.

STATEMENT OF CONFLICT OF INTEREST

The author declare no conflict of interest for this study.

AUTHOR'S CONTRIBUTIONS

The author declare that he has contributed a full contribution to the article.

STATEMENT OF ETHICS CONSENT

Ethical approval is not applicable, because this article does not contain any studies with human or animal subjects.

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