Türk. entomol. derg., 2022, 46 (4): 373-383
DOI: http://dx.doi.org/10.16970/entoted.1102841

ISSN 1010-6960
E-ISSN 2536-491X

Original article (Orijinal araştırma)

Effectiveness of various insecticides and predatory bug, *Orius laevigatus* (Fieber, 1860) (Hemiptera: Anthocoridae) releases on *Thrips hawaiiensis* (Morgan, 1913) (Thysanoptera: Thripidae) in lemon, *Citrus limon* (L.) (Rutales: Rutaceae), orchard in Mersin (Türkiye)

Mersin (Türkiye)'de limon, *Citrus limon* (L.) (Rutales: Rutaceae) bahçesinde farklı insektisitlerin ve avcı böcek *Orius laevigatus* (Fieber, 1860) (Hemiptera: Anthocoridae) salımının *Thrips hawaiiensis* (Morgan,1913) (Thysanoptera: Thripidae)'e karşı etkinliği

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Abstract

The important invasive thrips species Hawaiian flower thrips, *Thrips hawaiiensis* (Morgan, 1913) (Thysanoptera: Thripidae) was first reported in Türkiye in 2015. Since then, it has been causing damage in lemon orchards. This study was conducted to reveal the most effective insecticides, the most effective spraying time and the efficacy of biological control. For this purpose, the effectiveness of five insecticides (480 g/l spinosad, 25% spinetoram, 100 g/l spirotetramat, 50% flonicamid, 240 g/l tau-fluvalinate), effect of three spray programs and effectiveness of predatory bug *Orius laevigatus* (Fieber, 1860) (Hemiptera: Anthocoridae) were tested in a lemon orchard [*Citrus limon* (L.) (Rutales: Rutaceae)] in Erdemli district of Mersin province in 2018 and 2019. In order to determine the most effective spraying time, three spray programs were tested. In Program 1, two sprays during the flowering period were applied. In Program 2, two sprays were applied, one at petal fall and the other at the small fruiting stage. In Program 3, one spray at petal fall and two sprays in the fruiting stages were applied. According to the results, 240 g/l tau-fluvalinate and 50% flonicamid showed the lowest efficacy of the insecticides in the three programs. Spinetoram was found the most effective of the others. Insecticide applications to control *T. hawaiiensis* during the flowering period (Program 1) had low efficacy. Program 3 was found to be the most effective. Predatory bug *O. laevigatus*, as a biological control agent was found to have a potential efficacy for suppressing *T. hawaiiensis* populations.

Keywords: Biological control, insecticide, lemon, *Thrips hawaiiensis*

Öz

Önemli bir istilacı thrips türü olan Hawai çiçek tripsi *Thrips hawaiiensis* (Morgan, 1913) (Thysanoptera: Thripidae) Türkiye'de ilk defa 2015 yılında rapor edilmiştir. O zamandan beri, limon bahçelerinde zarara neden olmaktadır. Bu çalışma, limon bahçelerinde sorun olan *T. hawaiiensis*'in mücadelesinde en etkili insektisiti, en etkili ilaçlama zamanını ve biyolojik mücadelenin etkinliğini ortaya koymak için yürütülmüştür. Bu amaçla, 2018 ve 2019 yıllarında, Mersin ili Erdemli ilçesinde bir limon bahçesinde [*Citrus limon* (L.) (Rutales: Rutaceae)] 5 farklı insektisitin (480 g/l spinosad, %25 spinetoram, 100 g/l spirotetramat, %50 flonicamid, 240 g/l Tau-fluvalinate), üç farklı uygulama programının ve avcı böcek *Orius laevigatus* (Fieber, 1860) (Hemiptera: Anthocoridae)'un etkinliği denemeye alınmıştır. En etkili ilaçlama zamanını belirlemek için 3 ilaçlama programı denenmiştir. Birinci programda çiçeklenme döneminde iki ilaçlama test edilmiştir. İkinci programda, biri taç yaprak dökümü diğeri küçük meyve dönemi olmak üzere 2 ilaçlama test edilmiştir. Üçüncü programda ise taç yaprak dökümünde bir, meyve döneminde 2 ilaçlama test edilmiştir. Elde edilen sonuçlara göre, 240 g/l tau-fluvalinate ve %50 flonicamid üç programın hepsinde ilaçlar arasında en düşük etkiyi göstermişlerdir. Spinetoram etkili maddeli ilacın, diğerlerine göre en etkili preparat olduğu tespit edilmiştir. *Thrips hawaiiensis*'e karşı çiçek döneminde yapılan insektisit uygulamalarının (program 1) etkinliği düşük bulunmuştur. Üçüncü program en etkili program olarak bulunmuştur. Biyolojik mücadele ajanı olarak avcı böcek *Orius laevigatus*'un *T. hawaiiensis*'i baskı altına alabilme potansiyeli olduğu belirlenmiştir.

Anahtar sözcükler: Biyolojik mücadele, insektisit, limon, *Thrips hawaiiensis*

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Received (Alınış): 13.04.2022 Accepted (Kabul ediliş): 10.10.2022 Published Online (Çevrimiçi Yayın Tarihi): 17.10.2022

Introduction

Citrus is an important crop for Türkiye for both domestic consumption and export. The major citrus plantations are in Adana, Antalya, Hatay and Mersin Provinces in the Mediterranean Region of Türkiye. Insect pests, diseases and weeds are the main problems during citrus production. About 90 pest species, 17 of which are known to be economically important pests, have been identified in Türkiye (Uygun, 2001; Anonymous, 2021). Thrips species are known as one of the most important pest group causing economic losses by feeding on the sap of citrus flowers, fruit and leaves (Yiğit et al., 1991; Childers & Beshear, 1992; Tunç, 1992; Childers & Achor, 1995; Tekşam & Tunç, 2007). This pest group cause spot and scar damage on young fruit which leads to high negative effects on market and export value of citrus fruit (Jeppson et al., 1975).

There are many thrips species recorded as a pest on citrus (Blank & Gill, 1997; Froud et al., 2001; Childers & Nakahara, 2006; Costa et al., 2006; Navarro et al., 2008; Tekşam & Tunç, 2009). *Heliothrips haemorrhoidalis* (Bouché, 1833) and *Pezothrips kellyanus* (Bagnall, 1916) are important thrips species recorded as a pest on citrus in the Mediterranean countries (Tekşam & Tunç, 2009; Navarro et al., 2008; Jacas et al., 2010; Vassiliou, 2010; Navarro-Campos et al., 2012). Aguilar-Fenollosa & Jacas (2013) revealed that citrus species were more attractive to thrips in the period that starting from petal fall until fruit reach to 4 cm size. Thrips species on citrus are listed by Tunç (1989, 1996). Another thrips species, *Frankliniella occidentalis* (Pergande, 1895) was first recorded in Türkiye in 1993 and spread to different regions causing damage to different host plant species (Tunç & Göçmen, 1994; Atakan & Tunç, 2004; Atakan, 2007a, b; Nas et al., 2007; Hazır et al., 2011; Hazır & Ulusoy, 2012).

In Türkiye, *Thrips hawaiiensis* (Morgan, 1913) (Thysanoptera: Thripidae) was found as a first record in 2015 in Mersin in the eastern Mediterranean Region (Atakan et al., 2015). Adults are nearly 1.3 mm, abdomen is brownish, thorax and head are orange-brown, legs are yellow or yellowish-brown (Atakan et al., 2015) (Figure 3). The first instars are white or nearly transparent in the beginning while second instars are white to yellow-white without wings (Figure 4) (Mau & Martin, 1993). Murai (2001) conducted a study on the biology of *T. hawaiiensis* and showed that this pest completed its life cycle from egg to adult in about 37 days at 10ºC, 10 days at 25ºC and 8 days at 30ºC. The main damage of this pest appears on the fruit. The pest causes silver-brown spotting, necrosis and deformation of fruit (Figure 5) (Goldaranzena, 2011; Atakan & Pehlivan, 2020a, b). *Thrips hawaiiensis* is a polyphagous flower thrips and occurs in Asia, the Pacific Region, North America and southern Europe (CABI, 1983; Sakimura, 1986; Nakahara, 1994; Reynaud et al., 2008; Goldaranzena, 2011).

Limited studies were conducted on the chemical control of *T. hawaiiensis.* Fu et al. (2020) studied the effectiveness of insecticides against *T. hawaiiensis* in the laboratory and field conditions. Under the field conditions, spinetoram, spirotetramat and cyantraniliprole were found to be more effective. Atakan & Pehlivan (2020b) suggested that chemical applications should be applied 1 month after petal fall and when a few flowers remain on the lemon trees. In addition, spinosad with summer mineral oil was found to be quite effective against *T. hawaiiensis* according to their field observations.

Orius laevigatus (Fieber, 1860) (Hemiptera: Anthocoridae) is one of the most commonly used commercial predatory bugs in various agroecosystems against aphids, whiteflies and thrips in biological control programs (Frescata & Mexia, 1996; Hernández & Stonedahl, 1999; Venzon et al., 2002; van Lenteren & Bueno, 2003). *Orius laevigatus* is commonly used against *F. occidentalis* in greenhouse pepper in the Mediterranean countries (Sanchez & Lacasa, 2002).

This study aimed to contribute for developing chemical and biological control strategies against *T. hawaiiensis* in lemon, *Citrus limon* (L.) (Rutales: Rutaceae), plantations. For this purpose, experiments were conducted to determine the efficacy of five insecticides (spinetoram, spirotetramat, spinosad, tau-fluvalinate, and flonicamid), the efficacy of biological control by *O. laevigatus* releases and efficacy of three management programs in a lemon orchard in Mersin in 2018 and 2019.

Materials and Methods

Study area and materials

This study was conducted in a 5-ha lemon orchard (36.618° N, 34.326° E) of the Alata Horticultural Research Institute located in Mersin Province, Türkiye in 2018 and 2019 (Figure 1). Lemon cv. Kütdiken trees were planted at 6 x 8 m and were 12 years old. Trial area was surrounded by orange and grapefruit orchards. The insecticide applications were done by using garden sprayer at a pressure of 5-7 bar. Figure 2 shows the insecticide applications in the trial area. An *O. laevigatus* stock culture was obtained from Biological Control Research Institute, Adana and mass rearing of the predator was conducted in the insectarium of the Institute.

Figure 1. Aerial view of trial area.

Figure 2. Insecticide applications during this study.

Methods

The thrips adults were collected during flowering (Figure 3) and fruiting (Figure 4) periods in the experimental orchard. The adults were preserved in alcohol in Eppendorf tubes and identified to species by one of us (EK) with the needed expertise. The prevalence of *T. hawaiiensis* in all species was 70-80% in samples from flowers in April-May and 95-100% in samples from fruit in June-July.

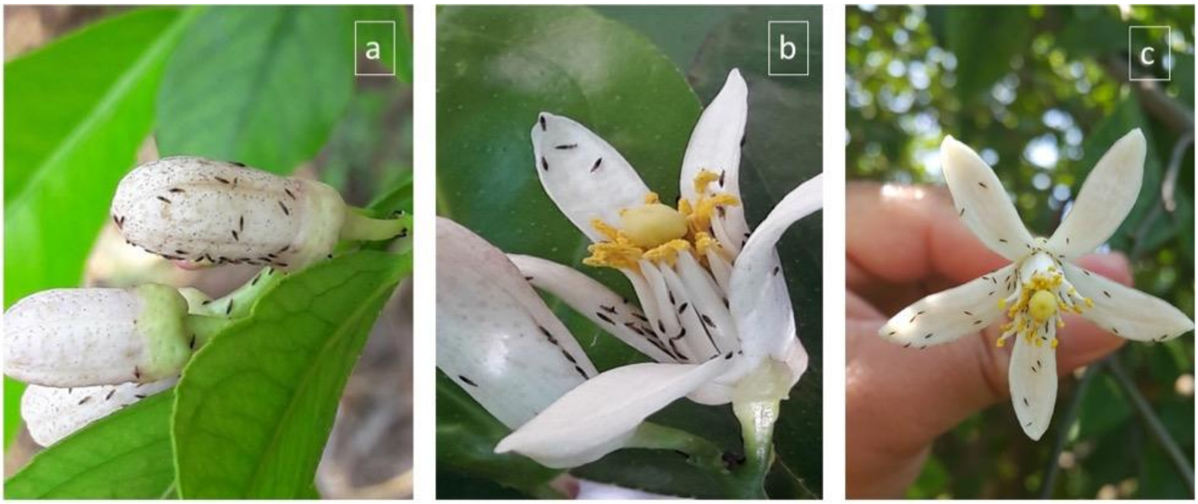

Figure 3 *Thrips hawaiiensis* individuals on lemon a) buds, and b, c) flowers.

Figure 4. a) *Thrips hawaiiensis* larvae on an unripe fruit, b) adult and larvae on a ripe fruit.

The experimental design was a randomized block design with six characters (4 insecticides + predatory bug release + control). Each treatment was applied to four replicates consisting of six trees each. One row was left as buffer between each treated plot. The insecticides tested in the first year were 480 g/l spinosad, 25% spinetoram, 100 g/l spirotetramat and 50% flonicamid, and in the second year, 480 g/l spinosad, 25% spinetoram, 100 g/l spirotetramat, 240 g/l tau-fluvalinate. The biological control agent used was the predatory bug, *O. laevigatus*. The predator adults were released at least a week after spraying to prevent them being exposed to the toxic effects of insecticides. The predators were released using packages of 20 adults up to 24 h old. Seven releases were made starting from full bloom until the fruit were 26-42 mm diameter.

Table 1 shows the applied rates of the insecticides and release of predatory bug.

Table 1. Active ingredients of insecticides, application rates and release number of *Orius laevigatus* in 2018 and 2019 spray programs

2018 spray programs		2019 spray programs	
Active Ingredient	Application rate	Active ingredient	Application rate
Spinetoram 25% WG	50 g/100 l	Spinetoram 25% WG	50 g/100 l
Spirotetramat 100 g/l SC	100 ml/100 l	Spirotetramat 100 g/l SC	100 ml/100 l
Spinosad 480 g/l SC	50 ml/100l	Spinosad 480 g/l SC	50 ml/100 l
Flonicamid 50% WG	15 g/100 l	Tau-fluvalinate 240 g/l	50 g/100 l
Predator (*Orius laevigatus*)	20 adults/tree	Predator (*Orius laevigatus*)	20 adults/tree
Control	No application	Control	No application

Spray programs in the various phenological periods

Three spray programs were tested in the trial in order to determine the best timing for chemical control. Each program was started at a particular phenological period of the lemon trees. In Program 1, two insecticide sprays were applied; the first at 50% flowering, and the second at 100% flowering (full bloom). In Program 2, two insecticide sprays were applied; the first at 20% petal fall, and the second when the fruit were about 18-33 mm in diameter. In Program 3, three insecticide sprays were applied; the first at 20% petal fall, the second when the fruit were about 18-33 mm in diameter and the third when the fruit were about 26-42 mm in diameter. In 2019, first spray in Program 1 was not be done at 50% flowering because there was no *T. hawaiiensis* present in the flowers therefore the treatments started at full bloom. Table 2 shows the phenology and dates of applications in each program in 2018 and 2019.

Table 2. Phenology and treatment application dates in three spray programs in 2018 and 2019

Phenology	2018 spray programs				2019 spray programs			
	Date	1	2	3	Date	1	2	3
50% flowering	3 April	++	--	--	--	--	--	--
100% flowering (full bloom)	10 April	++	--	--	13 May	++	--	--
20% petal fall + fruit (5 mm)	17 April	--	++	++	20 May	--	++	++
Small fruit (18-33 mm)	24 April	--	++	++	11June	--	++	++
Large fruit (26-42 mm)	15 May	--	--	++	27 June	--	--	++

Assessments

Assessments were made 1 month after last application in each year. The scarring and the silvering damage larger than 2 mm (shown in Figure 5) were recorded. The amount of damaged fruit was determined by examining 100 randomly selected fruit on the inward-facing branches of six trees in each plot. The assessment of biological control was made 2 weeks after last predator release. The results for both years are given in Tables 3 and 4. The effect of treatments relative to the control using Abbott formula (Abbott, 1925) are given in Table 5. Abbott's formula was used to determine relative effects of insecticides and *O. laevigatus* in Table 4 and 5 with below formula.

$$\%\text{Relative effect} = 1 - \left(\frac{Damaged\ number\ of\ fruit\ after\ treatment}{Damaged\ number\ of\ fruit\ in\ Control}\right) * 100$$

Figure 5. Damage symptoms of *Thrips hawaiiensis* on lemon fruit in the experimental area.

Identification of thrips species

To determine the Thysanoptera (thrips) species in the trial area, the flower and the fruit samples taken from the experimental plots were brought to Çukurova University Faculty of Agriculture Plant Protection Department Industrial Plant Pests laboratory in Eppendorf tubes (50 ml). Thrips were identified according to Atakan et al. (2015). The samples were extracted from flowers and fruit in Petri dishes and placed in 60% ethanol. These were the transferred to AGA medium (10:1:1 60% ethyl alcohol, glycerin and glacial acetic acid) for 2 days in order to facilitate their preparation and for this purpose to soften their bodies before returning them to 60% alcohol. Samples were placed separately into glass Petri dishes and kept in 10% KOH for approximately 1 h at 48°C. Body contents of thrips specimens were evacuated by entering the hind leg bases of thrips individuals with a very fine-tipped needle (maceration). The samples were cleaned by passing through alcohol series and transferred to Hoyer medium to prepare their microscopic slides.

Statistical analysis

Data were tested for normality and homogeneity of variance. One-way ANOVA and Duncan multiple comparison tests were performed with the SPSS 23 statistic program.

Results and Discussion

Results for 2018 spray programs

In Program 1, the results showed that there is no significant difference between control and 50% flonicamid for the number of damaged fruit (Table 3). The other insecticides gave control that was statistically different from control but these were not significantly different from each other. The number of damaged fruit was high in Program 1 compared to the other programs. Even with spinetoram, as the most effective insecticide for reducing damage in Program 1, its effect relative to the control was low (Table 5). This indicates that insecticides applied at 50-100% flowering may be unable to protect the fruit from thrips damage.

In Program 2, flonicamid was not statistically different from control (Table 3). The other insecticides provided statistically significant control but these were not significantly different from each other. The relative effects of the insecticides were higher than with Program 1 (Table 5). Spinetoram had the highest relative effect.

Although the results of Program 3 were similar to Program 2, the effect of spinetoram was statistically greater than spirotetramat and spinosad (Table 3). Again, spinetoram had the highest relative effect (Table 5).

Flonicamid failed to lower the amount of damaged fruit in all programs in 2018. For this reason, it was excluded from the trials of 2019. Overall is concluded from the 2018 insecticide data that spraying during the fruiting period suppress *T. hawaiiensis* population more effectively than spraying during the flowering period.

Release of *O. laevigatus* in 2018 was different from control (Table 4) which shows that it can reduce damage. However, the relative effect of this application was lower than the insecticides (Table 5).

Table 3. Number of damaged fruit with chemical control in 2018 and 2019 spray programs

Treatment	2018 spray programs			2019 spray programs		
	1	2	3	1	2	3
Control	7.52 ± 0.91 a	7.52 ± 0.91 a	7.52 ± 0.91 a	30.9 ± 0.91 a	30.9 ± 0.91 a	30.9 ± 0.91 a
50% Flonicamid	7.85 ± 1.29 a	6.65 ± 1.29 a	7.45 ± 1.29 a	-	-	-
240 g/l Tau-fluvalinate	-	-	-	15.8 ± 0.16 b	15.6 ± 0.85 b	14.8 ± 0.89 b
25% Spinetoram	4.65 ± 0.92 b	3.60 ± 0.92 b	2.50 ± 0.92b	8.56 ± 0.34 c	7.81 ± 0.69 c	7.43 ± 0.27 c
100 g/l Spirotetramat	5.40 ± 1.15 b	4.45 ± 1.15 b	4.40 ± 1.15c	10.9 ± 0.59 d	12.3 ± 0.14 d	12.0 ± 0.57 d
480 g/l Spinosad	5.35 ± 0.96 b	4.30 ± 0.96 b	5.20 ± 0.96 c	8.59 ± 0.87 c	9.96 ± 0.58 e	10.2 ± 0.49 e

Means followed by same letter within columns are no statistically different according to Duncan multiple comparison test ($p < 0.05$).

Table 4. Number of damaged fruit and relative effect of biological control in 2018 and 2019 spray programs

Treatment	Damaged Fruit	Relative effect (% of control)	Damaged Fruit	Relative effect (% of control)
Control	7.5 ± 2.5 a	44.0	30.9 ± 0.91 a	45.6
Releases of *Orius laevigatus*	4.2 ± 1.2 b		16.8 ± 0.81 b	

Abbott's formula was used to determine relative effects of biological control.

Table 5. Relative effect (% of control) of chemical control in preventing damage to fruit in 2018 and 2019 spray programs

Treatment	2018 spray programs			2019 spray programs		
	1	2	3	1	2	3
50% Flonicamid	0	11.6	0.93	-	-	-
240 g/l Tau- fluvalinate	-	-	-	49.0	49.6	52.2
25% Spinetoram	38.2	52.1	66.8	72.3	74.7	75.9
100 g/l Spirotetramat	28.2	40.8	41.5	64.7	60.1	61.1
480 g/l Spinosad	28.9	42.8	30.9	72.2	67.7	67.1

Abbott's formula was used to determine relative effects of insecticides.

Results for 2019 spray programs

In 2019, thrips population was higher than in 2018. Table 3 shows the average number of damaged fruit in the three programs in 2019. With Program 1, spinetoram, spirotetramat and spinosad were more effective than tau-fluvalinate, with spinetoram have the highest relative effect of 72.3% and tau-fluvalinate the lowest at 49.0% (Table 5).

In Program 2, all insecticides were significantly different from the control and each other (Table 3). The greatest control was obtained with spinetoram. The relative effect was also the greatest with spinetoram at 74.7% followed by spinosad at 67.7% (Table 5).

In Program 3, as in Program 2, spinetoram, spirotetramat and spinosad were significantly different from the control and each other (Table 3). The lowest damage was obtained with spinetoram. The greatest relative effect was again with spinetoram at 75.9% followed by Spinosad at 67.1% (Table 5). Of the treatments, Tau-fluvalinate had the lowest relative effect.

The effect of *Orius* releases was limited (Table 4) but still promising because it is an environmentally friendly method.

Combined results and observations

When both years are considered, it was seen that spinetoram was the most efficacious insecticide in lowering the thrips damage in lemon fruit. Program 3 was found to be the most effective program for the timing of the sprays.

During the study, it was observed that *T. hawaiiensis* populations first developed in the flowers of various weed species such as *Capsella bursa pastoris* (L.) (Brassicales: Brassicaceae) in and around the orchard. The thrips adults moved from weeds to the lemon trees at the beginning of flowering to form populations on lemon flower buds. It was observed that the continuous presence of even a small number of flowers on lemon trees in the fruiting period was a factor to support the thrips population and to increase the damage levels.

There are limited studies on the effectiveness of insecticides against *T. hawaiiensis*. Fu et al. (2020) studied the efficacy of imidacloprid and spirotetramat via injection in banana flowers, and this was effective under the field conditions and there were no negative effects on fruit yield.

Srivasta et al. (2008) studied the effectiveness of spinetoram against thrips in pepper in field conditions in Florida, USA and found that spinetoram 61 g ai/ha was as effective as spinosad 140 g ai/ha against *F. occidentalis*, *Frankliniella tritici* (Fitch, 1855) and *Frankliniella bispinosa* (Morgan, 1913) (Thysanoptera: Thripidae). In addition, the *Orius insidiosus* (Say, 1832) (Hemiptera: Anthocoridae) population and predation was higher and sufficient in the experiments.

Palumbo & Richardson (2008) conducted a study to determine the efficacy of spinetoram and spinosad on Romaine lettuce against *F. occidentalis* under field conditions with spinetoram found to be more effective than spinosad. However, spinetoram and spinosad should not be used rotationally because these active ingredients have the same mode of action and may their frequent use may cause resistance problems.

Jones et al. (2005) conducted a study on the effectiveness of spinosad against *F. occidentalis*, and effects of spinosad on some biological control agents in cucumber in southern Ontario, USA and found that this active ingredient had moderate toxicity to *O. insidiosus,* high toxicity to *Encarisa formosa* Gahan, 1924 (Hymenoptera: Aphelinidae) but low toxicity to *Amblyseius cucumeris* (Oudemans, 1930) (Acarina: Phytoseiidae).

Siebert et al. (2016) studied to compare the efficacy of spinetoram and spinosad against thrips on cotton and results showed that *Frankliniella fusca* (Hinds, 1902) (Thysanoptera: Thripidae) is more sensitive to spinetoram. In addition, spinetoram was not found to be adequately effective when the thrips population was high.

Conclusions

This study was conducted not only to find out the most suitable and effective insecticide against *T. hawaiiensis* but also to find out the best timing to initiate and maintain the chemical control. Flower application (Program 1) was ineffective and therefore not economical. However, in Programs 2 and 3, when the fruit were 18-33 mm and 26-42 mm in diameter respectively, were found to be effective. Similarly, Atakan et al. (2021) determined the critical period to control of *T. hawaiiensis* was 3-5 weeks after petal fall in lemon orchards. The insecticide 25% spinetoram was the most successful insecticide in all programs with Spinosad (480 g/l) the second most effective in both years.

In the present study, the biological control potential of *O. laevigatus* was also studied. Although the predator was less efficacious than the insecticides, it should be considered as an option because this pest can easily gain resistance to the insecticides, therefore, the potential value of the predator should not be ignored. It might be possible to increase the effectiveness of the predator by releasing more than 20 adults per tree, an option that should be tested in the field. In summary, for the biological control of *T. hawaiiensis,* it is concluded that *O. laevigatus* has potential and can be used in low population orchards where 10% of flowers are infested with the pest. For orchards with higher pest populations, the predator releases would be more effective when integrated with narrow-spectrum and environmental-friendly insecticides like those in the spinosyn group or higher application rates of *O. laevigatus*. Similarly, Srivastava et al. (2018) conducted field experiments in 2005 and 2006 in northern Florida to evaluate the various rates of spinetoram for control of thrips and to determine the impact on natural populations of *O. insidiosus*. In that study, the mean numbers of the predator were quite high in all treatments, and their numbers relative to the numbers of thrips indicated that predation was sufficient to suppress thrips populations in all treatments.

There are no registered insecticides for *T. hawaiiensis* in citrus in Türkiye. The insecticides that are registered against thrips in other crops are very expensive so the growers avoid using them because of high costs. The usage of ineffective products results in failure in thrips management and preventing this may be possible with the use of the natural enemy, *O. laevigatus*.

Besides chemical and biological control of this pest, cultural measures are also of importance. During our study, we observed that *T. hawaiiensis* adults form a colony and lay eggs on the fruit that remained on the trees after harvest (Figure 4b). The thrips adults and larvae feed on these orange/yellow lemon fruit and support a population in the orchard before the trees commence flowering. Consequently, fruit that are not picked during harvest and left on the tree, act as a reservoir of thrips that reinvest flowers, so removal and appropriate disposal of these kinds of fruit is recommended. In addition, the flowers that develop during the fruiting period that have no economic importance, act as a reservoir of thrips that can move to and damage fruit and, therefore, should be picked and removed from the orchard.

Acknowledgments

The authors thank to the Mersin Chamber of Commerce and Industry and the Republic of Türkiye Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies Adana Biological Control Research Institute for their financial support.

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