International Journal of
Agriculture, Environment and Food Sciences

JAEFS e-ISSN : 2618-5946 DOI: 10.31015/jaefs.2019.2.9 www.jaefs.com

Research Article Int J Agric Environ Food Sci 3(2):106-111 (2019)

Population change and distribution of *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) in strawberry greenhouses

Sevgi Gokkaya[1] **Ismail Karaca**[1,*]

[1]Isparta University of Applied Sciences, Faculty of Agricultural Sciences and Technologies, Department of Plant Protection, Isparta

[*]Corresponding Author: ismailkaraca@isparta.edu.tr

Abstract

Plant protection has an important place among problems related to strawberry cultivation. Red spider mites and thrips are the main pests observed on strawberries, and among these, the most important for Antalya province is *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae). This study was performed in 2017 and determined the population change and in-greenhouse distribution of *Frankliniella occidentalis* with direct counts on flowers and blue traps in three strawberry greenhouses in Serik county in Antalya province. The research was completed in three different greenhouses, with 25 blue sticky traps in the 1st greenhouse with 4 da size and the 2[nd] greenhouse with 3.5 da size and 15 traps in the 3[rd] greenhouse with 2.5 da size. Traps were collected each week, with the numbers of thrips recorded. On dates when the traps were changed, the thrips found on plants were counted by examining ten flowers on three plants below or close to the blue sticky traps by eye or with a loupe with counts performed until the day of harvest. At the end of the study, the pest population reached a certain level from the start of flowering in November in the three greenhouses, and then fell in the middle of December. From the middle of December, the population began to increase and this increase continued until the strawberries were harvested. The number of pests per trap varied from 0.6 to 1904.2. When the whole production season is considered, the mean pest numbers per trap in the three greenhouses were 287.2, 72.3 and 271.27 thrips/trap. The number of pests per flowerhead varied from 0.0 to 2.5. When the whole production season is considered, the mean numbers of pests per flowerhead in the greenhouses were 0.26, 0.08 and 0.16 thrips/flowerhead. In light of the data obtained in the study, and considering the economic damage threshold value recommended by previous research results, it was concluded there is no need for chemical intervention against *F. occidentalis* in the region.

Keywords: Antalya, Greenhouse, Population change, Western flower thrips

Received: 03 May 2018 Accepted: 28 May 2019 Published: 28 June 2019

Introduction

With an important place in the berry fruit group, strawberry (*Fragaria* sp.) (Rosaceae) is cultivated in many parts of the world. The perennial, herbaceous, evergreen strawberry is a plant rich in taste, vitamin and mineral material. It can be found in markets in the months before other fruit species, has very high allure and vitamin C content which has led to this fruit being very popular in markets in some countries and being sold for high prices (Erenoğlu et al., 2000).

In Turkey, strawberry cultivation began in the 1970s and has rapidly increased especially in recent years. Turkey's strawberry production of 353 thousand tons is third place after production from the USA and Mexico (TZOB, 2015).

Strawberry cultivation is found in a large portion of Turkey due to varying climatic and soil characteristics. However, the largest portion of Turkey's strawberry production comprises production from the Mediterranean, Marmara and Aegean Regions. In 2014, Turkish production was led by Mersin with 132,556 tons, following with Aydın at 62,859 tons and Antalya in third place with 56,412 tons, and these provinces were followed by Bursa, Manisa, Konya, Elazığ, and İzmir (TZOB, 2015).

In addition to economic problems in strawberry cultivation, problems related to plant protection have an important place. The main pests for strawberry are red spider mites and thrips with the most important of these in Antalya being *Frankliniella occidentalis* Pergande (Thysanoptera: Thripidae) (Keçecioğlu and Madanlar, 2002). Known as the Western Flower Thrips (WFT), *F. occidentalis* was first identified in Turkey on vegetables in Antalya in 1993 (Tunç and Göçmen, 1995) and reported a short time later in Çukurova (Atakan et al., 1998), İzmir (Yaşarakıncı and Hıncal, 1997) and the southeast Anatolian region (Göven and Özgür, 1990; Efil et al., 1999; Yıldız and Özpınar 1999).

As intervention against *F. occidentalis* generally involves intense pesticide application, resistance in observed against pesticides, which causes cultivators to use even more pesticides (Immaraju et al., 1992; Brodsgaard,

Cite this article as:
Gokkaya, S., Karaca, I. (2019). Population change and distribution of *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) in strawberry greenhouses. Int. J. Agric. Environ. Food Sci., 3(2), 106-111. DOI: https://dx.doi.org/10.31015/jaefs.2019.2.9
Year: 2019 **Volume:** 3 **Issue:** 2 (June) **Pages:** 106-111
Available online at : http://www.jaefs.com - http://dergipark.gov.tr/jaefs

1994; Espinosa et al., 2002; Herron and James, 2005; Dağlı and Tunç, 2007; Gao et al., 2012; Dağlı, 2018).

These applications have direct negative effects on beneficial insects and indirectly cause environmental pollution. These problems have led to the necessity to apply integrated and biological intervention methods.

In Turkey, thrips intervention comprises a significant portion of biotechnical intervention methods. Determining the population change and in-greenhouse distribution and assessing the threshold of population density will be beneficial in deciding about interventions. As stated by Binns and Nyrop (1992), deciding is an important aspect of current Integrated Intervention Programs, and will continue to play an important role in maturation of integrated intervention programs in the future. It is important to know the number and distribution of pests in an area when deciding about precautions to take against these pests. This may be determined with a good sampling method.

In this study, population variation and in-greenhouse distribution graphs were created for pests with the aid of blue traps and direct thrips counts on flowers in three strawberry greenhouses in Kadriye neighborhood of Serik county in Antalya province.

Materials and Methods

This study was completed in Kadriye Municipality linked to Serik county in Antalya where strawberry production is intensely practiced. The main materials in the trial were *F. occidentalis* populations, strawberry plants and blue sticky traps.

The study was completed in high tunnel greenhouses with sizes of 2.5, 3.5 and 4 da.

In the trial greenhouses where the research was completed, all processes related to plant cultivation were performed by producers in accordance with regional conditions. Some information related to the trial greenhouses in the study is given in Table 1.

The study was completed in two stages. The first stage used blue sticky traps to count mobile insects. With this method, blue traps were homogeneously hung in the strawberry areas with 25 blue sticky traps each in the 1st greenhouse with 4 da size and the 2nd greenhouse with 3.5 da size and 15 traps in the 3rd greenhouse with 2.5 da size. The traps were placed at 5-meter intervals. The traps were hung at 10-15 cm above the strawberry plants. The trial used the 10 x 25 cm size blue sticky traps obtained from Bioglobal Company. The first traps were hung on 20 November 2016 to monitor the change in pest populations. The labels on the traps had information about the date they were hung, trap number and greenhouse number. Traps were collected every week and thrips numbers were counted. On the dates the traps were changed, ten flowers on three plants immediately below or near the blue sticky traps were investigated by eye and with a loupe. Counts continued until the 25 March 2017.

Table 1. Information about the greenhouses in Kadriye Municipality where the experimens were established

Greenhouse no	Seedling type	Planting date	Beginning of flowering	Uprooting date	Coordinates
1	Frigo seedling	05.10.2016	20.11.2016	20.06.2017	36.8910940, 31.0026100
2	Tubed fresh seedling	29.09.2016	10.11.2016	26.05.2017	36.8912920, 31.0043500
3	Frigo seedling	07.10.2016	20.11.2016	20.06.2017	36.8904620, 31.0081500

Results and Discussion

In line with the Material and Method, the logarithmic graphs of population variation for *F. occidentalis* identified from counts of sticky traps in the greenhouses are given in Figure 1. During the study, a total of 379,208 individual thrips were counted with 376,798 in traps and 2,410 on flowers during the strawberry season.

When Figure 1 is investigated, the population development for *F. occidentalis* in the three greenhouses appears to be similar. Within the greenhouse, in November at the start of flowering a certain pest population level was reached and this level fell until the middle of December. From the middle of December, population increases began and these increases continued until strawberries were harvested. The number of pests per trap varied from 0.6 to 1904.2. Considering the whole production season, the mean number of pests were 287.2, 72.3 and 271.27 thrips/trap in the three greenhouses, respectively.

Data obtained from studies of flowers in parallel to trap studies are given in Figure 2.

When Figure 2 is investigated, there appears to be continuous variation in the pests on flowers. The number of pests per flower head varied from 0.0 to 2.5. When the whole production season is considered, the mean number of pests was 0.26, 0.08 and 0.16 thrips/flower in the three greenhouses, respectively.

Gonzalez Zamora and Garcia Mari (2003) reported the number of pest larvae on flower heads of old and young flowers varied from 2.60 to 3.53 while the number of adults varied from 0.56 to 4.23. Atakan (2008) determined the number of *F. occidentalis* larvae varied from 0.04 to 1.36 per flower head with the number of adults varying from 4.24 to 22.48 in 5 samplings of strawberry flowers in Adana performed in May and June 2008. Yıldırım and Başpınar (2013) in a study of two strawberry greenhouses in Aydın found *F. occidentalis* was the only thrips species and determined the pest began to be observed in the area from the middle of April, reached highest levels in June and population levels began to fall after July. The study reported the thrips count per flower were between 0.0 to 11.33. Atakan et al. (2016) in a study of a strawberry greenhouse in Adana in 2011-2012 identified the thrips larva and adult numbers were 0.0/flower to 5.05 larvae/flower and 11.75 adults/flower in 2011, while in 2012 this varied from 0.0/flower to 2.35 larvae/flower and 13.30 adults/flower.

When this study is compared with literature findings, it it appears to be similar, with the number per flower head found to be lower than maximum pest numbers.

The distribution of *F. occidentalis* linked to trap locations is given separately for each of the three greenhouses in Figure 3.

When Figure 3 is investigated, though the structure and trial patterns in the 1st and 2nd greenhouses were very similar, there were differences observed in both the population density and distribution within the greenhouse of pests. In greenhouse no. 1, a total of 208,207 thrips were caught during the whole experiment in all traps, while this number was 50,590 in greenhouse no. 2. In the 1st greenhouse, the first three places in terms of trapping were traps no. 24, 22 and 4, while in the 2nd greenhouse the first three places went to traps no. 9, 10 and 4. As understood from the trial pattern in Figure 3.3 and 3.4, the first two traps in greenhouse no. 1 were located at the east edge of the greenhouse, while the first two traps in greenhouse no. 2 were located in the northwest of the greenhouse. In both greenhouses, trap no. 4 located at the east edge of the greenhouse attracted the same proportion of pests. In total, 118,001 thrips were caught in greenhouse no. 3, with traps attracting most pests found in the center of the north edge of the greenhouse (Figure 3).

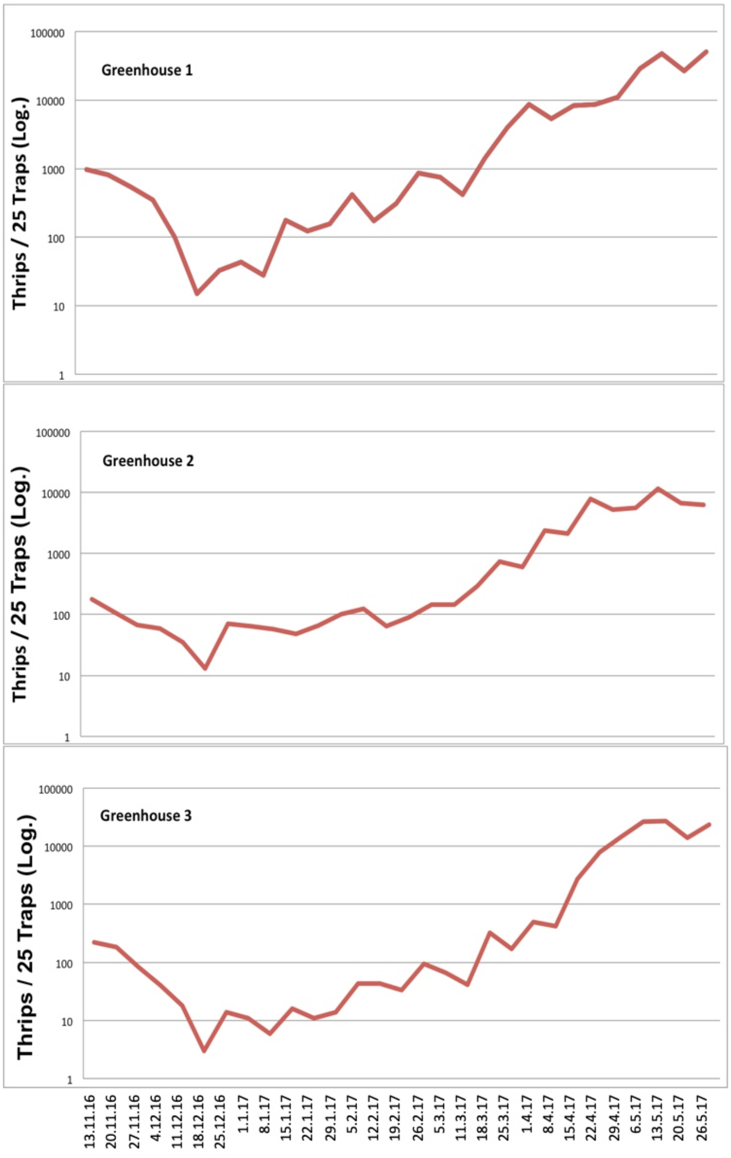

Figure 1. Population development of *Frankliniella occidentalis* in blue sticky traps. Logarithmic data were used in the graphs for the numbers of thrips population.

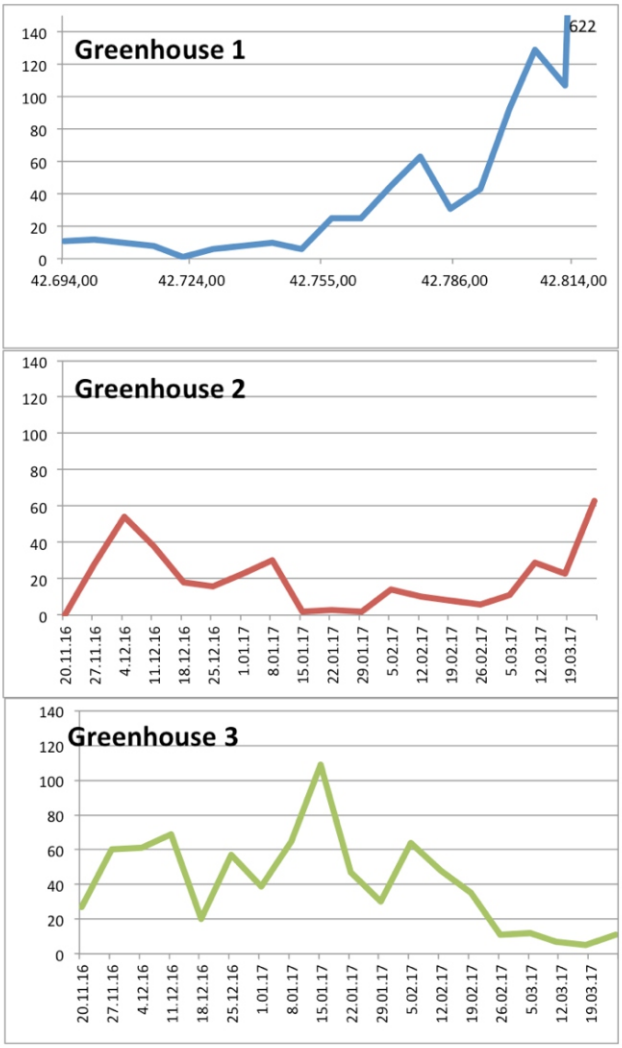

Figure 2. Population development of Frankliniella occidentalis on strawberry flowers

When all greenhouses are considered together by investigating Figure 3, there is no pattern found in terms of pest distribution.

When Figure 3 is investigated, the number of thrips caught in traps in the first greenhouse was least in the central row in east-west direction. In the second greenhouse the traps in the northeast corner and in the southwest corner had least number of thrips identified. In the third greenhouse, all traps found on the east edge of the greenhouse had lowest number to thrips.

In the study, as mentioned above, counts directly on strawberry flowers were completed, with the number of thrips according to location of flowers in the greenhouses given in Figure 4.

 DOI: https://dx.doi.org/10.31015/jaefs.2019.2.9

When Figure 4 is investigated, the first two greenhouses which resemble each other appear not to show similarities linked to the number of thrips in relation to the location of the flowers. In the first greenhouse, the regions in first place for density were the numbers 6, 3 and 1, while in the second greenhouse, the numbers 1, 2 and 16 were in first place. In the first greenhouse, these regions were two in the southwest of the greenhouse and one in the center of the west edge of the greenhouse. In the second greenhouse, again, the first two regions in terms of density were in the southwest, with the third in the southwest edge of the greenhouse. When the figure is investigated, the thrips population in the first greenhouse clustered in the southwest, while they were distributed mainly along the greenhouse edges in the second greenhouse. In the third greenhouse, the thrips population did not show clear distribution, with population a little higher in the northeast of the greenhouse.

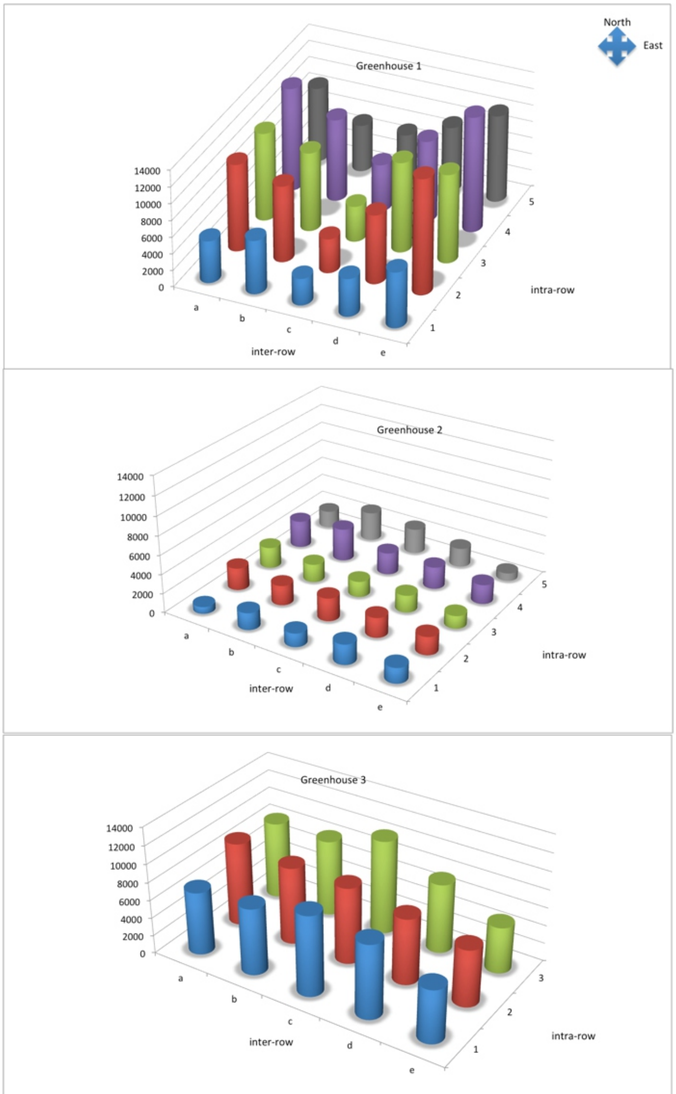

Figure 3. Distribution of *Frankliniella occidentalis* caught in traps within the greenhouses (position of traps shown by a, b, c, d, e length of greenhouse, 1, 2, 3, 4, 5, width of the greenhouse. Trap numbers: a1:1, a2:2, a3:3, a4:4, a5:5, b1:6, b2:7, b3:8, b4:9, b5:10, c1:11, c2:12, c3:13, c4:14, c5:15, d1:16, d2:17, d3:18, d4:19, d5:20, e1:21, e2:22, e3:23, e4:24, e5:25). Cumilative data according to time were used in the graphs for the numbers of thrips population.

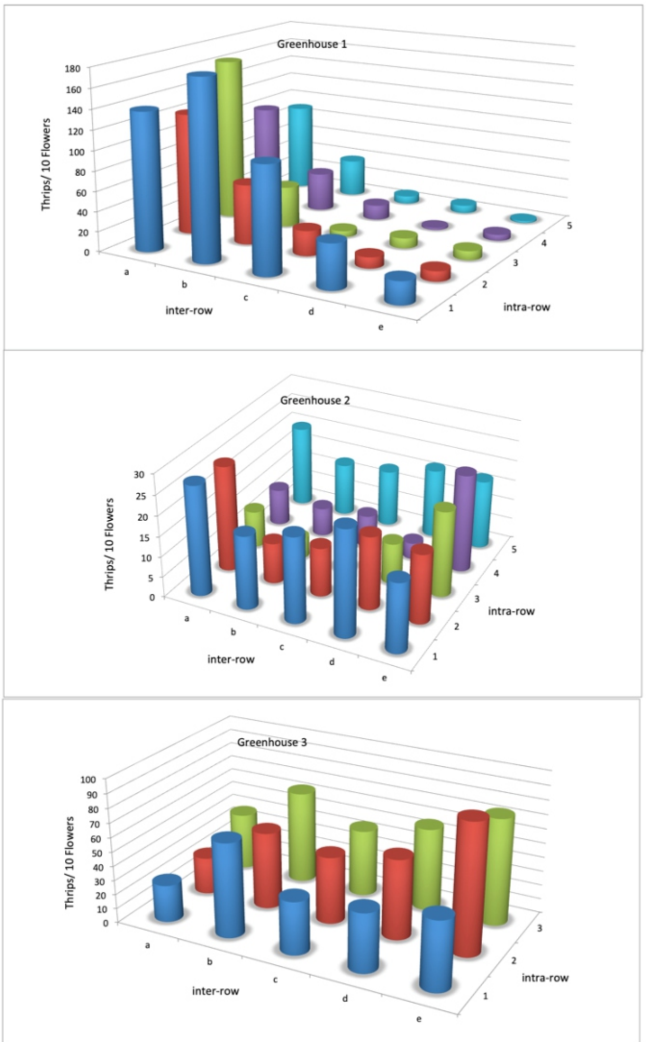

Figure 4. In-greenhouse distribution of thrips populations on flowers according to trap locations. Cumilative data according to time were used in the graphs for the numbers of thrips population.

Steiner and Goodwin (2005a) used yellow sticky traps for weekly counts in strawberry greenhouses and used transformed numbers to identify a low-level correlation between pest numbers on flowers and individuals in traps and emphasized that 20-30 females caught per trap reflected the economic damage threshold. This count was equivalent to 5 adult females per flower head with Steiner and Goodwin (2005b) accepting 5 adult females on flowers as the economic threshold. Grema et al. (1997) reported the number of thrips causing economic harm was 10 individuals per flower, while Coll et al. (2006) gave the economic damage threshold for *F. occidentalis* as 10 individuals/flower and 24 individuals/flower for winter and spring strawberries. Atakan et al. (2016) in a study of strawberries in Adana emphasized that damage was not observed in spite of 10 or more thrips adults per flower on more than 60% of strawberry flowers. Again, the authors in this study proposed that 15 pests per flower head did not cause damage and that the economic damage threshold for these pests needs to be recalculated.

In this study, during 19 weeks, counts determined the maximum thrips numbers per flower head were 2.5 and 0.3 on the 25 March in no. 1 and no. 2 greenhouses, while it was 0.4 on 15 January for no. 3 greenhouse. This study did not observe any signs of harm to fruit caused by thrips.

Conclusion

One of the most important elements in deciding to intervene against pests is knowing the population density of the pests. Sampling methods are important for identification of the population density of pests. One of the factors affecting samples and selection of sampling methods is the reproductive status of pests and distribution of nutritional areas. As stated by Southwood (1976), sampling methods should be designed linked to the insect species and according to the biology and distribution of the insects.

Spending a portion of their lives in the soil and with excessive reproductive ability, *F. occidentalis* was counted using blue sticky traps and directly on flowers in this study in an attempt to determine the status of this pest within the greenhouse.

The results of the study reveal that the pest did not show a certain distribution but spread throughout the greenhouse when both thrips numbers in traps and direct counts on flowers are assessed. As a result, it was concluded that in order to monitor and determine the pest population, random sampling should be made to represent the whole greenhouse rather than oriented sampling.

Additionally, as there was no linear correlation between the individual numbers caught in traps and direct counts on flowers, within the framework of integrated intervention studies, it is considered that direct counts on flowers will be more accurate in deciding on interventions. However, it is recommended that blue sticky traps be used for identification of the time the pest occurs and determination of population changes.

In light of the data obtained in the study, and considering the economic damage threshold values proposed in line with previous research results, the opinion that there is no need for chemical intervention against *F. occidentalis* in the region gained support.

In conclusion, due to different opinions and approaches related to the economic threshold of Western Flower Thrips in studies to date, there is a need for studies to create a more dynamic threshold for the pest based on the reality that this species will give different responses to different ecological factors, as with all pests.

Acknowledgements

We thank Süleyman Demirel University Scientific Research Projects Coordination Unit for material support of this study with project number 4999-YL1-17.

References

Atakan, E. (2008). Thrips (Thysanoptera) species and thrips damage associated with strawberry in Adana and Mersin provinces, Turkey. Turkish Journal of Entomology, 32 (2), 91 – 101. [Google Scholar]

Atakan, E., Ozgur, A.F., Kersting, U. (1998). *Frankliniella occidentalis* (Pergande) (Thysanoptera, Thripidae) on cotton in Çukurova Region. Procededings Sixth International Symposium on Thysanoptera, Antalya, Turkey, April 27 - May 1, 7- 12 pp.

Atakan, E., Pehlivan, S., Kiminsu, A. (2016). Pest status of western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), in tunnel-grown strawberry. Turkish Journal of Entomology, 40 (1), 61-71. [Google Scholar] [CrossRef]

Binns, M.R., Nyrop, J.P. (1992). Sampling insect populations fort he purpose of IPM decision making. Annu. Rev. Entomol. 37, 427-453. [Google Scholar] [CrossRef]

Brodsgaard, H. F. (1994). Insecticide resistance in European and African strain of Western flower thrips (Thysanoptera: Thripidae) tested in a new residue-on-glass test. Journal of Economic Entomology, 87 (5), 1141-1146. [Google Scholar]

Coll, M., Shakya, S., Shouster, I., Nenner, Y., Steinberg, S. (2006). Decision-making tools for Frankliniella occidentalis management in strawberry: consideration of target markets. Entomologia Experimentalis et Applicata 122, 59-67. [Google Scholar] [CrossRef]

Daglı, F. (2018). Spinosad resistance in a population of Frankliniella occidentalis (Pergande, 1895) from Antalya and its cross resistance to acrinathrin and formetanate. Turkish Journal of Entomology, 42 (4), 241-251. [Google Scholar] [CrossRef]

Daglı, F., Tunc, I. (2007). Insecticide resistance in Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae) collected from horticulture and cotton in Turkey. Australian Journal of Entomology, 46, 320-324. [Google Scholar] [CrossRef]

Efil, L., Ozgür, A.F., Ilkhan, A. (1999). The effect of different sowing dates to populatıon development of thrips tabaci lind. (Thysanoptera: Tyripidae) in Harran conditions. Harran Journal of Agricultural and Food Sciences, 3 (3-4), 97-106.

Erenoglu, B., Ergun, M. E., Ozdemir, E., Pirlak, L. (2000). Strawberry and other berries (Raspberries, Blackberries, Currants, Blueberries) report. DPT Report Number: 2649 – OIK Report Number: 657, 494-539.

Espinosa, P. J., Bielza, P., Contreras, J., Lacasa, A. (2002). Insecticide resistance in field populations of Frankliniella occidentalis (Pergande) in Murcia (south-east Spain). Pest Management Science, 58, 967-971. [Google Scholar] [CrossRef]

Gao, Y., Lei, Z., Reitz, S.T. (2012). Western flower thrips resistance to insecticides: Detection, mechanisms and management strategies. Pest Management Science, 68: 1111-1121. [Google Scholar]

Gonzalez-Zamora, J.E., Garcia-Mari, F. (2003). The efficiency of several sampling methods for *Frankliniella occidentalis* (Thysan., Thripidae) in strawberry flowers. Journal of Applied Entomology, 127, 516-521 ISSN 0931-2048. [Google Scholar] [CrossRef]

Goven, M.A., Ozgür, A.F. (1990). L'influence des ennemis naturelssur la population the *Thrips tabaci* Lind. Sur les cultures du cottonnier dans la Region de Sud-Est Anatolie. Proceedings of the Second Turkish National Congress of Biological Control, 26-29 September, Ankara, 155-163.

Gremo, F., Bogetti, C., Scarpelli, F. (1997). The thrips damaging to strawberry. Informatore Agrario, 53: 85-89.

Herron, G.A., James, T.M. (2005). Monitoring insecticide resistance in Australian *Frankliniella occidentalis* Pergande (Thysanoptera: Thripidae) detects fipronil and spinosad resistance. Australian Journal of Entomology, 44, 299-303. [Google Scholar] [CrossRef]

Immaraju, J.H., Paine, T.D., Bethke, J.A., Robb, K.L., Newman, J.P. (1992). Western flower thrips (Thysanoptera:

Thripidae) resistance to insecticides in Coastal California greenhouses. Journal of Economic Entomology, 85 (1): 9-14. [Google Scholar] [CrossRef]

Kececioglu, O., Madanlar, N. (2002). The effects of some insecticides on Western flower thrips Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae) on carnation in greenhouses in Antalya. Turkish Journal of Entomology, 26 (2), 147 – 154. [Google Scholar]

Southwood, T.R.E. (1976). Ecological Methods with particular reference to the study of insect populations. London. 524 p.

Steiner, M.Y., Goodwin, S. (2005a). Management of western flower thrips, Frankliniella occidentalis (Pergande) (Thysanoptera Thripidae), in hydroponic strawberry crops using yellow sticky traps to determine action thresholds. Australian Journal of Entomology, 44, 288-292. [Google Scholar] [CrossRef]

Steiner, M.Y., Goodwin, S. (2005b). Management of thrips (Thysanoptera: Thripidae) in Australian strawberry crops: within-plant distribution characteristics and action thresholds. Australian Journal of Entomology, 44 (2), 175-178. [Google Scholar] [CrossRef]

Tunc, I., Gocmen, H. (1995). Notes on two greenhouse pests, Polyphagotarsonemus latus (Banks) (Acrina, Tarsonemidae) and Frankliniella occidentalis (Pergande) (Thysanopıera, Thripidae), found in Antalya. Turkish Journal of Entomology 19(2), 101-109. [URL]

TZOB, (2015). Both yield and production increase in strawberry. Union of Turkish Chambers of Agriculture (TZOB) news. [URL]

Yasarakinci, N., Hincal, P. (1997). The Research on determining the pests and beneficial species and their population densities on the tomato, cucumber, pepper and lettuce glasshouses in İzmir. Plant Protection Bulletin, 37 (1-2), 79-89. [Google Scholar]

Yildirim, E.M., Baspinar, H. (2013). Population fluctuations of Frankliniella occidentalis (Pergande) (Thysanoptera: Thripidae) in strawberry in Aydın, Turkey. Turkish Bulletin of Entomology, 3 (4), 135 – 138. [Google Scholar]

Yildiz, S., Ozpinar, A. (1999). Population ffluctuations of Thrips tabaci Lind. (Thysanoptera: Thripidae) an early season pest, and its natural eenemies along with the plant phenological development in cotton growing areas of Harran plain. Harran University, Graduate School of Natural and Applied Science, Master Thesis. Thesis Number: 85349.