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Thrips (Insecta: Thysanoptera) Species in Pepper Fields in Tokat Province, Türkiye

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Abstract: Thrips (Thysanoptera) species in pepper fields was determined in Tokat province, Türkiye in 2021-2022. The density of thrips began to rise once the leaves emerged in late May, and the collection of thrips species started in June to October. In order to determine the thrips species common in the region, 25 flowers from a total of 25 plants randomly selected in the pepper field during each sampling period were taken into falcon tubes containing 60% ethyl alcohol. At the same time, the flowers and leaves of 25 plants, representing the field, were shaken onto white paper and the thrips were taken into 1.5 ml eppendorf tubes containing 60% ethyl alcohol with the help of a sable-tipped brush. In order to determine the common thrips species in the region, the flowers and leaves of 25 randomly selected plants in the pepper field in each sampling period were shaken on the white paper and the thrips were taken into 1.5 ml eppendorf tubes with the help of a sable-tipped brush. The assessment encompassed various thrips families belonging to the order Thysanoptera, specifically Thripidae, Aeolothripidae, and Phlaeothripidae. A total of 7 Thysanoptera species were identified in this study. The species were *Frankliniella occidentalis* (Pergande, 1895), *Thrips tabaci* (Lindeman, 1889), *Thrips meridionalis* (Priesner 1926) and *Chirothrips manicatus* (Haliday, 1836) in Thripidae family, and *Aeolothrips intermedius* (Bagnall, 1934) and *Aeolothrips fasciatus* (Linnaeus, 1758) in Aeolothripidae family, and *Haplothrips aculeatus* (Fabricius, 1803) in Phlaeothripidae family. Both adult and larval thrips were gathered from the flowers, with a significant abundance of larval thrips noted towards the end of June. In this study, the dominant species was *F. occidentalis* in pepper fields in Tokat province.

Keywords: Pepper , thrips, Thripidae, Aeolothripidae, Phlaeothripidae, Türkiye

Türkiye'de Tokat İlinde Biber Alanlarında Görülen Thrips (Insecta: Thysanoptera) Türleri

Öz: Türkiye'nin Tokat ili 2021-2022 yıllarında biber tarlalarında Thrips (Thysanoptera) türleri tespit edilmiştir. Mayıs ayı sonlarında yaprakların ortaya çıkmasıyla birlikte thrips yoğunluğu artmaya başlamış ve thrips türlerinin toplanması Haziran-Ekim ayları arasında yapılmıştır. Yörede yaygın olan trips türlerinin belirlenmesi amacıyla her örnekleme döneminde biber tarlasında rastgele seçilen toplam 25 bitkiden 25 çiçek%60'lık etil alkol içeren falkon tüplerine alınmıştır. Aynı zamanda tarlayı temsil edecek şekilde 25 bitkinin çiçek ve yarpakları beyaz kağıdın üzerine silkelenerek tripsler samur uçlu fırça yardımıyla 1,5 ml'lik efendorf tüplerine alınmıştır. Thysanoptera takımına ait Thripidae, Aeolothripidae ve Phlaeothripidae familyalarına ait 7 tür tespit edilmiştir. Türler, Thripidae familyasından *Frankliniella occidentalis* (Pergande, 1895), *Thrips tabaci* (Lindeman, 1889), *Thrips meridionalis* (Priesner 1926), *Chirothrips manicatus* (Haliday, 1836), *Aeolothrips intermedius* (Bagnall, 1934) ve Aeolothripidae familyasından *Aeolothrips fasciatus* (Linnaeus 1758) ve Phlaeothripidae familyasından *Haplothrips aculeatus* (Fabricius, 1803) tespit edilmiştir. Çiçeklerden hem ergin ve hemde larvalar toplanmıştır. Bu çalışmada Tokat ili biber alanlarında ana türün *F. occidentalis* olduğu ortaya konulmuştur.
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Anahtar kelimeler: Biber , thrips, Thripidae, Aeolothripidae, Phlaeothripidae , Türkiye

1. Introduction

Türkiye is a major producer of pepper, according to (2021) statistics, global pepper production reached 42.137.899 tons, with Türkiye ranking as the second-largest producer after Mexico, while the United States stood third (FAO, 2020). In 2021, Türkiye produced a total of 36.286.643 tons of pepper (FAO, 2023). Pepper production faces various pests, including aphids, flea beetles, pepper maggots, thrips, and European corn borers, all of which can cause substantial damage to the crops, additionally, several diseases. Thrips are a significant pest for horticultural crops globally as they can damage many crops and spread various plant viruses. Thrips has a slender and elongated body, measuring approximately 1-

2.5 mm or less in length, they have two pairs of fringed wings and exhibit a pale yellow to light brown colouration, generally adult females are larger than adult males, thrips are classified in the insect order Thysanoptera (Palmer et al., 1989). Thrips have the potential to affect both the quantity and quality of flower production in both greenhouse and field-grown plants, both larvae and adults cause damage by sucking plant sap from buds, flowers, and leaves, leading to distorted and discolored plant parts that exhibit gray or silver scars, in the damaged areas of the plant become filled with air, resulting in a silvery appearance with black spots (Bethke and Bates, 2013). Thrips have the ability to transmit various viruses, such as the tomato spotted wilt virus (TSWV) (Flint, 1998). Thrips species such as *Thrips tabaci* (Lindeman, 1889) and *Frankliniella occidentalis* (Pergande, 1895) can result in stippled and scarred petals, leaves, and other plant parts, leading to distorted terminals. These thrips are also significant carriers of TSW viruses, the life cycle of thrips encompasses an egg stage, two larval stages, a prepupal stage, a pupal stage, and an adult stage. The prepupal and pupal stages occur in protected locations or in the soil, thrips thrive better on flowering plants like sweet peppers compared to non-flowering plants (Hoddle etal., 2008). *Frankliniella occidentalis* and *T. tabaci* becomes active during the onset of spring and deposits its eggs on plant tissue. (Anonymous, 2002). Several studies were conducted to determine the thrips composition in tomato and pepper (Ssemwogerere et al., 2013), citrus species (Atakan, et al., 2016; Atakan, et al., 2021; Atakan and Pehlivan, 2021), fruit species (Hazır et al., 2011; Atakan, 2008), and winter vegetable (Atakan, 2008). In the study conducted by Ssemwogerere et al. (2013) a total of six thrips species (*Frankliniella occidentalis*, *Thrips tabaci*, *F. schultzei, Scirtothrips dorsalis*, *Ceratothrips ericae* and *Megalurothrips sjostedti)* determined in tomato field in Uganda and in pepper fields, beside these species *F. schultzei* was found. In the study performed in Adana, Türkiye, *F. occidentalis, T. tabaci,* and *Thrips hawaiiensis* were determined as a common species on citrus species (Atakan and Pehlivan, 2021). Based on the literature review, there are no studies on thrips compositions of pepper in Türkiye. So present study was conducted to determine the thrips species in pepper production areas of Tokat province, Türkiye.

2. Materials and Methods

The materials used in this study for thrips collection included a white paper, a fine brush petri dishes, plastic tubes and methanol.

Thrips species were sampled in pepper fields in the province of Tokat, Türkiye. Thrips individuals were collected from the districts in the pepper production areas during the years 2021-2022. Sampling was carried out in different districts including Tokat Centre, Erbaa, Turhal, Pazar and Niksar. In each sampling field, 25 plant leaves and flowers were carefully collected and transferred into 50 ml falcon tubes with 60% ethyl alcohol solution from randomly selected pepper plants in the pepper field. At the same time, the flowers and leaves of 25 plants, representing the field, were shaken onto white paper and the thrips were taken into 1.5 ml ephendorf tubes containing 60% ethyl alcohol with the help of a sable-tipped brush. In each sampling field we also sampled Solaneaceae family weed host plants for thrips. In pepper field areas especially *Solanum nigrum* L. is a common weed in pepper field areas. We sampled 25 *S. nigrum* flowers from each field. The flower samples were transported to the laboratory and thrips were placed in glass petri dishes for examination, to identify thrips species in pepper production areas of Tokat Province, Türkiye. They were observed using a stereomicroscope, thrips specimens, which were kept in AGA liquid (9 parts ethyl alcohol, 1-part glacial acetic acid, 1-part glycerin) for 2 days after collection and then taken in alcohol (60% ethyl alcohol), were kept in 10% NAOH liquid on the hot plate at 47°C for approximately 1 hour until a slight color change occurred in the individuals. Then, this liquid was allowed to enter the thrips body, and the body contents were cleaned by the very fine needle. After the samples were kept in 96% ethanol for 5 minutes, they were taken to Hoyer medium and microscope slides were made. Thysanoptera species were identified by Prof. Dr. Ekrem ATAKAN (Çukurova University, Faculty of Agriculture, Department of Plant Protection, Adana, Türkiye).

3. Results and Discussion

Thrips survey was carried out for two years, adults and larvae of thrips individuals belonging to the order Thysanoptera were collected from Tokat Province and its districts, Three different families of order Thysanoptera were found namely: Thripidae, Aeolothripidae and Phlaeothripidae. In (Table1) the determined thrips species

were given in family: Thripidae, *Frankliniella occidentalis (*Pergande, 1895), *Thrips tabaci* (Lindeman, 1889), *Thrips meridionalis* (Priesner, 1926) and *Chirothrips manicatus* (Haliday, 1836). In family Aeolothripidae were determined *Aeolothrips intermedius* (Bagnall, 1934) and *Aeolothrips fasciatus* (Linnaeus, 1758). In family Phlaeothripidae was determined *Haplothrips aculeatus* (Fabricius, 1803), the biggest group of thrips species belongs to the suborder Thripinae (Table 1).

In this study, 7 thrips species from three different families were found. The species are listed with their abundance (total numbers of individuals collected for a given species) in Table 2. While the major species were from the family Thripidae, the thrips were dominated by *F.occidentalis*, comprising (73.22%) of the total individuals. The percentages of *T.meridionalis* and *C. manicatus*were (0.1%). The total number of *H. aculeatus*with (0.2) individuals. There were no individuals of thrips belonging to *A. fasciatus* in 2021. This result agreed with (Deligeorgidis et al., 2005). They mentioned that the population of *F. occidentalis* and *T. tabaci* feeding on various types of vegetables from April to August or September, varied with the seasons. *Frankliniella occidentalis* species were identified in various locations, including the central area of Tokat, Erbaa, Niksar, Pazar, and Turhal. The samples collected indicated variations in population density.

In Table (2), the number of larvae and adult individuals (males and females) of *F. occidentalis* is presented. The largest samples of individuals were collected in the central area of Tokat, with a total of 20♀ 5♂ in 2021, and 18♀ 7♂ in 2022. The lowest number of individuals was collected in Pazar with 2♀ in 2021, also in Turhal founded 3♀ in 2023.This result agreed with (Kirk and Terry, 2003*).* Who mentioned that the western flower thrips (*F. occidentalis*) is a native of western North America, greenhouse pest in the U.S and capable present in Asia. The dominant species was *F. occidentalis* in pepper fields in Tokat Province. This result agreed with (Ertürk, 2018), who mentioned that the *F. occidentalis* which is an important pest in tomato and green pepper growing areas in Türkiye, the trials were conducted in Mersin, due to infestations of *F. occidentalis* damaging the export quality of tomatoes and green peppers.

Table (3) shows the data for individual T. tabaci, the results indicate that the highest numbers of males and females were found in the center, with approximately 21♀ 9♂ in 2021, and in Erbaa, with 14♀1♂ in 2021. However, the lowest number of individuals was observed in Pazar with 1♀ in 2022. This result agreed with (Atakan, 2008). Who mentioned that *F. occidentalis* and *T. tabaci* are dominant species in vegetable crops in Türkiye. They have been recorded in winter vegetables in the Çukurova region, the most thrips were collected from flowers or heads of vegetables in early spring**.**

The species *T. meridionalis* was observed in very low numbers, as indicated in (Table 4), only one female was observed in Pazar in 2021, suggesting that the species was not abundant there. This result agree with results of Aydın, (2020). In that study, the species *T. meridionalis*, belonging to the family Thripidae, was examined in three different orchards in the province of Isparta/ Türkiye, the selected orchards featured apple, cherry, and walnut trees, the active period for *T. meridionalis* was found to be between March 15th and April 1st, indicating that this variety appears for only a short period. In contrast Kaplan et al. (2016) found that *T. meridionalis* was an infrequent species (0.8%) in Mardin Province, Türkiye. However, *T. meridionalis* were observed in large numbers even though it seems to be active only short time in each year. This could be related to the seasonal blooming of its host plants and other environmental conditions (Alford 2007).

Table 1. Thrips species individuals and family in pepper fields of Tokat province in 2021-2022
Çizelge 1. *2021-2022 yılında Tokat ilinde biber alanlarında bulunan trips familyaları ve türleri*

Family	Thrips species	2021	2022	Total	Percent %)
Thripidae	*F. occidentalis (*Pergande, 1895)	141	127	268	73.22
	Thrips tabaci (Lindeman, 1889)	61	18	79	21.58
	Thrips meridionalis (Priesner, 1926)	1	0	1	0.27
	Chirothrips manicatus (Haliday, 1836)	0	1	1	0.27
Aeolothripidae	*Aeolothrips intermedius* (Bagnall, 1934)	3	0	3	0.82
	Aeolothrips fasciatus (Linnaeus, 1758)	0	12	12	3.28
Plaeothripidae	*Haplothrips aculeatus* (Fabricius, 1803)	0	2	2	0.55
Total		206	160	366	100.00

Table 2. Surveying results of *Frankliniella occidentalis* in the pepper fields of Tokat Province
Çizelge 2. *Tokat ilinde biber alanlarında bulunan Frankliniella occidentalis'in dağılımı*

Number of sample	Region	Province/ District	Coordinates		Altitude (meters)	Day-Month- year	No. of individual
			North	East			
1	Tokat	Center	40^{0}55′24′′	37^{0}39′21′′	610	20.07.2021	20♀ 5♂
2	Tokat	Center	40^{0}55′24′′	37^{0}39′21′′	610	15.08.2022	18♀ 7♂
3	Tokat	Gumenek	40^{0}42′24′′	36^{0}32′21′′	201	15.09.2021	1♀ 5♂
4	Erbaa	Kaleköyü	40^{0}44′55′′	36^{0}31′22′′	208	04.08.2022	3♀ 3♂
5	Erbaa	Karaağaç	40^{0}35′31′′	36^{0}55′47′′	317	04.08.2022	4♀ 3♂
6	Erbaa	Kızılçubuk	40^{0}40′39′′	36^{0}32′49′′	192	30.09.2021	5♀
7	Erbaa	Kızılçubuk	40^{0}44′31′′	36^{0}35′24′′	189	04.08.2022	4♀
8	Erbaa	Kızılköyü	40^{0}21′35′′	36^{0}38′22′′	628	04.08.2022	8♀ 2♂
9	Erbaa	Kızılköyü	40^{0}22′33′′	36^{0}40′59′′	624	04.08.2022	18♀ 4♂
10	Erbaa	Kızılköyü	40^{0}22′21′′	36^{0}41′20′′	625	04.08.2022	7♀ 1♂
11	Erbaa	Tebe kışlı	40^{0}42′24′′	36^{0}32′39′′	201	30.09.2021	5♀ 1♂
12	Erbaa	Tebe kışlı	40^{0}41′28′′	36^{0}32′19′′	199	30.09.2021	5♀ 1♂ 3l
13	Erbaa	Tepe kışla	40^{0}40′4′′	36^{0}38′21′′	220	04.08.2022	6♀ 1l
14	Erbaa	Tosunlar	40^{0}34′26′′	36^{0}54′50′′	296	30.09.2021	14♀ 1♂ 7l
15	Erbaa	Tosunlar	40^{0}44′52′′	36^{0}25′87′′	134	30.09.2021	2♀
16	Erbaa	Tosunlar	40^{0}41′28′′	36^{0}32′19′′	199	30.09.2021	2♀ 1l
17	Niksar	Hamidiye	40^{0}35′29′′	36^{0}56′10′′	277	30.09.2021	5♀ 3l
18	Niksar	Hayderbey	40^{0}33′57′′	36^{0}54′27′′	500	04.08.2022	6♀ 2♂ 1l
19	Niksar	Şahinli	40^{0}35′29′′	36^{0}56′10′′	277	30.09.2021	8♀ 1♂ 18l
20	Pazar	Center	40^{0}14′88′′	36^{0}12′07′′	553	15.09.2021	8♀ 2♂ 2l
21	Pazar	Center	40^{0}16′32′′	40^{0}16′34′′	561	11.11.2022	2♀ 1♂
22	Pazar	Köprübasi	40^{0}17′12′′	36^{0}21′78′′	554	15.09.2021	2♀ 1♂
23	Pazar	Ovayurt	40^{0}18′40′′	36^{0}14′59′′	539	11.11.2022	4♀ 1♂
24	Pazar	Üzümören	40^{0}16′50′′	36^{0}10′59′′	537	11.11.2022	8♀
25	Pazar	Center	40^{0}21′35′′	36^{0}38′59′′	569	15.09.2021	2♀
26	Pazar	Center	40^{0}16′56′′	36^{0}18′19′′	549	15.09.2021	2♀
27	Turhal	Dökmetepe	40^{0}18′19′′	36^{0}18′4′′	549	11.11.2022	7♀ 6♂
28	Turhal	Kat	40^{0}21′35′′	36^{0}38′59′′	569	15.09.2021	3♀ 3l
29	Turhal	Kat	40^{0}21′35′′	36^{0}38′31′′	636	15.09.2021	3♀

*(l) Letter indicated to the larvae number.

Table 3. *Thrips tabaci* survey in the pepper fields of Tokat Province
Çizelge 3. *Tokat ilinde biber alanlarında bulunan Thrips tabaci'nin dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month-year	No. of species
			North	East			
1	Tokat	Center	40^{0}55′24′′	37^{0}39′21′′	610	15.08.2021	21♀ 9♂
2	Erbaa	Kale	40^{0}40′16′′	36^{0}38′19′′	224	30.09.2021	8♀
3	Erbaa	Kızılköyü	40^{0}22′14′′	36^{0}341′21′′	632	04.08.2022	2♀ 1♂
4	Erbaa	Tosunlar	40^{0}40′22′′	36^{0}29′17′′	193	30.09.2021	14♀ 1♂
5	Pazar	Center	40^{0}16′59′′	36^{0}17′23′′	553	15.09.2021	1♀ 7 l
6	Pazar	Center	40^{0}16′7′′	36^{0}74′9′′	545	04.08.2022	5♀
7	Pazar	Ovayurtköyü	40^{0}16′58′′	36^{0}12′2′′	540	04.08.2022	6♀
8	Pazar	Üzümören	40^{0}16′50′′	36^{0}10′59′′	537	04.08.2022	1♀
9	Turhal	Dökmetepe	40^{0}18′23′′	36^{0}17′37′′	555	11.11.2022	3♀

The species *T. meridionalis* was observed in very low numbers, as indicated in (Table 4), only one female was observed in Pazar in 2021, suggesting that the species was not abundant there. This result agree with results of Aydın, (2020). In that study, the species *T. meridionalis*, belonging to the family Thripidae, was examined in three different orchards in the province of Isparta/ Türkiye, the selected orchards featured apple, cherry, and walnut trees, the active period for *T. meridionalis* was found to be between March 15th and April 1st, indicating that this variety appears for only a short period. In contrast Kaplan et al. (2016) found that *T. meridionalis* was an infrequent species (0.8%) in Mardin Province, Türkiye. However, *T. meridionalis* were observed in large numbers even though it seems to be active only short time in each year. This could be related to the seasonal blooming of its host plants and other environmental conditions (Alford 2007).

The *Chirothrips manicatus* species appeared in very few numbers, in (Table 5) shows that only 1 female observed in Pazar in 2022. Additionally, this species was not found in the central location. This species founded in many province of Türkiye. Uzun Yiğit et al., (2022), mentioned that the *C. manicatus* was found in Afyonkarahisar, Antalya, Burdur, Konya, and Isparta cereals production areas.

The species *A. intermedius* was found in low numbers, in (Table 6) shows approximately 1♀ in the center in 2021 and 2♀ in Erbaa in 2021, *Aeolothrips intermedius* found in pepper flowers. This result agreed with Trdan et al., (2005), mentioned that the *A. intermedius*, which inhabit flowers, have been observed on a wide range of 30 host plant species across 16 different botanical families, particularly on the vegetative portions of cultivated plants. Research on the Thysanoptera fauna in Türkiye's Aegean region was conducted in the spring seasons of 1993 and 1995, the study covered several provinces, including Afyonkarahisar, Aydın, Denizli, İzmir, Manisa, Muğla, and Uşak, and resulted in new findings for both the region and the country, newly recorded species for the Turkish fauna included *T. meridionalis,T.tabaci*, *A. intermedius*, and *Haplothrips reuteri* (Karny).

The species *Aeolothrips fasciatus* was found in varying numbers, with 1♀ 1♂ in Erbaa, 2♀ 1♂ in Niksar, and 5♀ and 2♂ in Turhal in 2022, (Table 7).

Table 4. *Thrips meridionalis* survey in the pepper fields of Tokat Province
Çizelge 4. *Tokat ilinde biber alanlarında bulunan Thrips meridionalis'in dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month year	No. of species
			North	East			
1	Pazar	Center	40º14′88′′	36º12′07′	553	15.09.2021	1♀

Table 5. *Chirothrips manicatus* survey in the pepper fields of Tokat Province
Çizelge 5. *Tokat ilinde biber alanlarında bulunan Chirothrips manicatus'un dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month-year	No. of species
			North	East			
1	Pazar	Kaledere	$40^0$19′20′′	$36^0$13′18′′	541	11.11.2022	1♀

Table 6. *Aeolothrips intermedius* survey in the pepper fields of Tokat Province
Çizelge 6. *Tokat ilinde biber alanlarında bulunan Chirothrips manicatus'un dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month-year	No. of species
			North	East			
1	Tokat	Center	$40^0$55′24′′	$37^0$39′21′′	610	16.09.2021	1♀
2	Erbaa	Tosunlar	$40^0$40′16′′	$36^0$38′19′′	224	30.09.2021	2♀

Table 7. *Aeolothrips fasciatus* survey in the pepper fields of Tokat Province
Çizelge *7. Tokat ilinde biber alanlarında bulunan Aeolothrips fasciatus'un dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month-year	No. of species
			North	East			
1	Erbaa	Kaleköyü	$40^0$45′0′′	$36^0$31′21′′	207	04.08.2022	1♀ 1♂
2	Niksar	Hayderbey	$40^0$33′13′′	$36^0$54′53′′	315	04.08.2022	2♀ 1♂
3	Turhal	Center	$40^0$18′19′′	$36^0$18′4′′	549	11.11.2022	5♀ 2♂

Table 8. *Haplothrips aculeatus* survey in the pepper fields of Tokat Province
Çizelge 8. *Tokat ilinde biber alanlarında bulunan Haplothrips aculeatus'un dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month- year	No. of species
			North	East			
1	Pazar	Kaledere	$40^0$19′20′′	$36^0$13′18′′	541	11.11.2022	1♀
2	Turhal	Şatroba	$40^0$17′12′′	$40^0$81′02′′	541	11.11.2022	1♀

The species *H. aculeatus* recorded in Pazar and Turhal in rate 1♂: 1♂ in 2022, (Table 8). This result agreed with findings of Çinkul etal., (2021). Who founded *Haplothrips* species in flowers of in the stone and pome fruit orchards in the districts of Balıkesir Province, Türkiye, in 2018 and 2019. This study was carried out to identify species belonging to Thysanoptera in stone and pome fruit orchards in the districts (Balya, Bandırma, Bigadiç, Burhaniye, Dursunbey, Erdek, Gönen, Havran, Kepsut and Manyas) of Balıkesir Province, Türkiye in 2018 and 2019. The survey revealed 32 Thysanoptera (thrips) species. Thrips were examined in 9900 flowers, leaves, and fruits species were, *H. reuteri T. meridionalis*.

3.1.Thrips Survey on the *Solanum nigrum*

In summer 2021-2022, a survey was conducted in various locations of Tokat province (Erbaa, Niksar, Pazar, Turhal and the center) to identify thrips species in the weeds surrounding pepper fields, the results shown that all the species found in these areas were *F. occidentalis.* The highest rate recorded in the center in the rate 12♀ 1♂ in 2021 (Table 9), and the number of *F. occidentalis* found in large numbers in Erbaa and Niksar, while the numbers were few in Turhal where it was found 9♀ in 2022.

In the summer of 2021-2022, a survey was conducted in various locations within Tokat Province, including Erbaa, Niksar, Pazar, Turhal, and the provincial center, to identify thrips species in the weeds surrounding pepper fields. The results indicated that all the species identified in these areas were *F. occidentalis*. The highest population was recorded in the provincial center, with a count of 12♀ and 1♂ in 2021, as shown in Table 9. *Frankliniella occidentalis* was also found in large numbers in Erbaa and Niksar. In contrast, the species was less abundant in Turhal, where only 9♀ were observed in 2022. This result agree with (Suganthy and Sakthivel, 2012) who mentioned that the *Solanum nigrum* Linn. is an annual herbaceous plant belongs to the family Solanaceae, it is commonly known as black nightshade, attacked different species of insect pests, like *Thrips* spp.

Table 9. *Frankliniella occidentalis* survey in the *Solanum nigrum* of Tokat province
Çizelge 9. *Tokat ilinde biber alanlarında Solanum nigrum üzerinde bulunan Frankliniella occidentalis'in dağılımı*

Number of sample	Region	Province/ District	Coordinated		Altitude (meters)	Day-Month-year	No. of species
			North	East			
1	Center	Gumenek	$40^0$21′35′′	$36^0$38′31′′	636	15.09.2021	11♀1♂
2	Center	Gumenek	$40^0$21′39′′	$36^0$38′59′′	603	15.09.2021	12♀ 1♂
3	Center	Kaleköyü	$40^0$40′39′′	$36^0$32′49′′	192	30.09.2021	2♀ 1♂
4	Erbaa	Kaleköyü	$40^0$40′39′′	$36^0$32′49′′	192	30.09.2021	3♀ 1♂
5	Erbaa	Kaleköyü	$40^0$44′55′′	$36^0$31′22′′	208	04.08.2022	21♀ 5♂
6	Erbaa	Karaağaç	$40^0$35′31′′	$36^0$55′47′′	317	04.08.2022	3♀
7	Erbaa	KızılÇubuk	$40^0$44′52′′	$36^0$25′87′′	134	30.09. 2021	18♀ 10♂
8	Erbaa	KızılÇubuk	$40^0$21′35′′	$36^0$38′22′′	628	04.08.2022	4♀ 1♂
9	Erbaa	Tosunlar	$40^0$41′28′′	$36^0$32′19′′	199	30.09. 2021	2♀ 1♂
10	Niksar	Hamidiye	$40^0$34′26′′	$36^0$54′50′′	296	30.09. 2021	11♀ 1♂
11	Niksar	Hayderbey	$40^0$33′57′′	$36^0$54′27′′	500	04.08.2022	11♀ 1♂
12	Niksar	Şahinli	$40^0$35′29′′	$36^0$56′10′′	277	30.09.2021	9♀
13	Niksar	Şahinli	$40^0$35′29′′	$36^0$56′10′′	277	30.09.2021	6♀ 1♂
14	Pazar	Center	$40^0$16′32′′	$40^0$16′34′′	561	11.11.2022	6♀ 1♂
15	Pazar	Ovayurtköyü	$40^0$18′40′′	$36^0$14′59′′	539	11.11.2022	4♀
16	Pazar	Center	$40^0$16′50′′	$36^0$10′59′′	537	11.11.2022	1♀
17	Pazar	Center	$40^0$17′12′′	$40^0$21′78′′	554	15.09.2021	6♀ 1♂
18	Turhal	Dökmetepe	$40^0$18′19′′	$36^0$18′40′′	549	11.11.2022	9♀

4. Conclusion

The results of this study have contributed to the identification of the Thysanoptera order in Tokat Province, Türkiye. Among the seven species identified from various families in this study, two thrips species, *F. occidentalis* and *T. tabaci*, were determined to be the primary species inhabiting the surveyed green pepper fields. However, there is no existing knowledge about the damage they cause or their economic importance in this region. Therefore, further studies are needed to address this issue. The survey indicated that *F. occidentalis* was the only thrips species identified in the weeds adjacent to pepper fields.

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