



## Harmful Insect and Mite Species and Natural Enemies in Strawberry Fields of Halkapınar (Konya) District

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### HIGHLIGHTS

- The study was carried out to determine harmful mites strawberry areas in Halkapınar District of Konya Province, Türkiye in 2011.
- One mite species, 19 pest species from 5 orders belonging to 16 families and 8 beneficial insect species from 4 orders belonging to 6 families were determined.
- The most important harmful mite and insects were *Tetranychus urticae* Koch, *Thrips tabaci* Lindeman, *Brachycaudus helichrysi* Kaltenbach and *Chaetosiphon fragaefolii* Cockerell
- The most important natural enemies were *Coccinella septempunctata* L *Scymnus pallipediformis* Günther, *Scymnus rubromaculatus* Goeze and *Scolothrips longicornis*

### Abstract

The aim of the study is to observe harmful mites and insect species and their natural enemies being in strawberry areas in Halkapınar District of Konya Province of Türkiye in 2011. Different methods were used to detect pests and useful insect species; picking up insects by using aerial net, examine of leaves, flowers, fruits and offshoots by inspection and lupe, in counting leaf determining of amount of insects and mites for per leaflet and pitfall trap methods. As a result, one mite species, 19 pest species from 5 orders belonging to 16 families and 8 beneficial insect species from 4 orders belonging to 6 families were determined. According to intensity and extensity, the important, harmful insects were *Tetranychus urticae* Koch, *Thrips tabaci* Lindeman, *Brachycaudus helichrysi* Kaltenbach and *Chaetosiphon fragaefolii* Cockerell; and beneficial insects were *Coccinella septempunctata* L *Scymnus pallipediformis* Günther, *Scymnus rubromaculatus* Goeze and *Scolothrips longicornis* Prisner.

**Keywords:** Halkapınar; harmful mites; harmful insects; natural enemies; strawberry

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## 1. Introduction

Strawberry, a berry fruit, is consumed both domestically and exported to other countries. Strawberry plant, which is perennial, herbaceous and evergreen has entered the diet of millions of people around the world with its flavor, vitamin (A, B, C) and mineral substance (calcium, iron, phosphorus). Strawberry production was restricted to only a few countries in the past. However, this situation has changed with breeding studies and breeding new varieties that provide sufficient yield under various environmental conditions (Çakaryıldırım 2004)

The fact that many other fruit types can be found in the market in the months when they are not yet released to the market, and the attractiveness and high vitamin C content have caused this fruit well-known in some country markets and to be sold at high prices. In recent years, it has appealed to a wide range of consumers due to processing or frozen besides and its fresh consumption. It can also be grown in lands on the hillside and mountain villages where agricultural production is limited, such as intermediate agriculture cultivation (Çakaryıldırım 2004).

Strawberry, consumed commonly as a table fruit in the Halkapınar district, is also an alternative product to cherry cultivation. Strawberry cultivation has become widespread in this region in recent years and producers establish new strawberry plantations. Based on interviews with Konya Halkapınar farmers, Halkapınar District Directorate of Food, Agriculture and Forestry technical staff and field observations regarding the current research subject, it was concluded that pesticides were applied unconsciously against mite and insect species in the production (Kılıç 2013). Several studies reported pest and beneficial species in strawberry fields in different regions of Türkiye (Erkılıç et al. 1996; Genç et al. 2004; Kaplan 2007). However, no study has been carried out on the pests found in strawberry fields in Konya Halkapınar district yet. In accordance with European Union legislation, a minimum amount of pesticide residue is required for directly consumed products. In recent years, some products exported abroad returned to Türkiye for this reason. With the current study, it is aimed to determine the mite and insect species that cause significant economic damage in the strawberry fields in the region and to collect information that will form the basis for the strawberry integrated pest management studies to be carried out in the coming years. In addition, natural enemies of common pests for biological control are also tried to be determined.

## 2. Materials and Methods

The main material of this study consisted of strawberry fields in Halkapınar district of Konya province, and the mite and pest insect species found in these areas and their natural enemies. In the study, 35 cm diameter standard aerial net, Eppendorf tubes, 70% alcohol, transparent polyethylene bags, loop, ethyl acetate, formaldehyde 37% and 500 ml plastic containers were used.

Sampling was carried out in six different locations in total- one location in Ivriz village, one in Yayıklı village, and four in Çakıllar village, Konya Province Halkapınar District, in 2011.

Observations were carried out between May and October in 2011 to determine the mite and insect species seen in different phenological periods of strawberry and their natural enemies. Specimens were collected four times a month during May-August and twice in September and October.

The aerial net method was used to collect mobile insects during the survey. The leaves, flowers, buds, fruits and shoots of the plant were examined visually and a 1 magnifying glass, and the existing mite and insect species, if any, were brought to the laboratory by taking them into killing bottles or in 70% alcohol.

Strawberry fields in the region are generally in parcels smaller than 1 decare. So, the samplings were done at 10 different points of an area of approximately 1 decare. The aerial net method was used to collect mobile insects. In this method, insects were collected by aerial nets a hundred times at 10 different points in the fields in a diagonal direction to scrape the upper part of the plants. Insects collected aerial nets were killed with ethyl acetate and brought to the laboratory, classified according to their order and families, and fixed for identification after needling and labeling.

In this study, buds, leaves, flowers, fruits and shoots of 25 plants were examined visually and with a loop by walking diagonally in the fields. Three leaves were taken from each of the plants and mixed and followed by taking 20 leaves from this mixture and counted with a magnifying glass, the species belonging to the existing mites, *Aphididae* and *Thripidae* families. In the leaf count, infestation rates and distribution areas of 6 locations in 3 different regions, per leaf of species belonging to mites, *Aphididae* and *Thripidae* families, were determined (Erkiliç et al. 1996). Insect species existed in the region and their population status was determined as a result of this survey.

Pitfall traps were used to detect soil pests (Önder 1979). This method has been used to detect pests dwelling in the soil such as wireworms, Carabids, and Tenebrionids. In the application of this method, 37% formaldehyde and a small amount of detergent were placed in 500 ml wide-mouthed plastic jars, and the insects were caught by burying jars in line with the soil surface. These traps were changed every 2 weeks and the adult insects in them were taken with the help of a gauze and prepared for identification.

### 3. Results

#### 3.1. Mites and Insect Species Found in Strawberry Fields

In this study, one mite species and 19 harmful insect species from 16 families belonging to 5 orders were determined (Table 1).

*Tetranychus urticae* Koch, 1836 (Acarina: *Tetranychidae*)

Common name: Two-spotted spider mite

Description: The color of the adults is greenish-yellow, light yellow, or reddish. There is a pair of black spots on the upper part of the body and near the middle. Dorsal setae are spiny-like. Their nymphs are smaller, and their colors are greenish yellow, light yellow (Demirözer 2008).

Distribution: It is found in almost every part of our country (Anonymous 2024a).

Damage and Hosts: Cotton, melon, watermelon, cucumber, pumpkin, okra, pepper, eggplant, bean, peanut, strawberry, blackberry (Anonymous 2024a). This species has been found in all study areas. Two-spotted spider mites cause significant damage by sucking the leaf sap and feeding on the buds that will form the next year's fruit flower. They first produce white, then yellow-brown spots on the leaves they suck on. Later, these spots coalesce and cause the leaf to dry and fall, thus causing a significant loss of product. It was reported that Two-spotted spider mite constitute primary pest group in strawberries, and they damage mesophyll cells in the leaves, causing plants to be stunted, sometimes to death, and yield reduction of about 50% in cases where the population density is high (Kaplan 2007). Also, Kaplan (2007) was noted that in cases where *T. urticae* damage is severe, there would be a decrease in flower and fruit set and a general regression in fruit development in the coming years. Erkiliç et al. (1996), in addition found that *T. urticae* was the most detrimental species in their study in the strawberry fields of Mersin province.

In this study, a total of 249 *T. urticae* individuals were found, 33 in İvriz village, 41 in Yayıklı village and 175 in Çakıllar village strawberry fields.

*Thrips tabaci* Lindeman, 1889 (Thysanoptera: *Thripidae*)

Common name: Tobacco thrips

Description: The Body of adult females is brown-black, and antennae are 8 segmented. The most distinctive morphological characteristic is the light color of the third antennal segment.

Distribution: Kaplan (2007) reported that this pest has a cosmopolitan distribution and is more or less common in almost every part of our country.

Damage and Hosts: Kaplan (2007) reported that this species is polyphagous, and its adults and larvae break the epidermis of leaves, stems, and fruits of plants, tearing or rasping, absorbing coming juice, and feeding sites on plants acquire a whitish or silvery color.

**Table 1.** Harmful mite and insect species detected in strawberry fields in Halkapınar district of Konya province and their locations.

Order	Family	Species	Locations		
			Konya-Halkapınar		
			İvriz Village	Yayıklı Village	Çakıllar Village
Acarina	Tetranychidae	<i>Tetranychus urticae</i> Koch,1836	x	x	x
Thysanoptera	Thripidae	<i>Thrips tabaci</i> Lindeman, 1889	x	x	x
Hemiptera	Aphididae	<i>Chaetosiphon (Pentatrachopus) fragaefolii</i> Cockerell,1901	x	x	x
		<i>Brachycaudus helichrysi</i> Kaltenbach, 1843			
		<i>Empoasca decipiens</i> Paoli, 1930	x	x	x
	Cicadellidae	<i>Psammotettix</i> sp.	x	x	x
		<i>Lygaeus equestris</i> Linnaeus, 1758	x	x	x
	Pyrrhocoridae	<i>Pyrrhocoris apterus</i> Linnaeus, 1758	x	x	x
	Pentatomidae	<i>Nezara viridula</i> Linnaeus, 1758		x	x
	Coreidae	<i>Centrocoris variegatus</i> Kolenati, 1845	x	x	x
Orthoptera	Acrididae	<i>Truxalis robusta</i> Uvarov, 1916			x
		<i>Aiolopus strepens</i> Latreille, 1804	x	x	x
	Gryllidae	<i>Gryllus bimaculatus</i> De Geer, 1773	x	x	x
	Gryllotalpidae	<i>Gryllotalpa gryllotalpa</i> Linnaeus, 1758	x		
Coleoptera	Curculionidae	<i>Polydrusus</i> sp.	x	x	x
	Scarabaeidae	<i>Epicometis (Tropinota) hirta</i> Poda, 1761	x	x	x
	Chrysomelidae	<i>Chrysolina orientalis</i> Olivier, 1807	x		x
	Buprestidae	<i>Acmaeodera pilosellae</i> Bonelli, 1842		x	x
	Carabidae	<i>Harpalus (Pseudoophonus) rufipes</i> De Geer, 1774	x	x	x
Dermaptera	Forficulidae	<i>Forficula auricularia</i> Linnaeus, 1758	x	x	x

As a result of the study, a total of 196 individuals of the species were identified, 33 in İvriz village, 32 in Yayıklı village, and 131 in Çakıllar village strawberry fields.

*Chaetosiphon (Pentatrachopus) fragaefolii* Cockerell, 1901 (Hemiptera: Aphididae)

Common name: Strawberry aphid

Description: Wingless individuals are small, oval-shaped elongated, transparent yellowish white to light greenish yellow. Body length is 0.9-1.8 mm (Kocadal 2006).

In winged individuals, the head and thorax are black, the abdomen is very pale greenish-white, and there is a brownish-black pattern on the dorsal of the abdomen. Body length is 1.3-1.8 mm (Kocadal 2006).

Distribution: This species is native to North America and has spread throughout world (Kocadal 2006).

Hosts: *Fragaria* spp, *F. vesca*, *Potentilla* spp. and *P. anserina* (Kocadal 2006).

Kovanci et al. (2003) determined 3 aphid species in the strawberry fields of Bursa province. One of these species is *Chaetosiphon (Pentatrachopus) fragaefolii*. The other two species were identified as *Aphis forbesi* Weed and *Aulocorthum solani* Kaltenbach.

In this study, this species was detected on strawberry plants.

The aphid species *Brachycaudus helichrysi* and *Chaetosiphon (Pentatrachopus) fragaefolii* were detected and, a total of 230 individuals were identified, 34 in İvriz village, 37 in Yayıklı village and 159 in Çakıllar village strawberry fields.

*Brachycaudus helichrysi* Kaltenbach, 1843 (Hemiptera: Aphididae)

Common name: Leaf-curling plum aphid

Description: Wingless viviparous females are oval-shaped, yellowish green or yellowish brown in color and covered with a white waxy-powdered substance on the abdomen. Antennae are short and half the length

of the body. The -head, legs, and cornicles are black. Sometimes a black spot can be found at the end of the abdomen. body length is between 1.5 and 2.0 mm (Kocadal 2006).

The winged forms are long and oval in shape, the body is covered with a white waxy substance, the head and thorax are black, the abdomen and the cauda are green or greenish yellow, and the cornicles are brown. Body length varies between 1.3-1.8 mm (Kocadal 2006).

Distribution: It is distributed in Central and West Asian countries, Italy, France, the southern region of Switzerland, Spain, Israel, Portugal, Egypt, Lebanon and is also found in Türkiye (Kocadal 2006).

Hosts: *Agave* spp, *Achillea santolina*, *Aciphylla squarrosa*, *Albizzia lophantha*, *Anthemis nobilis*, *Apium oraveolens*, *Artemisia* sp, *Aster* sp, *Borago officinalis*, *Capsella bursa-pastoris*, *Carthali* spp. *cyanus*, *Chrysanthemum* spp, *Gerbera* spp, *Gaillardia pulchella*, *Gnaphalium* spp, *Helianthus annuus*, *Matricaria parthenoides*, *Myosotis* spp, *Pallenis spinosa*, *Pyrus malus*, *Russelia juncea*, *Solanum tuberosum*, *Venidium venidium*. reported (Kocadal 2006).

Kovanci et al. (2003) reported 3 aphid species, except *Brachycaudus helichrysi*.

The aphid species *Brachycaudus helichrysi* and *Chaetosiphon (Pentatrachopus) fragaefolii* were found and, a total of 230 individuals were identified, 34 in İvriz village, 37 in Yayıklı village and 159 in Çakıllar village strawberry fields.

*Empoasca decipiens* Paoli, 1930 (Hemiptera: Cicadellidae)

Common name: Green leafhopper

Description: The aedeagus is simple, the ventral end of the pygopheric lobe has no protrusion, it tapers at the end, the ventral extension of the anal tube is directed posteriorly, there is an angular protuberance in the basal part, the pregenital sternite is rectangular in the female, the posterior edge is slightly wavy (Güçlü and Özbek 1994).

Its body color is completely green and can turn yellow or orange after death. The body length is 3.20 (3.00-3.35) mm for males and 3.55 (3.30-3.70) mm for females (Güçlü and Özbek 1994).

Distribution: The species have been reported from Afghanistan, Germany, Austria, Bulgaria, Czech Republic, Morocco, France, Netherlands, Iraq, England, Iran, Spain, Israel, Switzerland, Italy, Cyprus, Libya, Lebanon, Egypt, Pakistan, Poland, Romania, Russia, Tunisia, Türkiye, Jordan and Greece (Kaplan 2007).

It is found in all regions of Türkiye except the Black Sea Region and reported from Adana, Antalya, Aydın, Balıkesir, Çanakkale, Denizli, Erzurum, Eskişehir, Hatay, İzmir, Kahramanmaraş, Manisa, Mersin and Muğla provinces (Kaplan 2007).

Damage and Hosts: *Cicadellidae* species cause damage by sucking plant sap with their stinging-sucking mouth parts. They transmit plant pathogens to the plant with the effect of the toxic substances they give to the plant body during sucking. The damage caused by *Cicadellidae* species is firstly yellow or white spots seen around the sucking area due to the loss of chlorophyll, and the leaves are covered with these small white dots. Later, the white spots turn brown. Since the nutrition is mostly along the veins, the leaves gradually shrink and dry along the midrib (Kaplan 2007).

*Allium* spp, *Amaranthus* spp, *Avena* spp, *Capsicum* spp, *Castanea* spp, *Chenopodium* sp, *Citrus* spp, *Cyperus* spp, *Datura* spp, *Daucus* spp, *Granium* spp, *Juglans* spp, *Malva* spp, *Mercurialis* spp, *Sonchus* spp, *Xanthium* spp, *Vicia* spp, *Beta vulgaris* L, *B. vulgaris* var *rapa*, *Cannabis sativa* L, *Citrullus lanatus* L, *Crataegus oxyacantha* L, *Cucumis sativus* L, *Moschata lam*, *C. pepo* L, *Cynodon dactylon* L, *Ficus carica* L, *Glycine max* L, *Glycyrrhiza glabra* L, *Gossypium hirsutum* L, *Helianthus annuus* L, *Hibiscus esculentus* L, *Lactuca aculeata* L, *Malus domestica* L, *Medicago sativa* L, *Mentha piperita* L, *Nicotiana tabacum* L, *Olea europaea* L, *Oryza sativa* L, *Petroselinum sativum* Hoff., *Phaseolus vulgaris* L, *Pimpinella anisum* L, *Pisum sativum* L., *Polygonum aviculare* L, *Portulaca oleracea* L, *Prosopis stephaniana* Bieb, *Prunus amygdalus Dulcis*, *P. armeniaca* L, *P. avium* L, *P. domestica* L, *P. persica* L, *Raphanus raphanistrum* F, *R. sativus* L, *Ricinus communis* L, *Sesamum indicum* L, *Setaria glauca* L, *Solanum lycopersicum* L, *S. nigrum* L, *S. melongena* L, *S. tuberosum* L, *Sorghum halepense* L, *Spinacia oleracea* L, *Trifolium repens* L, *Vicia faba*, *V. sativa* L, *Vigna unguiculata* L, *Vitis vinifera* L. and *Zea mays* L. plants (Kaplan 2007).

In the current study, a total of 68 adults were collected from 6 in İvriz village, 10 in Yayıklı village and 52 in Çakıllar village strawberry fields.

*Psammotettix* sp. (Hemiptera: Cicadellidae)

A total of 20 adults were collected from 5 in İvriz village, 3 in Yayıklı village and 12 in Çakıllar village strawberry fields.

*Lygaeus equestris* Linnaeus, 1758 (Hemiptera: Lygaeidae)

Common name: Black-and-red-bug

Description: The bodies of adults are bright red or reddish orange. The antennae are four-segmented and black. There is a bright white spot in the form of a dot on the tip of the forewings. The legs are completely black (Demirözer 2008).

Distribution: Species is widespread in the Palearctic regions of the world. It is common almost everywhere in Türkiye (Kaplan 2007).

Damage and Hosts: the species feeds on plants and plant seeds, usually on the soil surface, under stones and debris, and on low plants. Although it has a wide host range, it has not economic importance (Kaplan 2007).

It is reported that feeding of *L. equestris* on sunflowers in Hungary in 2001 caused damage by increasing of 2.5% in the linoleic content of the grain (Kaplan 2007).

In Türkiye, *L. equestris* was recorded among the harmful species in pistachios in Şanlıurfa (Yanık and Yücel, 2001).

Gencer et al. (2004) determined 8 *L. equestris* individuals in their study conducted in the strawberry fields of Bursa province. Detecting this species on *Rubus* and *Rosa*, Gençer et al. (2004) reported that this species was *Fragaria* spp. It has been stated that it can also be found on the species, but it will not cause any economic damage in the study.

In this study, a total of 22 adults were collected from 4 in the village of İvriz, 2 in the village of Yayıklı and 12 in the strawberry fields of Çakıllar Village.

*Pyrrhocoris apterus* Linnaeus, 1758 (Hemiptera: Pyrrhocoridae)

Common name: Fire bug

Description: The body is oval, the dorsal has red and black markings, and the antennae and legs are black. The lower part of the abdomen is black and light-colored towards the edge. Its wings are short. There are no spines in the middle femur. Its body length is 7-11 mm (Lodos 1978).

Distribution: It can be found in almost every part of the Palearctic region including the Oriental sub-region and in North America (Lodos 1978).

It is a common species in almost every region of Türkiye, (Lodos 1978).

Damage and Hosts: The main host of the species is hibiscus. However, it can be sometimes seen in okra and some other *Malvaceae* plants. Adults and nymphs especially feed on the seeds of hibiscus. The damage is not significant.

Gencer et al. (2004) detected 2 *Pyrrhocoris apterus* L. in a strawberry fields study of Bursa province and stated that this species does not feed on strawberries.

Current study reported a total of 20 adults from 2 in İvriz village, 2 in Yayıklı village and 16 in Çakıllar village strawberry fields.

*Nezara viridula* Linnaeus, 1758 (Hemiptera: Pentatomidae)

Common name: Southern green stink bug

Description: Its general color is green, and in some individuals, the edges of the head and pronotum and the connexivum may be yellowish. Adults that emerge in autumn to spend winter are brownish in color. The body is flat and broad; It is covered with small, dense spots. There are 3 or 5 whitish calli at the base of the scutellum. The body length is 12-15 mm (Öncül 2006).

**Distribution:** It is a cosmopolitan species that is more or less common in almost all parts of Türkiye (Öncül 2006).

**Damage and Hosts:** It has economically importance species. It is common in agricultural areas, scrubs and meadows. It is highly abundant species. It feeds on a wide variety of vegetables, especially on tomatoes, peppers, beans, grasses (particularly corn, millet, rice), hemp, cotton, soybeans, sesame, clover, tobacco, hazel, citrus fruits, other fruit trees, and many wild and cultivated plants (Öncül 2006).

Kaplan (2007) detected this species in Elazığ strawberry fields, but did not mention any damage to strawberries.

In total of 20 adults were collected, 4 in the Yayıklı Village and 16 in the Çakıllar Village strawberry fields.

*Centrocoris variegatus* Kolenati, 1845 (Hemiptera: Coreidae)

Common name: Leaf-footed bug

**Description:** It is a species with a long oval body, a hard integument, dark brown color, yellowish spotted and patterned there are many spines on the sides of the pronotum. The proboscis reaches the middle coxa. It has a triangular projection on either side of the base of the pronotum, extending to the middle of the scutellum. The tip of the scutellum is convex, with a long carina in the middle. Femur and tibiae black. Its body length is 10-12 mm (Öncül 2006).

**Distribution:** It has been found in Ankara, Aydın, Balıkesir, Bursa, Denizli, İzmir, Manisa and Muğla provinces (Önder et al. 2006).

In the world, it has a presence in the Mediterranean, Caucasus and Cyprus (Önder et al. 2006).

**Damage and Hosts:** This species is not economically importance. It spreads in agricultural areas, scrubs and meadows. It is a rare species and feeds on plant (Önder et al. 2006). It occurs in plants of *Chenopodiaceae* family, particularly in cultivated and wild forms. There have also been reports of damage to sugar beets and spinach grown for seed (Lodos 1986).

In total of 13 adults were collected, 2 in the village of İvriz, 1 in the village of Yayıklı and 10 in the strawberry fields of Çakıllar Village.

*Truxalis robusta* Uvarov, 1916 (Orthoptera: Acrididae)

**Description:** The body length is 15-25 mm. The head is conical and elongated, and the muzzle is well developed with back wings (Sevgili et al. 2012).

**Distribution:** It is found in Iran, Russia and Azerbaijan.

It has been detected in Antalya, Kahramanmaraş, Gaziantep, Malatya, Amasya, Hatay, Elazığ, Van and Erzincan in Türkiye (Sevgili et al. 2012).

**Damage and Hosts:** It has been found in alfalfa, cotton, melon and cucurbits (Abıvardı 1965).

In a current study, one adult was identified in the strawberry fields of Çakıllar Village.

*Aiolopus strepens* Latreille, 1804 (Orthoptera: Acrididae)

Common name: Broad green-winged grasshopper

**Description:** The pronotum, 18-28 mm long, is slightly convex anteriorly, posteriorly triangular, central carina is prominent, the posterior femur is 3 times longer than the width, the inner surface is slightly reddish with two black spots, and the posterior tibia is red (Vidal 2000).

**Distribution:** It has been detected in Southern Europe, North Africa, North Asian Mountain ranges, plateaus and basins (Vidal 2000).

It has been found in the provinces of Adıyaman, İzmir, Diyarbakır, Samsun, Bursa and Tokat in Türkiye (Önder et al. 1999).

**Hosts:** It has been detected in bushes, false bromine, savanna grasslands, stony riverbanks, cultivated areas, riverine grasslands and grain boundaries (Vidal 2000).

Kovanci et al. (2003) found 12 individuals of *Aiolopus strepens* in the strawberry fields of Bursa province, but reported that there was no significant damage to the strawberry.

As a result, a total of 17 adults were found, 5 in İvriz village, 3 in Yayıklı village and 9 in Çakıllar village strawberry fields.

*Gryllus bimaculatus* De Geer, 1773 (Orthoptera: *Gryllidae*)

Common name: Two-spotted cricket

Description: The pronotum is almost equally wide anteriorly and posteriorly; body usually dark black, base of tegmina with yellow spots on both sides, these spots rarely take the form of a band, ventral of posterior femur red, tegmina black, sometimes brown; hind wings longer than tegmina; the body is 21-25 mm in males, 25-29 mm in females, and the ovipositor is 11-14 mm long (Özbek and Hayat 2003).

Distribution: It is a common species in the west and south part of Türkiye (Özbek and Hayat 2003).

Damage and Hosts: Causes damage to maize, rice, wheat, tobacco, cotton, cucurbits and some other plants. It gnaws on the cobs of the maize during the milk production period. They eat the stems and leaves of rice and wheat plants. It is also reported that they eat the newly planted seeds (Özbek and Hayat 2003).

As a result of the study, a total of 28 adults were collected, 2 in İvriz village, 6 in Yayıklı village and 20 in Çakıllar village strawberry fields.

*Gryllotalpa gryllotalpa* Linnaeus, 1758 (Orthoptera: *Gryllotalpidae*)

Common name: European mole cricket

Description: The general color of this species is gray brown, dark brown or reddish brown, the body is covered with short velvety hairs, the lower part of the body is yellowish, the pronotum is large and well developed, 4-5 spacing on the inner and upper part of the posterior tibiae. There are teeth or spines, the front legs are digging, the upper wings are short, the lower wings are well developed, the body length is between 35.0-50.0 mm, and sometimes larger individuals are encountered. The eggs are 2.5-3.0 mm in length and oval, first yellowish and later darker. Nymphs are very similar to adults except for the wings and size (Sönmezyıldız 2006).

Distribution: It has been reported spreading from the whole of Europe, Russia, West Asia, Java, China, Australia, North Africa, Somalia, Abyssinia, Israel, Iran, Iraq, Syria, Afghanistan, Pakistan to the Equator (Sönmezyıldız 2006).

This species is found in varying densities in almost every region of Türkiye

Damage and Hosts: *G. gryllotalpa*, an omnivorous species, eats some insects and worms living in the soil, but feeds mainly on cotton, tea, sugar beet, grass, potatoes, rice, carrots, tobacco, cucurbits, citrus fruits, olives, vines, various vegetables seedlings etc. Adults and nymphs cut the roots of the plants they come across while opening a gallery in the soil and hollowing out the tubers (Sönmezyıldız 2006).

Kovanci et al. (2003) detected only 3 *G. gryllotalpa* in their study in the strawberry fields of Bursa province.

One adult was found in İvriz village in this study.

*Polydrusus* sp. (Coleoptera: *Curculionidae*)

Damage and Hosts: Kovanci et al. (2004) reported 8 *Polydrusus* species in a study conducted in the strawberry fields of Bursa province. Species belonging to this genus are polyphagous, larvae feed on the roots of cultivated plants, and the adults feed on the leaves of various plants.

A total of 39 adults were collected from 6 in the village of İvriz, 9 in the village of Yayıklı and 24 in the strawberry fields of Çakıllar Village.

*Epicometis (Tropinota) hirta* Poda, 1761 (Coleoptera: *Scarabaeidae*)

Common name: Apple blossom beetle



Description: Adults are matte black. There are frequent and long yellow hairs on the body. There are white spots on the elytra (Demirözer 2008).

Distribution: This species spreads over a widespread from England to the Middle East and Central Asia, and can be found in almost every part of our country (Kaplan 2007).

Damage and Hosts: they generally cause damage by eating the flowers of various fruit trees, roses, peas, broad beans and other plants in the fields and gardens from the beginning of April (Kaplan 2007).

A total of 5 adults were found in current study, 1 in İvriz village, 2 in Yayıklı village and 2 in Çakıllar village strawberry fields.

*Chrysolina orientalis* Olivier, 1807 (Coleoptera: Chrysomelidae)

Description: Body length is 3-5 mm. Antennae are long and reddish-brown. The elytra is metallic green with numerous red-brown pits.

Distribution: It is reported from Hatay, Osmaniye, Amasya, Konya, Istanbul, Bilecik, Bursa and Afyon in our country (Özdikmen and Aslan 2009).

it can also be found in Syria, Israel, Cyprus, Iran, Iraq and Tunisia (Aslan et al. 2003).

Damage and Hosts: Field survey shave shown that it causes damage on strawberry leaves and *Amaranthus* spp. making holes in the leaves.

In the current study, a total of 6 adults were found, 2 in İvriz village and 4 in Çakıllar village strawberry fields.

*Acmaeodera pilosellae* Bonelli, 1842 (Coleoptera: Buprestidae)

Description: The body length of this species, belonging to the *Buprestidae* family, is 3-8 mm. This insect has a bright coppery bronze color and often has gray hairs on the sides of the body. The head is convex and the elytra is light yellow with black spots on the elytra (Thery 1942).

Distribution: It has been only found in İçel (Erdemli) in Türkiye (Tezcan 1995).

It has a global distribution and found in Greece, Macedonia, Bulgaria, Serbia, Montenegro, Austria, Iran, Albania, Czech Republic, Azerbaijan, France, Italy, Switzerland and Turkmenistan in the world (Anonymous 2024b).

Damage and Hosts: It is a polyphagous pest and generally prefers plants of the *Fagacea* family. Adults *Hieracium* sp, *Taraxacum* sp, *Convolvulus* sp and *Helianthemum* sp. It has been reported that it was found on (Thery 1942).

Prior to this study, this species had not reported in Türkiye, but 9 adults were found, and no damage was observed, 7 in the Yayıklı Village and 2 in the Çakıllar Village strawberry fields.

*Harpalus (Pseudoophonus) rufipes* De Geer, 1774 (Coleoptera: Carabidae)

Common name: Strawberry seed beetle

Description: The body length of the adult is 14-17 mm. Body color is matte black. The elytra is covered with yellowish hairs. Antennae and legs red-brown. The legs are covered with red-brown hairs (Anonymous2013b).

Distribution: In our country; Adana, Antalya, Ardahan, Artvin, Bartın, Bingöl, Bursa, Cankiri, Diyarbakir, Erzincan, Erzurum, Giresun, Gumushane, Iğdir, Isparta, Icel, İzmir, Kahramanmaraş, Karaman, Kars, Konya, Kütahya, Malatya, Mugla, Tokat, Trabzon, Osmaniye, Yalova (Kesdek and Yıldırım 2003).

In the world; Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Macedonia, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Russia, Sweden, Switzerland, Ukraine, Serbia, Montenegro, Algeria, Egypt, Morocco, Tunisia, it has been reported to be found in Afghanistan, Cyprus, Russia, Iran, Iraq, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Russia and China (Avgın 2006).

Damage and Hosts:

Cockscomb, legumes, cereals, raspberries and strawberries are the host of this species. Adults feed on strawberry seeds close to the soil and the flesh of the strawberry fruit (Anonymous 2013b).

In this study a total of 79 adults were found, 23 in İvriz village, 3 in Yayıklı village and 53 in Çakıllar village strawberry fields.

*Forficula auricularia* Linnaeus, 1758 (Dermaptera: Forficulidae)

Common name: Earwig

Description: They are bright brown-colored insects that are easily recognizable due to their short wings and pincer-shaped cerci at the end of the abdomen. The claws of females are straight, not curved like those of males. The forelimbs are very small, leathery and veinless. The hind wings are yellowish, with radial veins and fan-like. Their legs are reddish brown (Kansu 1999).

Distribution: It is seen in Türkiye, Bulgaria, USA, Greece and Europe (Sönmezyıldız 2006).

Damage and Hosts: Adults and nymphs are omnivores and feeds on the leaves, flowers and fruits of many plants. They cause damage, especially by eating the flowers of ornamental plants. They seek for food in the dark. They climb bushes and trees. They eat almost everything. (Sönmezyıldız 2006).

*Forficula auricularia* species cause extensive damage to forest trees and shrubs, ornamentals, vegetables and fruit trees. Damage is seen on almost all parts of the trees. It causes considerable damage to ornamental plants, especially dahlias, chrysanthemums, roses and carnations (Sönmezyıldız 2006). This insect eats small, soft-bodied insect other than plants. It especially feeds of aphids and small caterpillars. As a result of the study, a total of 32 adults were collected, 5 in İvriz village, 4 in Yayıklı village and 23 in Çakıllar village strawberry fields.

### 3.2. Description, habitat and distribution of natural enemies in strawberry fields

In the study conducted in 2011 in strawberry fields in Halkapınar district of Konya province, 8 beneficial insect species from 6 families belonging to 4 orders were identified.

*Coccinella septempunctata* Linnaeus, 1758 (Coleoptera: Coccinellidae)

Common name: Seven-spot ladybird

Description: It is a well-known species with an oval shape, 6-8 mm in length. The head and pronotum are black, with two small yellow spots on the head and two quadrangular yellow spots on the anterior corner of the pronotum. The elytra are red in color and has seven black spots on it. The right and left sides of the scutellum are lighter in color than the elytra (Uygun 1981).

Habitat: This species is an important enemy of aphids. It is very common on low and tall plants in gardens, fields, meadows, pastures and woods (Portakaldalı 2008).

In this study, a total of 5 individuals were identified, 1 in the Yayıklı Village and 4 in the Çakıllar Village strawberry fields.

Distribution: It is a widespread species in the Palearctic region. Uygun (1981) found this species almost every part of Türkiye.

*Scymnus rubromaculatus* Goeze, 1778 (Coleoptera: Coccinellidae)

Common name: Dusky ladybird

Description: It is a broadly oval species with a size of 2x1.8 mm. Elytra, pronotum and head completely black in females; In males, most of the pronotum and the middle back of the head are lighter in color (Uygun 1981).

Habitat: Yiğit and Uygun (1982), this species is a predator and a natural enemy of aphids (Yaşarakıncı and Hıncal 2000)

Bayram (2008) determined that this species feeds on *Eriosoma lanugierum*.

A total of 4 adults were identified, 1 in the Yayıklı Village and 3 in the Çakıllar Village strawberry fields in this study.

Distribution: Uygun (1981) reported as a common species in Türkiye, Adana, Afyon, Ankara, Antalya, Bursa, Hakkari, Hatay, İçel, Kahramanmaraş, Kastamonu, Kayseri and Marmara Regions

**Table 2.** Natural enemies detected in strawberry fields in Halkapınar district of Konya province and their locations.

Order	Family	Species	Locations		
			Konya-Halkapınar		
			İvriz Village	Yayıklı Köyü	Çakıllar Köyü
Coleoptera	Coccinellidae	<i>Coccinella septempunctata</i> Linnaeus, 1758		x	x
		<i>Scymnus rubromaculatus</i> Goeze, 1778		x	x
		<i>Scymnus pallipediformis</i> Günther, 1958		x	x
Thysanoptera	Thripidae	<i>Scolothrips longicornis</i> Prisner, 1926		x	x
	Nabidae	<i>Nabis pseudoferus</i> Remane, 1949	x		x
Hemiptera	Reduviidae	<i>Coranus griseus</i> Rossi, 1790	x	x	
Neuroptera	Chrysopidae	<i>Chrysoperla carnea</i> Stephens, 1836	x		x
	Raphidiidae	<i>Raphidia</i> sp.	x		

*Scymnus pallipediformis* Günther, 1958 (Coleoptera: Coccinellidae)

Common name: Bred minipiga

Description: It is an oval shaped species with a length of 1.85-2.8 mm. There are 2 or 4 round reddish spots on the elytra of this species. The number and size of the spots may vary. Specimens with two stains may be very similar to *S. apetzii*. Definitive species identifications can be made according to the condition of aedagus. The aedeagus and parameres of *S. pallipediformis* are equal or longer. The siphon tip is curved (Uygun1981).

Habitat: This species feeds on aphids, crustaceans and psyllids. It is a predator of *Lepidosaphes pistaciae* and *Agonoscena pistaciae*. It has been reported that it is fed with the maize leaf aphid *Rhopalosiphum maidis* in the Çukurova region (Portakaldalı, 2008).

As a result of the study, a total of 7 adult individuals were identified, 1 in the Yayıklı Village and 6 in the Çakıllar Village strawberry fields.

Distribution: It has been found in Adana, Antalya, Bursa, Hakkari, Hatay, İçel, Istanbul, İzmir, Kırklareli, Malatya, Mardin, Muğla and Urfa (Uygun1981).

*Scolothrips longicornis* Prisner, 1926 (Thysanoptera: Thripidae)

Common name: Six-spotted thrips

Description: The first instar L1 larva is very small (approximately 0.2 mm), transparent white color and red eyes. After molting, the L2 larva looks very similar to the L1 larva and only the body grows significantly (Şengonca and Gerlach 1986). These 2 larval stages are followed by 2 dormant protonymph and nymph stages, due to typical neometobola metamorphosis of Thysanoptera. During this period, nymphs are white in color and do not take food, although they can move. Antennae are free in protonymph and attached to the head in nymphs (Şengonca and Gerlach 1986).

Adults are about 1 mm in length and light lemon yellow in color. There are 3 brownish spots evenly spaced on the front wings in the form of eyelashes. Although the adult male is similar to the female, the body is smaller and the wings are shorter (Şengonca and Gerlach 1986).

Habitat: *Scolothrips longicornis* has been found in areas of cotton, field vegetable and peanut production, also fruit growing and apple production areas on plateau, and in herbaceous plants in the coastal areas (Tunç 1990). It has been found together with *T. urticae* on fruit trees and herbaceous plants. It should be kept in mind that *S. longicornis* may also be related to *T. cinnabarinus* Boisduval (Şengonca and Gerlach 1986), which lives on herbaceous plants on the beach and is known to feed on it under controlled conditions. On plateau, *Bryobia rubrioculus* (Scheuten 1857))

*Panonychus ulmi* (Me Gregor), *T. urticae*, *T. viennensis* (Zacher) were mostly detected on fruit trees. However, it should be noted that there is no information feeding under controlled conditions with the exception of *T. urticae* (Şengonca and Gerlach 1986).

As a result of the study, a total of 5 adults were identified, 2 in the Yayıklı Village of Halkapınar district of Konya and 3 in the strawberry fields of Çakıllar Village.

Distribution: *Scolothrips longicornis* is a common species, and has been reported to attract attention in the Mediterranean and Southeastern Anatolia regions of Türkiye (Şengonca and Gerlach 1986).

In the world; it is found in Egypt, Romania, Hungary, Austria, France, Spain and North America (Tunç 1990).

*Nabis pseudoferus* Remane, 1949 (Hemiptera: *Nabidae*)

Common name: Almindelig nymfetaege

Description: It has an elongated body, grayish or dirty yellowish color. There is usually a longitudinal line on the back of the head and anterior to the pronotum. Hemelytra always fully developed and distinctly longer than abdomen, covered with dense and short hairs. Corium has less than 45 (usually between 25-35) hairs on the apex-lateral part. Aedeagus has one mating hook. Its body length is 7-8 mm (Lodos 1986).

Habitat: Öztemiz (2012) reported this predator insect feeds on the eggs and larvae of *Tuta absoluta*. It has also been reported that *Nabis pseudoferus* feeds on soft-bodied insects, aphids, *Cicadellids* and *Noctuidae* larvae (Lodos 1986).

As a result of the study, a total of 2 adult individuals were identified, 1 in the strawberry field of İvriz Village and 1 in the Çakıllar Village strawberry field.

Distribution: It has been reported to be found in the region from Europe to Iran. It is also common species in our country (Lodos 1986).

*Coranus griseus* Rossi, 1790 (Hemiptera: *Reduviidae*)

Description: Body length is 8.5-11.2 mm. Body color is gray, brown-gray and sometimes black. The underside of the elytra is red or orange. Antennae are gray and short (Straub and Günther 2006).

Habitat: They are found in grassy grasses, rocks and places with sparse vegetation. They feed on small arthropods (Anonymous, 2013 c).

A total of 3 adults were identified, 1 in the strawberry field of İvriz Village and 2 in the strawberry field of Yayıklı Village in the current study.

Distribution: In the world; Albania, Andorra, Bosnia and Herzegovina, Bulgaria, Germany, France, Greece, Italy, Croatia, Malta, Macedonia, Montenegro, Portugal, Romania, Russia, Serbia, Slovenia, Spain, Switzerland, Ukraine, Hungary,

It is reported in Algeria, Morocco, Tunisia, Afghanistan, Armenia, Azerbaijan, Georgia, Iran, Iraq, Israel, Kazakhstan, Syria, Tajikistan, Turkmenistan, Uzbekistan and Cyprus (Straub and Günther 2006).

It is found in Aydın, Bilecik, Çorum, Denizli, Diyarbakır, Eskişehir, İzmir, Konya, Malatya, Mardin, Muğla, Siirt, Tekirdağ and Şanlıurfa in our country (Önder 1980).

*Chrysoperla carnea* Stephens, 1836 (Neuroptera: *Chrysopidae*)

Common name: Green lacewings

Description: The head is green and there are very little dark spots on it. The chest and abdominal segments are green, and there are black, short hairs on it. The wing opening is 20-30 mm, 8-10 mm in height females and 6-8 mm in men (Bozdoğan et al. 2012).

Habitat: The wintering adults in the secluded places of the tree branches, in the walls of the houses and so on. They spend on the floor. Depending on the temperature of winter, the colors return from green to red. They fly in the light around the electrical lamps in the evening. During the day, they relax in the shade places of trees, shrubs or grasses close to aphids (Bahadırođlu and Daymaz 2001). It is an important predator and was reported as a natural enemy feeding larvae and some types of mites (Lodos 1984).

As a result of the study, a total of 6 adult individuals were identified in İvriz Village of Halkapınar district of Konya and 5 in the strawberry areas of Çakıllar Village.

Distribution: Europe is located in North America with a large part of Asia. It is quite common in Türkiye (Koca 2009).

*Raphidia* sp. (Neuroptera: Raphidiidae)

Common name: Snakefly

Habitat: They usually prey on small insect such as weak aphids and small caterpillars. Larvae do not know how to eat well, but soft-bodied insects eat (Anonymous 2013 a).

As a result of the study, a total of 1 adult were identified as 1 in the strawberry area of İvriz Village.

#### 4. Conclusions

One mite species, 19 harmful insect species from 16 families belonging to 5 orders and 8 beneficial insect species from 6 families of 4 orders were determined in this study carried out in İvriz in 2011 in Halkapınar district of Konya and in İvriz, Yayıklı and Çakıllar villages in 2011. Among insect species identified, *Tetranychus urticae* Koch, *Thrips tabaci* Lind *Brachycaudus helichrysi* Kaltenbach and *Chaetosiphon fragaefolii* Cockerell were important in terms of pest prevalence and density, and as predator *Coccinella septempunctata* L. and *Scymus pallipediula-niformis* longi were found important species in strawberry fields.

More species were identified in the strawberry fields of the village of Çakıllar than in the other two villages. It is thought that the reason for the detection of more species in Çakıllar village is due to the large number of sampled sites and the high altitude.

Kaplan (2007) determined 58 harmful species from 20 families belonging to 7 orders and 21 beneficial insect species from 11 families in a faunistic study conducted in strawberry fields in Elazığ province. Erkiç et al. (1996) detected 48 insect and mite species in their faunistic study in the strawberry fields of İçel province. In this study, fewer species were detected compared to previous studies, and this is thought to be due to late start of strawberry cultivation, low number of strawberry locations, and they are spraying surrounding orchards with broad-spectrum insecticides.

The most common pest is *T. urticae*. Yigit and Erkiç (1992), Schuster et al. (1979) and Lapre et al. (1982) stated in various studies that red spiders, which constitute the most important pest group in strawberries, damage the mesophyll cells in the leaves, causing the plants to be stunted, sometimes to death, and 50% yield loss, especially in cases where the population density is high. However, since it creates a low population, there is no obvious harm.

Aphid species *Brachycaudus helichrysi* and *C. fragaefolii* detected in all the sampling area are. Although these species were seen to a greater or lesser extent at all 1 sampled locations from the beginning of the season through July, August, September and October, they did not show a significant population densities. Kaplan (2007) reports that aphids primarily transmit viruses when they feed by stinging sucking sap but, they also cause deformities as a result of feeding when their populations are high.

*T. tabaci* is the only thrips species found to be harmful to strawberries in the current study. Although they are generally seen in gardens like aphids, their population level are low. Cultural measures should be given importance in the management of thrips species.

As a result, it was reported that the most common pests such as spider mites, aphids and thrips were also detected in this study in the strawberry fields of Halkapınar district of Konya province, have not yet reached the population density that requires management methods.

Strawberry cultivation in Halkapınar district has started to become widespread since 2010. As strawberry pest population are low, intensive spraying is not used. It is essential to take the necessary plant protection measures to maintain the equilibrium state, and to train and raise awareness of the practitioners in this context.

It was noted during the censuses that the presence of weeds had a great effect on the population increase of small arthropods in strawberry fields. Therefore, weed removal should be given special attention alongside other cultural measures.

With this research, detrimental insect species and their natural enemies have been revealed in the strawberry fields of Halkapınar district of Konya province, and it is thought that it will contribute to the studies to be carried out on this subject.

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## References

- Abıvardı C (1965). Iranian entomology applied entomology. 1. Cilt, *Swiss Federal Institute of Teknology, Zurich, Switzerland*, p. 603.
- Anonymous (2013a). [http:// everythingabout.net/articles/biology/animals/arthropods/insects/snafkefly](http://everythingabout.net/articles/biology/animals/arthropods/insects/snafkefly) (access date: 26.03.2013].
- Anonymous (2013b). [http://www.schaedlingskunde.de/Steckbriefe/htm\\_Seiten/Behaarter-Erdbeersamenlaufkaefer - Pseudoophonus-rufipes.htm](http://www.schaedlingskunde.de/Steckbriefe/htm_Seiten/Behaarter-Erdbeersamenlaufkaefer - Pseudoophonus-rufipes.htm) (access date: 23.05.2013).
- Anonymous (2013 c). <http://redbook-ua.org/item/coranus-griseus-rossi/> (access date: 06.06.2013).
- Anonymous (2024 a) [https://www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/009\\_pamuk.pdf](https://www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/009_pamuk.pdf) (access date: 28.06.2024).
- Anonymous (2024 b) <https://www.gbif.org/es/species/4431338> (access date: 28.06.2024).
- Aslan İ, Gruev B, Özbek H (2003). A preliminary review of the subfamiliy *Chrysomelinae* (Coleoptera, *Chrysomelidae*) of Turkey. *Linzer Biologische Beiträge* 35(1): 581-605.
- Avgın SS (2006). Kahramanmaraş ili ve çevresi *Carabidae* (Coleoptera) faunası ve taksonomisi üzerine çalışmalar. PhD Thesis, Çukurova University (Unpublished).
- Bahadıroğlu C, Daymaz Y (2001). Kahramanmaraş ilinde *Chrysopidae* (Neuroptera) familyasına ait türler ve biyolojik özellikleri. *Kahramanmaraş Sütçü İmam Üniversitesi Fen ve Mühendislik dergisi* 4(2): 30-36.
- Bayram Ş (2008). Ankara'da Karaağaç (*Ulmus glabra* Mill.)'da gal yapan yaprakbitlerinde avcı *Coccinellidae* (Coleoptera), *Chrysopidae* ve *Hemerobiidae* (Neuroptera) familyasına bağlı türler. *Tarım Bilimleri Dergisi* 14(4): 386-393.
- Bozdoğan H, Bahadıroğlu C, Toroğlu S (2012). Altıngözlü böcekler (Neuroptera: *Chrysopidae*), genel özellikleri ve biyolojik mücadelede önemi. *Neşehir Üniversitesi Fen Bilimleri Enstitü Dergisi* 1: 51-57.
- Çakaryıldırım N (2004). Çilek. *Tarımsal Ekonomi Araştırma Enstitüsü Bakış* 12(7): 1-4.
- Demirözer O (2008). Isparta ili yağ gülü (*Rosa damascena* Miller) üretim alanlarında bulunan zararlılar, yayılışları, doğal düşmanları ve önemlilerinin populasyon değişimleri. PhD Thesis, Süleyman Demirel University (Unpublished).
- Erkılıç L, Yumruktepe R, Mart C (1996). İçel ili çilek alanlarında bulunan Arthropod türleri. *Türkiye 3. Entomoloji Kongresi*, Ankara, Türkiye, pp. 440-447.
- Güçlü Ş, Özbek H (1994). Erzurum yöresinde *Cicadellidae* (Homoptera, *Auchenorrhyncha*) türleri üzerinde faunistik ve sistematik çalışmalar. *Atatürk Üniversitesi Ziraat Fakültesi Dergisi* 25 (3): 367-379.
- Kansu İA (1999). Genel entomoloji. *Ankara Üniversitesi Ziraat Fakültesi*, Ankara, Türkiye, p. 400.
- Kaplan M (2007). Elazığ ili çilek alanlarında bulunan zararlı böcek ve akar türleri ile bunların doğal düşmanlarının belirlenmesi üzerinde araştırmalar. Yüksek Lisans Tezi, Harran Üniversitesi Fen Bilimleri Enstitüsü, Şanlıurfa, 76.
- Kesdek M, Yıldırım E (2003). Contribution to the knowledge of *Carabidae* fauna of Turkey part 1: Harpalini (Coleoptera, *Carabidae*, *Harpalinae*). *Linzer Biol. Beitr* 35 (2),1147-1157.
- Kılıç A (2013). Konya/Halkapınar ilçesi çilek alanlarında bulunan zararlı böcek ve akar türleri ile bunların doğal düşmanları. Master Thesis, Selcuk University (Unpublished).
- Koca S (2009). Kayseri ilinde gilaboru bitkisi (*Viburnum opulus* L.) üzerinde bulunan Arthropoda türlerinin belirlenmesi. Master Thesis, Selcuk University (Unpublished).

- Kocadal E (2006). Kuzey Kıbrıs Türk Cumhuriyeti'ndeki *Aphidoidea* (Homoptera) türleri, bunların konukçuları, parazitoit ve predatörlerinin belirlenmesi. Master Thesis, Çukurova University (Unpublished).
- Kovancı B, Gençer NS, Kovancı OB, Akgül HC (2003). Bursa ili çilek alanlarında bulunan Orthoptera türleri. *Uludağ Üniversitesi Ziraat Fakültesi Dergisi* 91-102.
- Lapre LF, Sances FV, Toscono NC, Oatman ER, Voth V, Johnson MW (1982). The effects of Acaricides on the physiology, growth and yield of strawberries. *Journal of Economic Entomology* 75: 616-619.
- Lodos N (1978) Türkiye *Pentatomoidea* (Heteroptera) üst familyası üzerinde araştırmalar. *Türkiye Bitki Koruma Dergisi* 2 (4): 195 - 239.
- Lodos N (1986). Türkiye Entomolojisi (Genel, Uygulamalı ve Faunistik), Cilt II. (Gözden Geçirilmiş II. Basım). Ege Üniversitesi Basımevi, İzmir, Türkiye, p. 580.
- Lodos N (1984). Türkiye Entomolojisi II (Genel Uygulamalı ve Faunistik). *Ege Üniversitesi Ziraat Fakültesi Dergisi* 150.
- Öncül T (2006). Edremit (Balıkesir) yöresi zeytin bahçelerindeki Heteroptera faunasının kışlak tuzaklarla belirlenmesi üzerinde araştırmalar. Master Thesis, Balıkesir University (Unpublished).
- Önder F (1979). Toprakta Arthropoda faunasını saptamada kullanılan yeni bir toplama yöntemi etilen glikollü (ethanediol) çukur tuzak. *Bitki Koruma Bülteni* 19 (2): 103-110.
- Önder F (1980). Preliminary list of the Turkish Reduviidae (Heteroptera). *Journal of the Agricultural Faculty of Ege University* 17, 1-20.
- Önder F, Karsavuran Y, Tezcan S, Fent M (2006). Türkiye *Heteroptera* (Insecta) kataloğu. *Meta Basım*, İzmir, Türkiye, p. 164.
- Özbek H, Hayat R (2003). Tahıl, sebze, yem ve endüstri bitki zararlıları, *Atatürk Üniversitesi Yayınları*, No:930, Erzurum, Türkiye, p. 60.
- Özdikmen H, Aslan K (2009). First records of some leaf beetles for mediterranean region in Turkey and south Turkey (Coleoptera: *Chrysomelidae*). *Mun. Ent. Zool.* 4 (1), 276-279.
- Öztemiz S (2012). Domates güvesi [(*Tuta absoluta* Meyrick (Lepidoptera: *Gelechiidae*)] ve biyolojik mücadelesi, *KSÜ Doğa Bilimler Dergisi* 15(4): 47-57.
- Portakaldalı M (2008). Artvin ve Rize illeri Coccinellidae (Coleoptera) faunası üzerine araştırmalar. Master Thesis, Çukurova University (Unpublished).
- Schuster DJ, Price JF, Horwand CM, Alberegıs EE (1979). Two spotted spider mites, control on strawberry with organotin, naphthoquinone, and cyclopropane Acaricides. *Journal of Economic Entomology* 72: 360-361.
- Sevgili H, Demirsoy A, Durmuş Y (2012). Gaziantep'in biyolojik çeşitliliği. Gaziantep Kent Konseyi, Gaziantep, Türkiye, p. 570.
- Sönmez yıldız H (2006). Bartın yöresinde fidanlarda ve süs bitkilerinde zarar yapan böcekler. Master Thesis, Zonguldak Karaelmas University (Unpublished).
- Straub G, Günther H (2006). Bestimmungsmerkmale der *Coranus*-Arten (Heteroptera, Reduviidae) europas und der kanarischen inseln mit einem neunachweis für Deutschland. *Biologiezentrum Linz, Austria*, pp. 987-985.
- Şengonca Ç, Gerlach S (1986). Avcı Thrips, *Scolothrips longicornis* Prisner (Thysanoptera: *Thripidae*) üzerinde araştırmalar. *Türkiye 1. Biyolojik Mücadele Kongresi*, Adana, Türkiye, pp. 319-329.
- Tezcan S (1995). Contribution to the study of the genera *Acmaeodera* Eschscholtz and the *Acmaeoderella* Cobos (Coleoptera, *Buprestidae*, *Acmaeoderinae*) of Turkey. *Türkiye Entomoloji Dergisi* 19(1): 69-79.



- Thery A (1942). Fauna de France. *Libririe De La Faculte Des Sciences*, Paris, France, pp. 1-221.
- Tunç İ (1990). Antalya'da bulunan avcı Thysanoptera türleri ve habitatları. *Türkiye 2. Biyolojik Mücadele Kongresi*, Ankara, Türkiye, pp. 181-187.
- Uygun N (1981). Türkiye *Coccinellidae* (Coleoptera) faunası üzerinde taksonomik araştırmalar. *Çukurova Üniversitesi Ziraat Fakültesi Yayınları*, Adana, Türkiye, p. 110.
- Vidal JMO (2000). Atlas of the Orthoptera of Catalonia. *Atlas of Biodiversity*, No:1, Catalonia, pp. 337-458.
- Yanık E, Yücel A (2001). The pistachio (*P. vera* L.) pests, their population development and damage state in Şanlıurfa province. Plant Protection Department, Harran University, Şanlıurfa, Turkey 56, 301-309.
- Yaşarakıncı N, Hıncal P (2000). İzmir ilinde örtüaltı biber yetiştiriciliğinde bulunan zararlılar ile doğal düşmanları ve populasyon gelişmeleri üzerinde araştırmalar. *Bitki Koruma Bülteni* 40(3-4): 135-152.
- Yiğit A, Uygun N (1982). Investigations on the population dynamics of hawthorn mite *Tetranychus viennensis* Zacher (Acarina: *Tetranychidae*) and its predators in apple orchards. *Çukurova Üniversitesi Ziraat Fakültesi Yıllığı* 13 (2): 64-69.
- Yiğit A, Erkiş L (1992). Studies on the chemical control of *Tetranychus cinnabarinus* Bosid. (Acarina, *Tetranychidae*), a pest of strawberry in the east mediterranean region of Turkey. *Crop Protection* 11, pp. 433-438.