Acta Entomology and Zoology

**E-ISSN:** 2708-0021
**P-ISSN:** 2708-0013
www.actajournal.com
AEZ 2022; 3(1): 01-03
Received: 18-10-2021
Accepted: 02-12-2021

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# Spider species feeding on *Cimbex quadrimaculata* (Müller, 1766) (Hymenoptera: Cimbicidae)

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**DOI:** https://doi.org/10.33545/27080013.2022.v3.i1a.47

**Abstract**
The study was conducted in almond orchards contaminated with *Cimbex quadrimaculata* (Müller, 1766) (Hymenoptera: Cimbicidae) in Diyarbakır and Elazığ provinces between 2019-2021. Predatory spider species that feed on *C. quadrimaculata*, an important pest of almond trees, were determined. Spider species that feed on different biological stages of the pest were collected with the help of beating umbrella, pooter and fine-tipped tweezers, brought to the laboratory and taken into 70% ethanol. Among these species, *Araneus marmoreus* Clerck, 1757, *Clubiona genevensis* L. Koch, 1866, *Cheiracanthium mildei* L.Koch,1864, *Euophrys* sp., *Heliophanus flavipes* (Hahn, 1832), *Linyphia hortensis* Sundevall, 1830 and *Philodromus longipalpis* Simon, 1870 fed on the larvae of the pest in almond canopy. The results of the study are the first findings that these species feed on species belonging to the order Hymenoptera (non-formicid).

**Keywords:** Almond sawfly, araneae, predatory spider, Turkey

## Introduction
Almond (*Prunus dulcis* Miller) culture play a great economic role in Turkey and approximately 10% of total almond production of Turkey is obtained from Diyarbakır and Elazığ [1]. Unfortunately, there are many pests in the almond orchards that affect almond cultivation negatively. So far, many harmful and beneficial insect species have been detected in almond orchards and some harmful insects have been reported to cause economic damage [2, 3]. *Cimbex quadrimaculata* Müller, 1766 a pest mainly on almond, but also feeds on apple, apricot, cherry, peach and pear in Turkey [4]. Pest's first instars attack newly opened buds of the host, while older instars feed along the main leaf veins.
Spiders are predators on insect pests in agroecosystems and they have a fundamental role on the natural balance [5]. This study aimed to determine the spider's species feeding on *Cimbex quadrimaculata* (Müller, 1766) in some almond orchards of Diyarbakır and Elazığ.

## Materials and Methods
This study conducted in almond orchards contaminated with *Cimbex quadrimaculata* (Müller, 1766) (Hymenoptera: Cimbicidae) in Diyarbakır and Elazığ provinces between 2019-2021. For this purpose, studies were conducted in five locations including Çermik, Ergani, Sivrice, Maden and Keban districts between April and August. Spider materials of the study were colected with the help of beating umbrella, pooter and fine-tipped tweezers, brought to the laboratory and taken into 70% ethanol. Also, insect samples were taken from the almond orchards in same localities of Diyarbakır and Elazığ provinces by employing methods such as striking, burlap band traps, and visual examinations of leaves, twigs and other parts of the trees. Spider identification was performed by using the identification keys of [6-8]. Predator-prey interaction experiments were carried out by placing a barrier that predator exclusions involve around almond canopy during a certain period of time in semifield conditions and by direct field observations.

## Results and Discussion
A total of 36 species belonging to 31 genera and 14 families of order Araneae were determined almond orchards contaminated with *Cimbex quadrimaculata* (Müller, 1766) (Hymenoptera: Cimbicidae) in Diyarbakır and Elazığ province (Table 1). Cheiracanthiidae, Philodromidae, Clubionidae, Thomisidae, Araneidae, Linyphiidae, Salticidae and Theridiidae families were come to the fore in terms of abundancy, respectively.

In this study, *Philodromus longipalpis* Simon, 1870 (Philodromidae), *Clubiona genevensis* L. Koch, 1866 and *Tmarus piochardi* (Thomisidae) were founded as a most abundant species in almond orchard canopy.

In terms of predators, spiders are divided into two groups as "web weavers and "active hunter". Among the families recorded in the present study, family Araneidae, Theridiidae, and Dictynidae are the orb web weavers and most of the rests are belonging to the active hunters. [9] in an almond orchard from Chile were characterized by a highest abundance of wandering spiders, while web-building spiders were the most frequent in surrounding areas. Similarly, in our study, wandering hunting spiders in the almond orchard were found to be the high abundant. As stated in [10], this result originates from that the web builders are found in areas with higher structural complexity, and disturbances in agricultural practices.

*Araneus marmoreus* Clerck, 1757, *Clubiona genevensis* L. Koch, 1866, *Cheiracanthium mildei* L.Koch, 1864, *Euophrys* sp., *Heliophanus flavipes* (Hahn, 1832), *Linyphia hortensis* Sundevall, 1830 and *Philodromus longipalpis* Simon, 1870 fed on the larvae of the pest in almond canopy. It has been observed that predatory spider species feed on the first biological stages (1st and 2nd larval stages) of harmful larvae. It has been determined that the secretions of the pest prevent the feeding of spider species and that the feeding decreases as the larval stages of the pest grow.

Hunting spiders as Thomisidae, Lycosidae, Oxyopidae, and Salticidae frequently capture Orthoptera, Homoptera, Hemiptera, Lepidoptera, Diptera, and some Coleoptera and Hymenoptera (Young and Edwards1990; Nyffeler *et al*. 1994). In this study, *Tmarus piochardi* (Simon, 1866) and *Monaeses* sp. (Thomisidae) found as formicid ant predators. [11] for *Tmarus* Simon, 1875 and *Monaeses* Thorell, 1869 genera, in the western palaearctic found similar results.

**Table 1:** Spider species in almond orchards contaminated with *Cimbex quadrimaculata* in Diyarbakır and Elazığ

| Family | Species |
|---|---|
| *Agelenidae* | *Allagelena gracilens* (C. L. Koch, 1841) |
| *Araneidae* | *Araneus marmoreus* Clerck, 1757 |
| | *Araneus sturmi* (Hahn, 1831) |
| | *Araniella cucurbitina* (Clerck, 1757) |
| *Cheiracanthiidae* | *Cheiracanthium mildei L. Koch, 1864* |
| *Clubionidae* | *Clubiona genevensis L. Koch, 1866* |
| | *Clubiona neglecta* O. Pickard-Cambridge, 1862 |
| | *Clubiona* sp. |
| *Dictynidae* | *Dictyna latens* (Fabricius, 1775) |
| *Filistatidae* | *Filistata insidiatrix* (Forskål, 1775) |
| *Gnaphosidae* | *Aphantaulax cincta* (L. Koch, 1866) |
| | *Micaria rossica* Thorell, 1875 |
| | *Prodidomus redikorzevi* Spassky, 1940 |
| | *Synaphosus* sp. |
| | *Zelotes* sp. |
| *Linyphiidae* | *Linyphia hortensis* Sundevall, 1830 |
| | *Walckenaeria* sp. |
| *Oecobiidae* | *Oecobius rhodiensis* Kritscher, 1966 |
| *Oxyopidae* | *Oxyopes lineatus* Latreille, 1806 |
| *Philodromidae* | *Philodromus longipalpis* Simon, 1870 |
| | *Philodromus* sp. |
| *Salticidae* | *Ballus* sp. |
| | *Euophrys* sp. |
| | *Heliophanus flavipes* (Hahn, 1832) |
| | *Philaeus chrysops* (Poda, 1761) |
| | *Pseudicius* sp. |
| | *Thyene imperialis* (Rossi, 1846) |
| *Scytodidae* | *Scytodes kinzelbachi* Wunderlich, 1995 |
| *Thomisidae* | *Monaeses* sp. |
| | *Tmarus piochardi* (Simon, 1866) |
| | *Xysticus* sp. |
| *Theridiidae* | *Enoplognatha mandibularis* (Lucas, 1846) |
| | *Enoplognatha* sp. |
| | *Latrodectus tredecimguttatus* (Rossi, 1790) |
| | *Neottiura bimaculata* (Linnaeus, 1767) |
| | *Steatoda paykulliana* (Walckenaer, 1806) |
| | *Theridion* sp. |

## Conclusion

Despite the potential for competition and intraguild predation, spiders form abundant and diverse assemblages in orchards, and have an important role by consuming as natural enemies a large number of various insect pests [12-14]. Some spider species lives on tree trunks throughout the year, whereas others spiders use trees only for a certain period, mainly during overwintering [15, 18, 16, 17] stated that bark-dwelling spiders act as pest control agents in orchards and reported that small pesticide tolerant spiders such as Theridiidae and Dictynidae were found in the commercial apple orchard, while larger susceptible spiders such as Clubionidae and Philodromidae were in the abandoned pear orchard.

**Acknowledgements**
This study was supported by TUBITAK 118O124 number" 3001 project" and all authors would like to thanks to TÜBİTAK Scientific Council.

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