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# Determination of harmful and beneficial insect species in wheat cultivation areas of Midyat district, Mardin, Türkiye

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# Abstract

Wheat has been the most important food source in human nutrition throughout history. In agricultural areas, numerous harmful insects negatively affect wheat yield and quality. Identifying significant pest species and implementing effective control strategies are crucial for sustainable agriculture. This study was conducted between March-July 2022–2023 at two-week intervals to determine pest and beneficial insect species in wheat cultivation areas of Midyat district, Mardin. Sampling methods including sweep nets, quadrat (50x50 cm), pitfall traps, and visual inspection were used. The study identified 12 pest insect species belonging to 11 families within 7 orders and 7 beneficial insect species belonging to 6 families within 4 orders. Species distribution was: 4 species from 3 families in Coleoptera, 10 species from 8 families in Hemiptera, 2 species from 2 families in Hymenoptera, and 1 species each from Lepidoptera, Thysanoptera, Neuroptera, and Diptera orders. Among harmful species, *Eurygaster integriceps* Put., *Dolycoris baccarum* (L.), *Cephus pygmaeus* L., *Brancoplia leucaspis* Castelnau, *Zabrus* spp., *Oulema melanopus* (L.), and *Cercopis sanguinolenta* Scopoli showed high density and widespread distribution. The highest mean density was recorded for *E. integriceps* (13 adults + nymphs/m²). Field surveys revealed that Sunn pest (*Eurygaster integriceps* Put.) and Wheat stem borer (*Brancoplia leucaspis* Castelnau) are the most significant pests reaching economic damage thresholds. Among beneficial predator species, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) and *Coccinella septempunctata* L. (Coleoptera: Coccinellidae) were the most widespread.


# Introduction

Wheat is a cereal crop belonging to the Gramineae (Poaceae) family. Among cultivated plants, wheat holds a significant position worldwide in terms of cultivation area and production volüme (Anonymous 2022a). In addition to being the most fundamental food source in human nutrition, wheat is also an essential crop used as animal feed. Due to its wide adaptability, wheat ranks first in terms of cultivation area and production both globally and in Türkiye. It is a crucial staple food for approximately 50 countries. While wheat contributes around 20% of the total calories derived from plant-based foods worldwide, this rate is approximately 53% in Türkiye (Sayan 2010). As of 2022, a total of 242.675.832 hectares of wheat were cultivated worldwide, yielding 946.167.568.19 tons of production. Türkiye ranked 13th globally with a cultivation area of 6.601.805 hectares and a production volume of 19.750.000 tons (Anonymous 2022a). In 2023, Türkiye's wheat cultivation reached 68.326.019 decares, producing 22.000.000 tons (Anonymous 2024). According to the Turkish Statistical Institute (TÜİK) 2022 agricultural production data, the wheat cultivation area in Midyat district, Mardin province was 56.045 decares, with a total production of 13.749 tons (Anonymous 2022b). Wheat is grown in vast production areas and serves as a primary source of income for many farmers. However, several harmful insect species negatively impact wheat yield and quality. Many insect species feed on wheat plants, but only a few cause significant damage over large geographic areas (Singh et al. 1986; Hatchett et al. 1987). Protecting both human and environmental health from past to future is only possible through sustainable agricultural practices and the implementation of integrated pest management (IPM)

programs. Therefore, identifying the existing pest species and their natural enemies in agricultural production areas remains crucial.

## Materials and methods

# Material

The main materials of the study consisted of wheat cultivation areas in Midyat district, Mardin province, where harmful and beneficial insect species were identified. Additionally, sweep nets, an iron frame (50x50 cm), an aspirator, and various laboratory equipment were used.

## Method

The study was conducted between November 2022 and June 2023 under open-field conditions in Midyat district, Mardin province. Fieldwork was carried out every fifteen days from April to July during the wheat-growing season (Table 1). Insect sampling methods included sweep nets, an iron frame (50x50 cm), pitfall traps, and visual inspection. Depending on the field size, sweep nets were used for insect collection by walking in a pattern across the field, performing 100 sweeps. To determine the pest density, an iron frame (50x50 cm) was used. For Sunn pest (*Eurygaster integriceps* Put.) population counts, sampling started from the field edges and proceeded toward the center, with the iron frame placed at intervals of at least 20 steps.

Table 1
The scale used to determine the number of insect population dynamics in the wheat fields studied

| Field Area (da) | Number of Frames Thrown |
|---|---|
| 1–15 | 8–12 |
| 16–50 | 13–16 |
| 51–200 | 17–24 |
| 201–800 | 25–32 |
| 800-< | 33–42 |

The pitfall trap method was used to detect soil-dwelling pests (Önder, 1979). This method has been utilized for identifying pests that live underground, such as elaterids, carabids, and tenebrionids. In applying this method, 100 ml wide-mouthed plastic containers were filled with 3% formalin and a small amount of ethylene glycol, then buried level with the soil surface to capture insects entering the traps. These traps were replaced every two weeks, and the insects inside were collected using a sieve and prepared for identification (Karaca and Özgökçe 2002).

## Results

# Harmful insect species identified in wheat fields of Midyat (Mardin)

In a study conducted under open-field conditions in the Midyat district of Mardin province, 13 pest insect species belonging to 11 families across 7 orders were identified (Table 2).

Table 2
Harmful insect species identified associated with the different families in the surveyed wheat fields in the Mardin province of Türkiye

| Order | Family | Species |
|---|---|---|
| Coleoptera | Scarabaeidae | *Brancoplia leucaspis* Castelnau |
| | Carabidae | *Zabrus tenebriodes* Geeze |
| | Chrysomelidae | *Oulema melanopus* L. |
| Diptera | Anthomyiidae | *Phorbia* sp. |
| Hymenoptera | Cephidae | *Cephus pygmaeus* L. |
| Hemiptera | Scutelleridae | *Eurygaster integriceps* Put. |
| | Pentatomidae. | *Aelia rosrata* Boh. |
| | | *Nezara viridula* L. |
| | | *Eurydema* sp. |
| | | *Piezodorus lituratus* Fab. |
| | | *Dolycoris baccarum* L. |
| | Aphididae | *Schizaphis graminum* Rond. |
| | | *Sitobion avenae* F. |
| | Cercopidae | *Cercopis sanguinolenta* Scopoli |
| Lepidoptera | Scythrididae | *Syringopais tempratella* Led. |
| Thysanoptera | Phloeothripidae | *Haplothrips tritici* Kurdj. |

In the wheat fields where the study was conducted, it was determined that the pest species *Eurygaster integriceps* Put., *Dolycoris baccarum* (L.), *Cephus pygmaeus* L., *Brancoplia leucaspis* Castelnau, *Zabrus* spp., *Oulema melanopus* (L.), and *Cercopis sanguinolenta* Scopoli showed high density and widespread distribution. Surveys conducted in the wheat trial fields identified the Sunn pest (*Eurygaster integriceps* Put.) and the wheat beetle (*Brancoplia leucaspis* Castelnau) as significant pest insect species in terms

of reaching high population density and the economic damage threshold. It was observed that these species occasionally reached peak population levels and caused significant damage in certain locations.

## Beneficial insect species identified in wheat fields of Midyat (Mardin)

In this study, it was conducted under field conditions in the Midyat district of Mardin province, seven beneficial insect species belonging to six families across 4 orders were identified (Table 3).

Table 3
Beneficial insect species identified associated with the different families in the surveyed wheat fields in this study

| Order | Family | Species |
|---|---|---|
| Coleoptera | Coccinellidae | *Coccinella septempunctata* L. |
| | | *Hippodamia variegata* Goeze |
| | | *Oenopia conglobata* L. |
| Neuroptera | Chrysopidae | *Chrysoperla carnea* Stephens |
| Hymenoptera | Scelionidae | *Trissolcus* sp. |
| Hemiptera | Anthocoridae | *Orius* sp. |
| | Nabidae | *Nabis* sp. |
| | Miridae | *Deraeocoris* sp. |

In wheat fields, *Coccinella septempunctata* L., *Hippodamia variegata* Goeze, *Hippodamia variegata* Goeze (Coleoptera: Coccinellidae), and *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) were recorded as the most common general predators.

## Discussion

In this study, 7 beneficial species from 6 families across 4 orders were identified. Similar to this study, Dilmen et al. (2023) conducted a study in 2020–2021 to identify harmful and beneficial (predatory) insect species in wheat cultivation areas in Siirt province and its districts. As a result, they identified 42 species belonging to 25 families across 6 orders. Among these species, the most widespread and abundant ones were the primary pest *E. integriceps* and secondary pests *Aelia acuminata* (Linnaeus, 1758), *Dolycoris baccarum* (Linnaeus, 1758) (Hemiptera: Pentatomidae), *Cephus pygmaeus* (Linnaeus, 1767) (Hymenoptera: Cephidae), and *Melanogryllus* sp. (Orthoptera: Gryllidae). Additionally, Özgökçe et al. (2022) conducted a study in Van province and its districts to determine the harmful and beneficial insect species present in wheat fields. As a result of their research in 165 different locations, they identified 66 insect species belonging to 39 families across 7 orders. Sayan (2010) conducted a study in 2009 on wheat fields in Adana and identified 109 species, 95 genera, and 65 families belonging to 10

orders, including Odonata, Orthoptera, Thysanoptera, Homoptera, Neuroptera, Coleoptera, Lepidoptera, Diptera, and Hymenoptera. The most significant pests in the wheat agro-ecosystem were identified as the Sunn pest *Eurygaster maura* L., *E. integriceps* Put., aphids *Rhopalosiphum padi* L., *Sitobion avenae* F., *Schizaphis graminum* (Rond.), wheat leaf beetle *Oulema melanopus* L., wheat stem sawflies *Cephus pygmaeus* L., *Tracheolus tabidus* F., wheat chafer *Anisoplia* sp., wheat humpback beetle *Zabrus tenebrioides* Geeze, wheat moth *Syringopais temperetella* Led., wheat weevils (Curculionidae, Apionidae), leafhoppers (Cicadellidae), and flea beetles (*Phyllotreta* sp., *Chaetocnema* sp.). All these pest species were classified as primary pests. Additionally, the presence of wireworms (Elateridae), spittlebugs (Cercopidae), grasshoppers (Orthoptera: Acrididae, Tettigoniidae, Gryllotalpidae), and thrips was also recorded. Avcı (1998) conducted a study in Balcalı in 1996 and 1997 to identify beneficial and harmful insect species in wheat fields. The study recorded species belonging to Orthoptera, Hemiptera, Homoptera, Neuroptera, Coleoptera, Lepidoptera, Diptera, and Hymenoptera. In 1996, species from 27 families were identified, while in 1997, species from 39 families were recorded, with an overall identification of species belonging to 43 families. Kıran (1994) identified five species of aphids in wheat and barley cultivation areas in the Southeastern Anatolia Region, including *Sitobion avenae* F., *Rhopalosiphum padi*, *R. maidis* Fitch., *Schizaphis graminum* Rondani, and *Myzus persicae* Sulz. Dilmen et al. (2023) conducted a study to identify beneficial (predator) insect species in wheat cultivation areas in Siirt province and its districts. They recorded species from the order Coleoptera, including the family Coccinellidae (*Coccinella septempunctata*, *Oenopia conglobata*, *Scymnus bivulnerus*), from the order Neuroptera, including the family Ascalaphidae (*Libelloides macaronius*) and the family Chrysopidae (*Chrysoperla carnea*), and from the order Hemiptera, including the family Nabidae (*Nabis* sp.) and the family Reduviidae (*Triatoma* sp.). Similarly, Özgökçe et al. (2022) identified several widely distributed beneficial species in wheat fields of Van province and its districts. These included *Hippodamia variegata* Guérin-Méneville, *Coccinella septempunctata* L., *Scymnus bivulnerus* Capra & Fürsch, 1967 (Coleoptera: Coccinellidae), as well as *Stenodema laevigata* (L.) (Hemiptera: Miridae), a species listed on the red list and under protection. Additionally, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) was recorded as one of the most common natural enemies. Sayan (2010) conducted a study in wheat fields in Adana and identified the presence of highly important and widespread beneficial species. These included species from the family Aeolothripidae (order Thysanoptera); the families Nabidae and Miridae (order Hemiptera); the family Chrysopidae (order Neuroptera); the families Carabidae, Cantharidae, Coccinellidae, Cleridae, and Staphylinidae (order Coleoptera); the families Syrphidae, Asilidae, and Tachinidae (order Diptera); and the families Braconidae, Chalcidae, Eulophidae, Haltidae, Ichneumonidae, and Scelionidae (order Hymenoptera). Elmalı and Toros (1994) conducted a study in wheat cultivation areas in and around Konya province between 1989 and 1990. They identified predatory insects belonging to the families Coccinellidae (14 species), Syrphidae (3 species), Chamaemyiidae (1 species), Miridae (1 species), and Nabidae (2 species), along with one mite species and four aphidiid and one aphelinid parasitoid species from the order Hymenoptera. They reported that coccinellids were the most common and effective predatory species. Kıran (1994) identified several natural enemies in wheat and barley cultivation areas of the Southeastern Anatolia Region, including *Sphaerophoria rueppelli* Wied. (Diptera: Syrphidae), *Coccinella septempunctata* L. (Coleoptera: Coccinellidae), *Chrysoperla carnea* Steph.,

*Chrysopa* sp. (Neuroptera: Chrysopidae), *Lysiflebus fabarum* Mors. (Hymenoptera: Aphididae), and *Ephedrus plagiator* Nees.

In agricultural production areas, the larvae of species from the Chrysopidae family are general predators and prey on many pest insect groups. These species feed on harmful types such as aphids, mites, tobacco aphids, whitefly nymphs, and leaf pests (Kasap et al. 2003). *Chrysoperla carnea* primarily preys on aphids, but also feeds on psyllids, mealybugs, spider mites, and other soft-bodied insects(Souliotis et al. 2002; Atlıhan and Özgökçe, 2003; Rashid et al. 2012).

Many species from the Coccinellidae family play a pioneering role as general predators in biological control. William (2021) stated that species from the Coccinellidae family are the most common among all beneficial insect species. Among these species, the seven-spotted ladybird, *C. septempunctata*, is a significant predator of aphids, psyllids, potato beetles, and leaf (Honěk and Hodek 1996; Kedici et al. 1998; Erler 2004; Bolu et al. 2007). It has been reported that this species is widespread throughout Türkiye (Uygun 1981). *C. septempunctata* has been identified as a predator of aphids in wheat fields in Antakya (Serinyol) and Reyhanlı (Hatay) (Yiğit et al. 2007). Additionally, *Nabis pseudoferus* has been reported as an aphid predator in wheat production areas in Edirne province (Kıvan and Dirik 2016). *Nabis* species have also been reported as predator species in various ecosystems in many studies (Alaoglu and Özbek 1987; Atlıhan and Özgökçe, 2003; Kıvan and Dirik 2016).

# Conclusion

As a result of the study conducted between March and July of 2022–2023 in wheat fields of Midyat district, Mardin province, with the aim of identifying harmful and beneficial insect species, 12 harmful species from 11 families across 7 orders and 7 beneficial species from 6 families across 4 orders were identified. Among the harmful species identified in the wheat fields, *Eurygaster integriceps* Put., *Dolycoris baccarum* (L.), *Cephus pygmaeus* L., *Brancoplia leucaspis* Castelnau, *Zabrus* spp., *Oulema melanopus* (L.), and *Cercopis sanguinolenta* Scopoli, and the beneficial predator species such as *Coccinella septempunctata* L., *Hippodamia variegata* Goeze, and *Chrysoperla carnea* Stephens were determined to be important in terms of density and distribution. Survey studies conducted in wheat trial fields revealed that *Eurygaster integriceps* and *Brancoplia leucaspis* were significant pest species in terms of density and reaching the economic injury threshold. It was observed that the populations of these species sometimes increased to high levels, causing significant damage in certain locations.

In conclusion, some arthropods found in wheat fields are important for agricultural production. Harmful arthropods cause yield loss by feeding on plants' leaves, stems, and roots, while beneficial arthropods play a role in biological control as natural enemies of pests. For example, while pests like aphids and *Süne* suck the sap of wheat plants, beneficial species such as ladybugs and parasitoid wasps control these pests and maintain the balance of the ecosystem. Therefore, the diversity and impact of arthropods should be carefully studied in terms of sustainable agricultural practices.

# Declarations


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### Author contributions

All authors were involved in writing, review, and editing. They have also read and approved the final manuscript

### Data Availability

All data generated and/or analyzed during the present study are available in the manuscript, and the corresponding author has no objection to the availability of data and materials upon reasonable request.

### Ethics approval:

"This article does not contain any studies with human participants or animals performed by any of the authors"

### Competing interests

The authors declare that they have no conflicts of interest.

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