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Diversity of Insect Species on Bird's Eye Chili Pepper (*Capsicum frutescens* L.) in Tudua Village, Morowali Regency

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Abstract

Insects are the most diverse group of living organisms, accounting for nearly 80% of all known animal species. They belong to the phylum Arthropoda and exhibit a wide range of morphological characteristics. Insects can be found in almost all habitats, ranging from lush tropical rainforests to harsh deserts, as well as aquatic environments such as rivers and lakes. This study aimed to identify and describe insect species associated with bird's eye chili pepper (*Capsicum frutescens* L.) in Tudua Village. The research was conducted in October 2025. The study sites were selected using purposive sampling, with three observation plots measuring 10 × 10 m each. Insect samples were collected using a combination of sweeping nets, pitfall traps, light traps, and yellow traps. The collected specimens were identified based on their morphological characteristics up to the order, family, genus, or species level and were analyzed descriptively to determine their ecological roles within the agroecosystem. The results revealed a total of 29 insect species belonging to eight orders: Araneae, Coleoptera, Hemiptera, Orthoptera, Odonata, Lepidoptera, Hymenoptera, and Blattodea. The identified insects exhibited diverse ecological roles, including pests, herbivores, predators, pollinators, and decomposers. Members of the order Hemiptera and some species of Coleoptera were the most commonly encountered pest groups. Meanwhile, Araneae, Hymenoptera, and Odonata functioned as natural predators, Lepidoptera acted as pollinators, and Blattodea served as decomposers. The presence and distribution of insects were influenced by environmental factors such as temperature, humidity, light intensity, and soil pH.

Keywords: Bird's eye chili pepper (Capsicum frutescens L.); insect species; Tudua Village; ecological roles; environmental factors.

INTRODUCTION

Indonesia a country located along the equator with a tropical climate, possesses abundant natural resources. Its favorable geographical and climatic conditions make Indonesia one of the world's biodiversity-rich countries, including a wide variety of medicinal plants, vegetables, ornamental flowers, and fruits with significant economic value (Setiawan, 2022). One of the most important commodities widely favored by Indonesian people is chili pepper, particularly bird's eye chili (*Capsicum frutescens* L.) (Wasita & Hidayat, 2025). Bird's eye chili belongs to the family *Solanaceae* and is classified as a seasonal crop. This plant not only serves as an essential ingredient that enhances food flavor but also possesses high nutritional and economic value. It is extensively cultivated by local communities due to its relatively short harvesting period and its ability to grow under a wide range of environmental conditions (Andani et al., 2025). In Tudua Village, Morowali Regency, bird's eye chili is one of the primary sources of income for the local community.

Bird's eye chili is a crop that grows optimally at temperatures ranging from 24°C to 30°C, with moderate rainfall and adequate sunlight intensity. Indonesia's agroclimatic conditions, located within the tropical zone, are highly favorable for the year-round cultivation of this crop. Bird's eye chili can grow well in various soil types, particularly in loose, well-drained soils rich in organic matter, with a soil pH ranging from 5.5 to 6.8 (Nugraha & Sutrisni, 2021). The agroclimatic conditions of Tudua Village, which are conducive to the cultivation of horticultural crops, allow bird's eye chili to grow successfully throughout the year. However, the productivity of bird's eye chili plants often faces various constraints, one of which is damage caused by insect infestations (Setiawan, 2022).

Insects are the most species-rich group of organisms, accounting for nearly 80% of all known animal species. Of the approximately 751,000 insect species identified worldwide, around 250,000 are found in Indonesia. Insects belong to the class Insecta within the phylum Arthropoda and exhibit remarkable morphological diversity, including variations in wing structure, antennae, body shape, and coloration. They can be found in almost every habitat, ranging from lush tropical rainforests and arid deserts to aquatic environments such as rivers and lakes. In agricultural ecosystems, insects play important roles as pests, predators, parasitoids, and natural enemies that help regulate pest populations (Elisabeth et al., 2021). The diversity of insects associated with bird's eye chili plants includes members of several orders, such as Lepidoptera, Hemiptera, and Coleoptera. Certain insects, including bees and butterflies, function as pollinators and can contribute to increased crop yields (Fitriyani, 2025). Conversely, pest insects such as aphids and caterpillars may cause significant damage to bird's eye chili plants (Santoso et al., 2023). The diversity and abundance of insects associated with a particular crop are strongly influenced by environmental factors. Climatic conditions, soil characteristics, pesticide application, and cropping patterns can all affect the presence and distribution of insect communities within agricultural ecosystems (Taradipha, 2019).

To date, scientific information regarding the insect species associated with bird's eye chili plants in Tudua Village, Morowali Regency, remains very limited. This situation highlights the importance of conducting research to obtain data and information on the occurrence and diversity of insects associated with bird's eye chili cultivation in the area. Therefore, this study aims to identify and describe the insect species found on bird's eye chili plants (*C. frutescens* L.) in Tudua Village, Morowali Regency. The findings of this research are expected to provide valuable information for local communities, farmers, and students on insect species associated with bird's eye chili plants, including those that act as pests as well as those that function as natural enemies. Furthermore, the results may serve as a scientific basis for the implementation of integrated pest management (IPM) strategies and support efforts to enhance the productivity and sustainability of bird's eye chili cultivation in the region.

MATERIALS AND METHODS

Study area

This study was conducted in October 2025 in a bird's eye chili plantation located in Tudua Village, Morowali Regency, Central Sulawesi Province, Indonesia (Figure 1). Tudua Village is a rural area where the majority of the population relies on agriculture as their primary source of livelihood. Geographically, the village is situated in a tropical climate characterized by relatively warm temperatures and sufficient rainfall, conditions that are favorable for agricultural activities. These environmental conditions support the growth and reproduction of bird's eye chili plants while also providing suitable habitats for various insect species associated with the crop. The study area is surrounded by diverse vegetation, including food crops, shrubs, and wild plants, which may serve as alternative habitats and resources for insects.

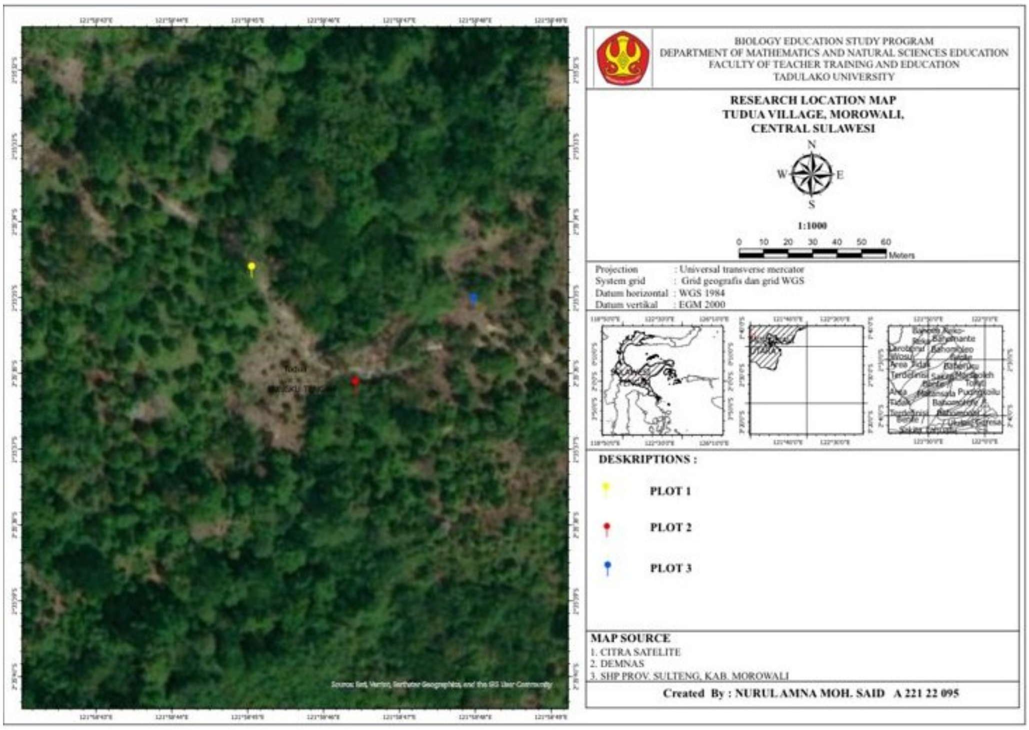

Figure 1. Map of the research location in Tudua Village, Morowali Regency, Central Sulawesi Province, Indonesia.

Materials
The materials and equipment used in this study included an insect net (sweep net), stationery, measuring tape, raffia string, forceps, sample bottles, label paper, flashlight, thermometer, hygrometer, lux meter, pH meter, ruler, camera, scissors, lamps, paper, 70% ethanol, and detergent solution. Insect specimens served as the research material, while bird's eye chili plants cultivated by local farmers in Tudua Village, Morowali Regency, were used as the research object.

Procedures
Determination of Study Site and Observation Objects
The study site was selected using a purposive sampling method, in which locations were deliberately chosen to optimize research efficiency by reducing the time and effort required for data collection. Based on these considerations, three sampling locations were established as research plots, each measuring 10 × 10 m. The observation objects consisted of insects associated with chili pepper cultivation areas within the selected plots.

Sampling Procedure
Insect sampling was conducted using four techniques: sweep netting, pitfall traps, light traps, and yellow traps. Sampling using the sweep net and hand collection methods was carried out simultaneously in the morning and afternoon using a sweep net. The pitfall trap method was implemented by establishing plots measuring 10 × 10 m at each sampling point. Small holes were made in the soil to place plastic cups containing a mixture of 70% alcohol and a small amount of detergent solution. The traps were installed with the rim of each cup level with the soil surface and were left in place for 24 hours. Trap inspections were conducted three times during the sampling period. The light trap method utilized a lamp as a light source. The lamp was positioned above a basin containing water mixed with detergent and 70% alcohol. One light trap was installed around the chili pepper plants in each plot. The traps were operated from 18:00 to 07:00 WITA and were inspected twice during the sampling period. The yellow trap method employed Aqua bottles covered with yellow plastic sheets and coated with rat glue as an adhesive. One trap was installed in each plot around the chili pepper plants. The traps were set between 23:00 and 00:00 WITA and remained in the field for 24 hours before specimen collection was conducted.

Insect Identification
The collected insect specimens were documented and identified based on their morphological characteristics, including body shape, coloration, wing type, antennae, and leg structures, using insect identification guides and literature following the methods described by Sutiharni et al. (2023). Identification was conducted up to the order, family, genus, or species level. The identification process was carried out at the Laboratory of the Biology Education Study Program, Faculty of Teacher Training and Education, Tadulako University.

Data analysis
Data obtained from the study of insects associated with bird's eye chili plants were analyzed using a descriptive qualitative approach. This analysis involved describing the insect species identified based on direct field observations and collections. The collected insects were grouped according to their morphological characteristics and classified into the taxonomic levels of order, family, genus, and species whenever possible. Each identified insect species was subsequently analyzed according to its ecological role within the bird's eye chili agroecosystem, including as a pest, natural enemy (predator or parasitoid), or pollinator. The results of the qualitative analysis were presented in the form of tables and descriptive narratives to illustrate the composition of insect species associated with bird's eye chili plants at the study site.

RESULTS AND DISCUSSION

Overview of the Study Area
Tudua Village is one of the villages located in the Bungku Tengah District, Morowali Regency, Central Sulawesi, Indonesia. The village is characterized by diverse topographical features, ranging from lowland areas to hilly terrain, which support various agricultural and plantation activities carried out by the local community. The village boundaries are as follows: to the west, it is bordered by forest areas; to the east, by the open sea; to the south, by Puungkoilu Village; and to the north, by Bahontobungku Village. Geographically, Tudua Village lies within Morowali Regency, a region characterized by a tropical climate with relatively high annual rainfall. The natural landscape of the village is predominantly composed of plantation lands and tropical vegetation, which serve as the primary source of livelihood for the local population. These environmental conditions provide suitable habitats for a wide variety of insect species, making the area an appropriate location for ecological and biodiversity studies.

Measurement of Environmental Physical Conditions
The measurement of environmental physical conditions in this study included temperature, humidity, soil pH, and light intensity recorded throughout the observation period. These environmental parameters were measured to characterize the habitat conditions of the study area and to provide supporting data for interpreting insect diversity and distribution. Based on the measurements obtained, the average values recorded at the study site are presented in Table 1.

Table 1. Measurement of Environmental Physical Conditions.

No	Parameter	Physical-Chemical Environmental Conditions			Average
		Plot 1	Plot 2	Plot 3	
1	Temperature	32	34	30	32
2	Humidity	70	75	72	72,3
3	Soil pH	6,1	6,3	6,3	6,2
4	Light Intensity	1.335 cd	1683 cd	1.140 cd	1386 cd

Insect Species Composition

Observations conducted in three sampling plots established within chili pepper cultivation areas in Tudua Village, Morowali Regency, recorded a total of 29 insect species belonging to 8 orders (Table 2 and Figure 2). The identified insects represented various ecological roles, including pollinators, predators, parasitoids, herbivores, and decomposers. The presence of these diverse insect groups indicates that the chili pepper agroecosystem in Tudua Village provides suitable habitat conditions and resources to support a wide range of insect taxa.

Table 2. Insect Species Recorded on Chili Pepper Plants in Tudua Village.

No	Order	Family	Species	Ecological Role
1	Araneae	Araneidae	*Gasteracantha curvipina*	Predators
		Araneidae	*Neoscona arabesca*	Predators
		tetragnarhidae	*Tetragnathidae Montana*	Predators
2	Coleoptera	Coccinellidae	*Epilachna admirabilis*	Herbivores
		Chrysomelidae	*Chysochus cobaltinus*	Herbivores
		Elateridae	*Cardiophorus gramineus*	Pests
3	Hemiptera	Aleyrodidae	*Besmisia tabaci*	Pests
		Reduviidae	*Zelus longipes*	Predators
		Reduviidae	*Rhynocoris iracundus*	Predators
		Pentatomidae	*Nezara viridula*	Pests
		Alydidae	*Leptocorisa oratorius*	Pests
		Alydidae	*Riptortus linearis*	Pests
		Pyrrhocoridae	*Dysdercus cingulatus*	Pests
		Rhyparochromidae	*Drymus unus*	Pests
		Pentatomidae	*Zicrona caerulea*	Predators
4	Orthoptera	Tettigoniidae	*Caedicia simplex*	Herbivores
		Tettigoniidae	*Conocephalus gracillimus*	Herbivores
		Tettigoniidae	*Mecopoda elongata*	Herbivores
		Gryllidae	*Gryllus bimaculatus*	Dekomposer
		Acrididae	*Valanga nigricornis*	Herbivores
		Acrididae	*Heteropternis obscurella*	Herbivores
		Acrididae	*Opia obscura*	Herbivores
5	Odonata	Aeshnidae	*Anax junius*	Predators
6	Lepidoptera	Erebidae	*Nyctemera baulus*	Pollinators
		Nyamphalidae	*Danaus chrysippus*	Pollinators
		Pieridae	*Appias drusilla*	Pollinators
7	Hymenoptera	Formicidae	*Odontomachus troglodytes*	Predators
		Vespidae	*Rhynchium haemorrhoidale*	Predators
8	Blattodae	Ectobiidae	*Blattella germanica*	Dekomposer

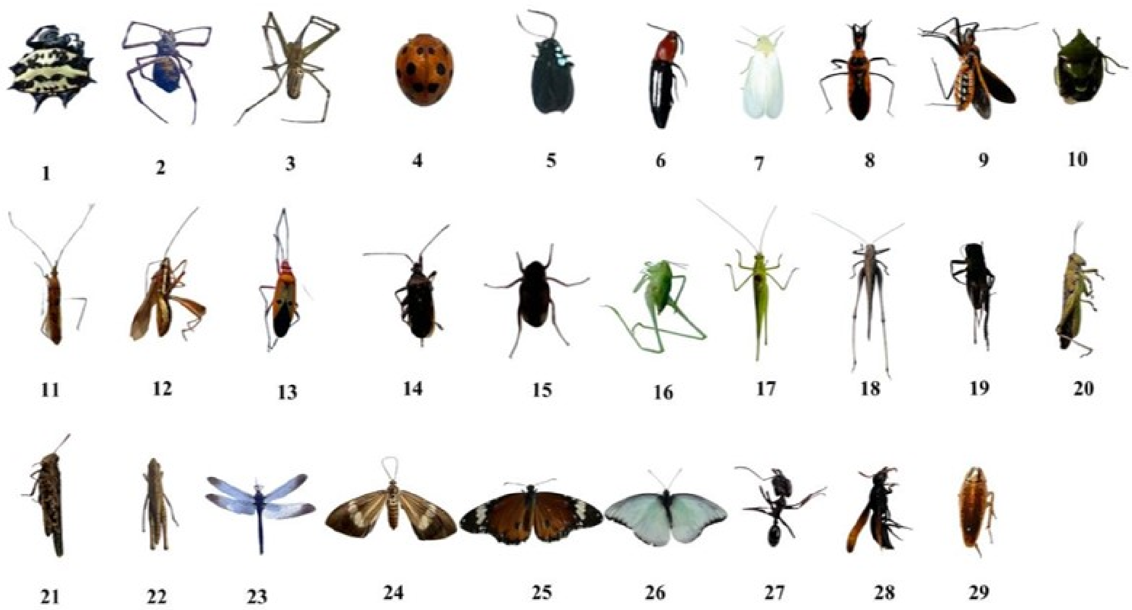

Figure 2. Several insect species were recorded in Tudua Village, Morowali Regency. 1. *Gasteracantha curvipina*, 2. *Neoscona arabesca*, 3. *Tetragnathidae montana*, 4. *Epilachna admirabilis*, 5. *Chysochus cobaltinu*, 6. *Cardiophorus gramineu*, 7. *Besmisia tabaci*, 8. *Zelus longipes*, 9. *Rhynocoris iracundus*, 10. *Nezara viridula*, 11. *Leptocorisa oratorius*, 12. *Riptortus linearis*, 13. *Dysdercus cingulatus*, 14. *Drymus unus*, 15. *Zicrona caerulea*, 16. *Caedicia simplex*, 17. *Conocephalus gracillimus*, 18. *Mecopoda elongate*, 19. *Gryllus bimaculatus*, 20. *Valanga nigricornis*, 21. *Heteropternis obscurella*, 22. *Opia obscura*, 23. *Anax junius*, 24. *Nyctemera baulus*, 25. *Danaus chrysippus*, 26. *Appias drusilla*, 27. *Odontomachus troglodytes*, 28. *Rhynchium haemorrhoidale*, 29. *Blattella germanica*.

Discussion

The results of this study showed that 29 insect species belonging to eight orders were recorded on chili pepper (*C. frutescens* L.) plants in Tudua Village, Morowali Regency. These orders were Araneae, Coleoptera, Hemiptera, Orthoptera, Odonata, Lepidoptera, Hymenoptera, and Blattodea. This diversity indicates that chili pepper plants provide habitat and resources for a wide range of insects with different ecological roles. The insect community consisted of pests, herbivores, predators, and decomposers, which collectively form a complex network of interactions within the agroecosystem (Jihadi et al., 2024).

Among the recorded orders, Hemiptera was the most dominant group throughout the study. The dominance of this order suggests that chili pepper plants provide abundant food resources for sap-sucking insects. Species such as *Bemisia tabaci*, *Nezara viridula*, *Leptocorisa oratorius*, *Riptortus linearis*, *Dysdercus cingulatus*, and *Drymus unus* feed on plant sap as their primary source of nutrition. Their feeding activities can cause various symptoms of plant damage, including leaf yellowing, curling, wilting, and a reduction in fruit quality (Lukmana et al., 2023). However, the same order also included predatory species such as *Zelus longipes*, *Rhynocoris iracundus*, and *Zicrona caerulea*, which function as natural enemies of agricultural pests and contribute to the biological control of pest populations (Kurniansyah et al., 2023).

The order Araneae was represented by three species, namely *Gasteracantha curvipina*, *Neoscona arabesca*, and *Tetragnatha montana*, all of which function as predators. Spiders are recognized as effective natural enemies because they prey on a wide range of insect pests. *Gasteracantha curvipina* and *Neoscona arabesca* construct webs to capture flying or crawling prey around crop plants (Akhyar et al., 2022). In contrast, *Tetragnatha montana* actively hunts on the surfaces of leaves and stems. The presence of Araneae species indicates that the chili pepper agroecosystem still provides suitable environmental conditions for sustaining natural predator populations, which can contribute to reducing farmers' dependence on chemical pesticides (Sulthoni et al., 2023).

Within the order Coleoptera, three species with different ecological roles were identified. *Epilachna admirabilis* and *Chrysochus cobaltinus* function as herbivores that feed on chili pepper leaf tissues, reducing the photosynthetically active leaf area and potentially inhibiting plant growth (Mursyidin et al., 2025). Meanwhile, *Cardiophorus gramineus* acts as a pest, particularly during its larval stage, when it lives in the soil as a wireworm and attacks plant root systems. Root damage can interfere with water and nutrient uptake, resulting in suboptimal plant growth and development. The occurrence of these Coleopteran species indicates that threats to chili pepper plants originate not only from above-ground herbivores but also from soil-dwelling pests that affect underground plant structures (Prayogo et al., 2022).

The order Orthoptera was represented by seven species, with most of them functioning as herbivores, including *Valanga nigricornis*, *Heteropternis obscurella*, *Oxya obscura*, *Mecopoda elongata*, *Conocephalus gracillimus*, and *Caedicia simplex*. These species utilize plant leaves as their primary food source. Their feeding activity can cause significant plant damage by reducing leaf surface area through tissue consumption, which in turn may inhibit the photosynthetic process (Herlin et al., 2025). In addition to herbivorous species, *Gryllus bimaculatus* was also recorded and identified as a decomposer. This species contributes to the decomposition of organic matter on the soil surface, thereby accelerating nutrient recycling processes. Such activity plays an important role in maintaining soil nutrient availability and supporting soil fertility within the chili pepper agroecosystem (Rubiana & Meilin, 2022).

The order Odonata was represented by *Anax junius*, which functions as a predator. Dragonflies are known as active predators in both their nymph and adult stages. Adult individuals are capable of preying on various small flying insects around agricultural areas, thereby helping to suppress pest populations. The presence of dragonflies is often considered an indicator of relatively good environmental conditions and habitat quality that supports the sustainability of predatory organisms (Herlinda & Mayasari, 2021).

The order Lepidoptera was represented by three species, namely *Nyctemera baulus*, *Danaus chrysippus*, and *Appias drusilla*, which function as pollinators. These species utilize floral nectar as their primary food source and therefore indirectly contribute to the pollination process. Pollination activity plays an essential role in supporting fruit formation and enhancing plant reproductive success. The presence of various butterfly species in agricultural areas of Tudua Village indicates that the surrounding environment still provides adequate floral resources and vegetation that support the survival of pollinating insects (Khoirunnisa et al., 2025).

The order Hymenoptera consisted of *Odontomachus troglodytes* and *Rhynchium haemorrhoidale*, both of which act as predators. These species are capable of preying on larvae, caterpillars, and other small insects that may function as agricultural pests. Predatory ants such as *Odontomachus troglodytes* possess strong hunting abilities and contribute to reducing pest populations in the field. The presence of Hymenoptera plays an important role in maintaining insect population balance within the chili pepper agroecosystem (Djaya et al., 2022).

The order Blattodea was represented by the species *Blattella germanica*, which functions as a decomposer. Although commonly regarded as a nuisance insect, cockroaches play an ecological role in the decomposition of organic matter in agricultural environments. The activity of this species helps break down plant residues and other organic materials into smaller particles, thereby accelerating the decomposition process carried out by soil microorganisms. This process is essential in maintaining nutrient cycling that supports plant growth (Rahayu et al., 2025).

In addition, environmental conditions at the study site were also favorable for insect presence. The results of environmental measurements showed an average temperature of 32°C, humidity of 72.3%, soil pH of 6.2, and average light intensity of 1,386 cd. These temperature and humidity ranges are considered optimal for the activity of most tropical insects. Warm temperatures enhance insect metabolic activity, reproduction, and mobility, while relatively high humidity helps maintain insect body fluid balance, allowing them to survive effectively (Handayani et al., 2020). Furthermore, soil pH close to neutral supports the growth of chili pepper plants as well as soil organisms that form an important part of the agroecosystem food web (Maita et al., 2020).

CONCLUSIONS

Based on the results of this study conducted on chili pepper in Tudua Village, Morowali Regency, a total of 29 insect species belonging to eight orders were identified, namely Araneae, Coleoptera, Hemiptera, Orthoptera, Odonata, Lepidoptera, Hymenoptera, and Blattodea. The identified insect taxa demonstrate a wide range of ecological roles, including pests, predators, pollinators, and decomposers. The most dominant group recorded was the order Hemiptera, most of which function as plant pests. In contrast, the orders Araneae, Hymenoptera, Odonata, and Coleoptera were predominantly represented by natural predators. In addition, the order Lepidoptera was found to act as pollinators that support plant reproductive processes. The order Blattodea was also recorded and functions as decomposers that contribute to the breakdown of organic matter. The presence and distribution of these insect groups are influenced by environmental conditions such as temperature, humidity, light intensity, and soil pH, all of which support insect survival and activity in the chili pepper agroecosystem.

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Competing Interests: The authors declare that there are no competing interests.

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