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Diversity of Insect Pests on Two Varieties of Bird's Eye Chilli (*Capsicum frutescens* L.) Under the Intercropping System in Sidamukti Village, Baros District, Serang Regency

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Abstract

The diversity of insect pests plays an important role in determining crop yield and quality. This study aims to examine the diversity, evenness, dominance, and types of insect pests found on two varieties (Ori 212 and Or Trisula Hijau) of bird's eye chilli (*Capsicum frutescens* L.) under an intercropping system in Sidamukti Village, Baros District, Serang Regency, Banten. The purposive sampling method used was purposive sampling. Sample points were systematically determined along a diagonal line. Thus, in each plot of the bird's eye chilli varieties, there were five sampling points. Insects were collected using sweep nets and yellow pan traps, preserved in 70% alcohol, then identified and counted. The results of the study revealed five genera of insect pests: *Bactrocera* sp., *Gryllus* sp., *Oxya* sp., *Nilaparvata* sp., and *Aphis* sp. The diversity index was moderate, the evenness index was relatively high, and the dominance index was relatively low in the two bird's eye chilli varieties studied.

Keywords: Bird's Eye Chilli, Pest, Diversity, Insects.

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INTRODUCTION

Bird's eye chilli (*Capsicum frutescens* L.) is one of the important vegetable crops widely cultivated in Indonesia. This commodity has a promising prospect in meeting both domestic and export market demands. During the period from 2017 to 2021, the demand for bird's eye chilli was estimated to increase by 2.65% per year, covering the needs for seeds, direct consumption, and industrial raw materials. Conversely, the production of bird's eye chilli was predicted to decline by approximately 0.4% per year during the same period, due to a decrease in harvested area by 0.85% per year (Sofiarani and Ambarwati, 2020). One of the strategies for utilizing vacant land among main crops is through the implementation of an intercropping system, which involves planting more than one type of crop simultaneously.

The production of bird's eye chilli in Serang Regency has declined over the past three years. In 2021, the production of bird's eye chilli was approximately 9,430.50 quintals, while in 2022 it was around 7,647.60 quintals, and in 2023 it decreased to about 3,241.40 quintals (Badan Pusat Statistik, 2024). One of the main constraints in bird's eye chilli cultivation is the decline in productivity caused by attacks from Plant Pests and Diseases (Organisme Pengganggu Tanaman/OPT). OPT attacks may originate from various types of pests, diseases, or weeds. Several pests that frequently cause serious damage to bird's eye chilli plants include aphids (family Aphididae), thrips (family Thripidae), and armyworms (*Spodoptera litura*) (Rante and Manengkey, 2018).

By identifying the types of insect pests that attack bird's eye chilli plants, farmers can select the appropriate pesticides that are suitable for the target pests. The identification of insect pests can help farmers determine the right time to take control measures and the most effective type of control for bird's eye chilli

cultivation areas. The analysis of insect pest dominance indices is used to determine whether a particular insect pest species dominates within a given insect population. Based on the explanation above, it is therefore important to understand the diversity of insect pests so that we can determine the roles these organisms play within the environment.

RESEARCH METHODOLOGY

Type, Location, and Time

This study is categorized as a quantitative descriptive research, conducted from October to November 2024, on bird's eye chilli cultivation land under an intercropping system Sidamukti Village, Serang Regency. Insect identification was carried out at the Laboratory of Basic Sciences and Plant Protection, Faculty of Agriculture, Sultan Ageng Tirtayasa University. The tools used in this study included sample bottles, yellow pan traps (12 cm in diameter and 5 cm in height), sweep nets, tweezers, stereo microscopes, latex gloves, petri dishes, measuring tapes, mobile phone cameras, the *Insect Identification Key* by Kanisius (1991), and *An Introduction to the Study of Insects* by Borror (1996). The materials used in this study were bird's eye chilli plants of the Ori 212 and Or Trisula Hijau varieties, 70% alcohol, water, and detergent.

The technique used to determine the research location was purposive sampling. Sampling points were systematically determined along a diagonal line. Thus, in each plot of each bird's eye chilli variety, there were five sampling points. Insect diversity data were collected using three methods: yellow pan traps, sweep nets, and direct collection.

Research Implementation

Observations were conducted to obtain information about the condition of the research site that would be used for sampling. Interviews were also conducted with the owner and local farmers regarding the cultivation practices applied at the research site. Subsequently, sampling points were determined, with yellow pan traps placed at five sampling points in each plot of each bird's eye chilli variety. Meanwhile, sampling points using the sweep net trap were determined following a diagonal pattern by performing five double sweeps. The yellow pan trap was made from a plastic container measuring 12 cm in diameter and 5 cm in height, filled halfway with soapy water solution, and placed on the soil surface with five traps per plot of each variety. The soapy water was replaced with a fresh solution after each sampling, conducted four times over a one-month period.

Observation and sample collection using sweep nets were conducted once a week for one month, resulting in four observation and sampling sessions. In this study, the sweep net sampling was carried out at two different times, namely in the morning from 08.00 to 09.00 Western Indonesian Time (WIB / UTC+7) and in the afternoon from 15.00 to 16.00 WIB. Meanwhile, the yellow pan traps were installed for 24 hours, from 08.00 WIB until 08.00 WIB the following day. The collected insect pests were then placed into sample bottles containing 70% alcohol for identification in the laboratory.

Data Analysis

The collected insects were identified up to the family and genus levels, and the identification results are presented in Table 1. Data on the number of individuals of each insect type were analyzed using Microsoft Excel. Furthermore, each individual and insect type was analyzed to determine the values of the diversity index, evenness index, and dominance index, which are presented in Tables 2 and 3.

Shannon-Wiener Diversity Index

To calculate the diversity index of insect pests, the Shannon-Wiener formula was used, as follows:

$$H' = -\sum pi \ln pi \; ; pi = \frac{ni}{N}$$

Description:
H = Shannon-Wiener diversity index
Ni = number of individuals of the *l*-th species
N = total number of individuals of all species
*P*i = proportion of individuals of the i-th species to the total number of individuals of all species
In = natural logarithm

Evenness Index

The evenness index is used to determine the distribution evenness of each species within a given community.

$$E = 1H'/\ln S$$

Description:
E = evenness index
ln = natural logarithm
S = number of species

Dominance Index

The dominance index value for each group of insect pests was calculated using Simpson's formula (1949):

$$C = \sum\left(\frac{ni}{n}\right)^2$$

Description:
C = dominance index
ni = number of individuals of a single species
N = total number of individuals of all species

RESULTS AND DISCUSSION

Based on the research findings, five genera, five families, and three orders were identified on two varieties. Among the five genera, two are recognized as major pests of bird's eye chilli, namely fruit flies (*Bactrocera* sp.) and aphids (*Aphis* sp.). The insect pests identified are presented in Figure 1.

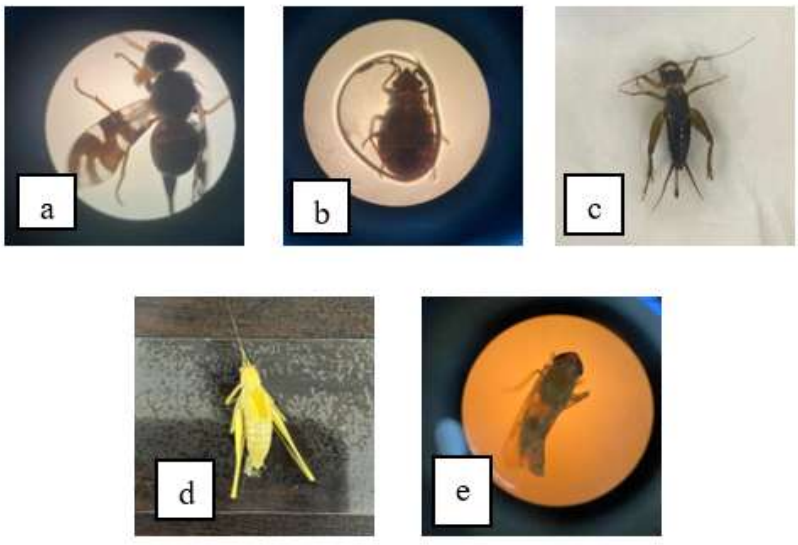

Figure 1. Insect pests on bird's eye chilli plants: (a) Bactrocera sp., (b) Aphis sp., (c) Gryllus sp., (d) Oxya sp., (e) Nilaparvata sp.

In Figure 1(a), fruit flies (*Bactrocera* sp.) were found as one of the major insect pests that attack bird's eye chilli plants. The general characteristics of fruit flies are found on the head, thorax, wings, and abdomen, including the presence of antennae, compound eyes, and a facial spot on the head. Bird's eye chilli plants infected by fruit flies show symptoms such as the appearance of black spots that gradually enlarge, leading to fruit rot and eventually causing the fruit to fall off. Fruit fly

infestation usually happens from the early fruit development stage until just before harvest. This was explained by Septiawati (2021), who stated that fruit flies damage chili peppers by having the female insert her ovipositor into the fruit to lay eggs. Approximately three days later, the eggs hatch into larvae that begin feeding on the inner part of the fruit, causing it to rot. Severely damaged fruits will fall before harvest.

In Figure 1(b), aphids (*Aphis* sp.) are shown as one of the insect pests that attack bird's eye chilli plants. In addition, *Aphis* sp. also functions as a virus vector that can reduce crop yields. According to Tigauw et al. (2015), this pest has piercing-sucking mouthparts, so its attack can cause leaf curling and shoot distortion, which ultimately inhibits plant growth. This pest damages plants by sucking sap from the leaves, shoots, flower stalks, and other plant parts, resulting in nutrient loss and damage to plant cells and tissues. Furthermore, it also secretes honeydew or sugary liquid that adheres to the leaf surface, thereby obstructing the photosynthesis process.

In Figure 1(c), the insect pest cricket (*Gryllus* sp.) was found, which belongs to the family Gryllidae and is a member of the order *Orthoptera*. According to Nunasikha and Juniati (2022), crickets are also known for their chirping sounds, which are produced by male crickets. This chirping serves to attract females and to repel rival males. On bird's eye chilli plants, these crickets attack the leaves. Although they are usually not present in large numbers, they can cause damage by feeding on the leaves until the foliage is entirely consumed.

In Figure 1(d), the green grasshopper (*Oxya* sp.) is shown as an insect pest belonging to the order Orthoptera and the family Acrididae, which is characterized by a long and slender body, with a large and prominent head and eyes. According to Sofian et al. (2023), grasshoppers possess specialized mouthparts called mandibles, which are strong and sharp jaws used for biting and chewing plant tissues. The most visible symptom is the feeding habit of this insect, which causes holes in chili leaves, thereby disrupting the photosynthesis process and slowing down plant growth. At the larval stage, this insect can also damage stems and roots, which inhibits the absorption of air and nutrients. As a result, the plant experiences suboptimal growth, leaf yellowing, and may die if the infestation is not promptly controlled.

In Figure 1(e), planthoppers (*Nilaparvata* sp.) were found, which are known as major pests in rice crops. However, *Nilaparvata* was also observed attacking bird's eye chilli plants in the research area. This may have been caused by the presence of rice plants near the study site. Planthoppers have a very wide distribution range. This insect is small, approximately 3 mm in length, and very agile, capable of quickly jumping when disturbed. It possesses piercing-sucking mouthparts and damages plants by extracting fluids from plant tissues, which causes the plants to weaken. Signs of damage appear as white spots on the leaves due to the insect's feeding activity, especially on the upper leaf surface. In the case of severe infestation, nearly the entire leaf surface may be covered with white spots.

Number of Insect Pests Found

Based on the identification of insect pests conducted at the Laboratory of Basic Sciences and Plant Protection, Faculty of Agriculture, Sultan Ageng Tirtayasa University, using a stereo microscope with 10x magnification, a total of 118 insect pests were found on two varieties of bird's eye chilli plants at the research site using two types of traps. In the yellow pan trap on the Ori 212 bird's eye chilli variety, 21 insect pests were found, while 47 insect pests were found using the sweep net. In the yellow pan trap on the Or Trisula Hijau variety, 15 insect pests were found, and 35

insect pests were collected using the sweep net, as presented in Table 1.

Table 1. Number of Insect Pests on Two Bird's eye chilli Varieties under Intercropping System in Sidamukti Village, Baros District, Serang Regency, Banten

Order	Family	Genus	Variety				Total (Individuals)
			O212		OTH		
			YPT	SN	YPT	SN	
Orthoptera	Grylludae	*Gryllus* sp.	21	8	15	6	**50**
	Acrididae	*Oxya* sp.	-	3	-	21	**24**
Diptera	Tephritidae	*Bactrocera* sp.	-	19	-	-	**19**
Hemiptera	*Dephacida*	*Nilaparvata* sp.	-	6	-	3	**9**
	Aphididae	*Aphis* sp.	-	11	-	5	**16**
Total			**21**	**47**	**15**	**35**	**118**

Table 1 shows that the Ori 212 variety, using the sweep net method, had the highest number of insect pests. Conversely, the lowest number of insect pests was found in the Or Trisula Hijau variety using the yellow pan trap. The most frequently encountered insect pest species was *Gryllus*, with a total of 50 individuals, while the least frequently found species was *Nilaparvata*, with 9 individuals.

Based on Table 1, the highest number of insect pest individuals was found on the Ori 212 bird's eye chilli variety, and a difference in insect pest species was observed, with fruit flies found only on the Ori 212 variety. This is attributed to the color differences between the two varieties, where the Ori 212 variety tends to be yellow to reddish, while the Or Trisula Hijau variety tends to be green and red. This is consistent with the opinion of Sahetapy *et al*. (2019), who stated that fruit color variation affects the intensity of fruit fly infestation, with yellow-colored fruits being more susceptible to attack as the color is more attractive to fruit flies. It is known that fruit fly host preference is influenced by visual factors such as color, as well as the aroma produced by the fruit. This explains why chili varieties with brightly colored or soft-colored fruits at ripening tend to be more vulnerable to infestation.

The research results showed that the number of insect pests captured using the sweep net was higher compared to the yellow pan trap in both observed varieties. This finding is also in line with the opinion of Shara (2019), who stated that the sweep net operates actively by being swept across the plants, allowing it to catch insects that are moving or flying around the plant canopy. This type of trap is suitable for capturing active insects with a high mobility range. In contrast, the yellow pan trap is passive, relying solely on the insects' attraction to the yellow color and capturing those that happen to approach and become trapped in the provided liquid.

The research results showed that crickets (*Gryllus* sp.) were among the most frequently found insect pests on bird's eye chilli plants. This high cricket population was likely influenced by several factors, such as humidity, temperature, and dense plant cover, which correspond to the conditions in the bird's eye chilli field in Sidamukti Village, where many dense plants and even weeds were present. This is explained by Sijabat et al. (2020), who stated that crickets generally live in hidden places such as rock crevices, decaying wood, riverbanks, shrubs, and small holes in the ground. Therefore, crickets were more frequently captured using the yellow pan trap, which was left in place for 24 hours and remained active through the night.

Planthoppers (*Nilaparvata* sp.) were recorded as one of the least frequently found

insect pest species on bird's eye chilli plants. According to Lestari et al. (2023), the host preference of leafhoppers tends to favor plants from the Poaceae family, such as rice or maize, over horticultural crops like chili peppers. This preference is also a contributing factor to the low population of leafhoppers on bird's eye chilli plants. The morphological structure of chili leaves, which are relatively thicker and have a sharper texture, is less favorable for feeding activity compared to the leaves of their primary host plants. This is consistent with the condition at the research site, where bird's eye chilli plants in Sidamukti Village were located near rice fields.

Diversity, Evenness, and Dominance Indices

The diversity index (H') is used to describe the condition of an organism population mathematically. The evenness index is used to determine how evenly individuals are distributed among all species within a community. The dominance index is an ecological measure used to assess the extent to which a particular species dominates an ecosystem community. Based on the analysis of diversity, evenness, and dominance indices conducted on the two bird's eye chilli plant varieties, the index values for the Ori 212 variety are presented in Table 2.

An analysis was also conducted on the Or Trisula Hijau variety, and the results are presented in Table 3.

Table 2. Diversity, Evenness, and Dominance Indices of Insect Pests on the Ori 212 Variety

No.	Genus	Total	Pi	Ln.Pi	Pi.LnPi	
1.	*Gryllus* sp.	29	0.426	-0.852	-0.363	
2.	*Oxya* sp.	3	0.044	-3.121	-0.138	
3.	*Bactrocera* sp.	19	0.279	-1.275	-0.356	
4.	*Nilaparvata* sp.	6	0.088	-2.428	-0.214	
5.	*Aphis* sp.	11	0.162	-1.822	-0.295	
	Total	**75**				**Category**
	Diversity Index (H')	**1.37**				**Moderate**
	Evenness Index (E)	**0.85**				**High**
	Dominance Index (C)	**0.30**				**Low**

Table 3. Diversity, Evenness, and Dominance Indices of Insect Pests on Bird's eye chilli Plants of the Or Trisula Hijau Variety

No.	Genus	Total	Pi	Ln.Pi	Pi.Ln Pi	
1.	*Gryllus*	21	0.420	-0.868	-0.364	
2.	*Oxya*	21	0.420	-0.868	-0.364	
3.	*Nilaparvata*	3	0.060	-2.813	-0.169	
4.	*Aphis* sp.	5	0.100	-2.303	-0.230	
	Total	**62**				**Category**
	Diversity Index (H')	**1.13**				**Moderate**
	Evenness Index (E)	**0.81**				**High**
	Dominance Index (C)	**0.37**				**Low**

Diversity Index

Based on the data calculations presented in Tables 2 and 3 for the two bird's eye chilli plant varieties, namely Ori 212 and Or Trisula Hijau, the average diversity index value obtained was 1.25, which falls into the moderate category. This is supported by Baderan *et al*. (2021), who stated that if the value of H' is 1 or higher, the area is considered to have a moderate level of diversity. An H' value above 3 indicates high diversity, while a value between 0 and less than 1 indicates that the community in the area has a low level of diversity.

This moderate species diversity is influenced by the recurring dynamics of vegetation changes, as well as the availability of nutrients, light, and air utilized by the vegetation. It is presumed that the development of insect pests is strongly affected by environmental conditions, including physical, biotic, and chemical factors. Physical factors such as temperature, humidity, rainfall, and wind play a significant role. According to the research conducted by Ricco et al. (2019), humidity levels between 70–72% fall within the ideal range for the growth and development of most insect pests. This corresponds to the conditions at the research site, which had humidity levels ranging from approximately 74% to 90%.

Evenness Index

Based on the data analysis in Tables 2 and 3 for the two bird's eye chilli varieties, the results showed the same category of high evenness. This indicates that the distribution of insect pests across the bird's eye chilli plots in both varieties was uniform. The index value ranges from 0 to 1, where values approaching 1 indicate that the distribution of individuals among species is more even. This is supported by Ismaini (2015), who stated that the evenness index describes how evenly the number of individuals is distributed among all species within a community. If all species have the same number of individuals, the evenness value reaches its maximum level.

According to Habibi et al. (2022), if the evenness index of insect pests is high or evenly distributed, it means that various types of pests have relatively balanced populations in the bird's eye chilli cultivation area. As a result, no single pest species dominates; instead, multiple pest species actively attack different parts of the plant simultaneously, causing concurrent damage to the leaves, stems, and fruits.

Dominance Index

Based on the data analysis in Tables 2 and 3 for the two bird's eye chilli varieties, the results showed the same category of low dominance index. According to Komul and Hitipeuw (2021), who stated that the dominance index (C) also reflects the distribution pattern and species concentration within a stand. The value of this index ranges from 0 to 1. If only one species dominates the stand, the C value will approach 1, indicating a concentration or clustering of certain plant species. Conversely, if the C value approaches 0, it indicates the absence of concentration, meaning that several plant species dominate simultaneously. Based on the obtained dominance values, it is indicated that the level of dominance in the Ori 212 variety is classified as low, which means that no single species prominently dominates. Instead, there is a relatively even distribution of dominance among several species.

A low dominance index was obtained, which may indicate the influence of natural enemies (predators/parasitoids) that help maintain population balance. In this study, the identified natural enemies were *Camponotus sanctus*, *Oxyopes matiensis*, *C. sexmaculata*, *E. admirabilis*, and *Telicota brachydesma*. According to Heviyanti and Mulyani (2016), natural enemies play a significant role in

controlling insect pest populations, keeping them below the economic threshold level and preventing significant damage to the plants.

CONCLUSION AND RECOMMENDATION

Based on the research results, there were no differences in the values of the diversity index, evenness index, and dominance index between the two bird's eye chilli varieties (Ori 212 and Or Trisula Hijau) under the intercropping system in Sidamukti Village, Baros District, Serang Regency, Banten. Both varieties fell within the index value range categorized as moderate for diversity, high for evenness, and low for dominance. Therefore, since there were no differences in the values of diversity, evenness, and dominance indices, farmers can cultivate both bird's eye chilli varieties. In addition, considering that the types and numbers of insect pests vary depending on the type of trap used, the application of various types of traps and sampling at different times should be implemented in future studies to obtain more comprehensive data. It is also recommended that farmers implement biological control methods for managing insect pests.

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