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Species diversity and abundance of Staphylinidae beetles in monoculture and polyculture vegetable agroecosystems in Cikole Village, West Bandung District, Indonesia

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Abstract. *Puspasari LT, Siregar AZ, Suputa, Majid AHA. 2025. Species diversity and abundance of Staphylinidae beetles in monoculture and polyculture vegetable agroecosystems in Cikole Village, West Bandung District, Indonesia. Biodiversitas 26: 2139-2147.* Biodiversity plays an important role in maintaining ecosystem balance and supporting the sustainability of agricultural systems. One group of insects that contributes significantly to biological control is Staphylinidae (Coleoptera). Staphylinidae as biological control can be affected because monoculture practices can increase pest pressure, which is often overcome using synthetic pesticides. This study was conducted to fill this knowledge gap by measuring and comparing the diversity and abundance of Staphylinidae on tomato plants (*Solanum lycopersicum*) and chili (*Capsicum annuum*) in four types of vegetable agroecosystem habitats: monoculture tomatoes, polyculture tomatoes, monoculture chilies, and polyculture chilies. The study conducted in the Cikole Lembang area, West Bandung District, Indonesia from July to September 2024 using the descriptive-exploratory method showed that the highest diversity was found in the Chili Polyculture (CP) agroecosystem with a H': 1.655 value, while the lowest was in Tomatoes (T) with H': 1.103. The highest uniformity was recorded in the CP agroecosystem (E: 0.572), indicating a more even distribution of individuals among species. Monoculture agroecosystems such as T (E: 0.398) have an uneven distribution of individuals, reflecting the dominance of certain species. The highest dominance value in T (D: 0.584) indicates the presence of a strong dominant species. In contrast, CP shows the lowest dominance value (D: 0.345), indicating a more balanced and diverse community. The highest similarity was observed between Chili (C) and Tomato Polyculture (TP) (index 0.84), indicating similar Staphylinidae communities in monoculture chili and polyculture tomato planting patterns. Polyculture planting patterns provide benefits to the diversity of Staphylinidae communities, especially in creating habitats that support unique species and increasing the even distribution of species. Monoculture, although efficient in production, tends to favor the dominance of certain species, which can limit biodiversity and increase the risk of ecosystem imbalance.

Keywords: Biodiversity, distribution, horticulture, insect, predators

INTRODUCTION

Biodiversity plays an important role in maintaining ecosystem balance and supporting the sustainability of agricultural systems. One of the insect groups that contributes significantly to biological control is Staphylinidae (Coleoptera). These insects are known as natural predators of pests and decomposers that support soil fertility (Magura et al. 2022). Agricultural intensification practices, such as monoculture and excessive use of pesticides, have led to a decline in biodiversity in various agroecosystems (Elouattassi et al. 2023), including in Lembang, which is one of the centers of vegetable production in Indonesia. Research on the relationship between agricultural systems and biodiversity, especially in the Staphylinidae group, is important to support the implementation of more sustainable agricultural practices (Tamburini et al. 2020; Brandmeier et al. 2023).

The Lembang area has great potential in supporting biodiversity due to climate and soil conditions. The monoculture farming pattern, which dominates this area, tends to reduce habitat heterogeneity, which in turn can reduce the population of natural predators such as Staphylinidae. Polyculture systems, which mix several types of crops in one area, are believed to increase biodiversity by increasing food resources and shelter for various soil organisms (Hatt et al. 2019; Rakotomalala et al. 2023). However, comparative research on the effects of monoculture and polyculture on the diversity and abundance of Staphylinidae is still rare, especially in tropical vegetable agroecosystems. Several studies, including those by Márquez (2003), Quinto et al. (2021) and Rojas et al. (2024) have examined the presence of Staphylinidae across different habitats. However, these studies do not specifically compare the effects of polyculture and monoculture on this family.

Vegetable agroecosystems in tropical regions, such as in Lembang, present unique dynamics in terms of interactions between crops, pests, and their natural enemies. The monoculture farming system dominating this area has been shown to reduce habitat heterogeneity, thereby decreasing the availability of resources needed to support populations of natural predators like Staphylinidae (Gagic et al. 2019). On the other hand, polyculture systems, which combine multiple crop types in one area, are known to enhance biodiversity including pests, natural enemies, and microorganisms (Trisnawati et al. 2024). Polyculture provides alternative food sources and more diverse shelter for soil organisms, creating conditions that are more conducive to the sustainability of Staphylinidae populations (Letourneau et al. 2017).

Staphylinidae is an important indicator in assessing soil ecosystem health. The diversity of Staphylinidae is influenced by various factors, such as the type of cultivated crops, farming systems, and land management. Previous studies have shown that sustainably managed agroecosystems, such as those using biopesticides or growing multiple crop types simultaneously, have higher insect diversity compared to conventional systems (Rusch et al. 2016). Additionally, environmental conditions such as microclimate, soil type, and resource availability also play a crucial role in determining the presence and abundance of Staphylinidae species in a habitat (Tscharntke et al. 2021).

Biodiversity can provide essential ecosystem services that support agricultural productivity (Christianah and Folarin 2024). For example, Staphylinidae can control pest populations by preying on larvae and eggs of insects harmful to crops. Moreover, their activity in organic matter decomposition helps enhance nutrient cycling in the soil. However, these ecosystem services are often overlooked in intensive farming practices that prioritize short-term yields over ecosystem sustainability (Dainese et al. 2019). Recent studies highlight the close relationship between biodiversity and ecosystem stability. The presence of Staphylinidae in agroecosystems can reflect the overall condition of the ecosystem. Therefore, studying the factors influencing the diversity of this group can provide valuable insights for developing more sustainable farming systems (Hallmann et al. 2017). The study highlights that sustainability of the agricultural system in Lembang is threatened by low biodiversity due to monoculture practices. Polyculture systems offer a potential solution, but their effectiveness in increasing natural predator populations in vegetable agroecosystems still requires further scientific evidence. In addition, the influence of crop type (tomato or chili) and planting system (monoculture or polyculture) on the dynamics of Staphylinidae diversity is still not well understood (Kleijn et al. 2019).

By understanding the relationship between agroecosystem structure and biodiversity, this research aims to provide deep insights into the importance of environmentally friendly land management. The findings are expected to serve as a foundation for developing sustainable agricultural strategies that not only reduce negative environmental impacts but also support long-term productivity growth. The implications of this research include reducing dependence on synthetic pesticides, enhancing ecosystem services through the utilization of natural predators, and making a significant contribution to achieving global sustainability goals in the agricultural sector.

MATERIALS AND METHODS

Time and location

This research was conducted at the Balai Pengujian Standar Instrumen Tanaman Sayuran, Cikole Village, Lembang Sub-district, West Bandung District, West Java, Indonesia, which is located at 6°48'07"S, 107°38'57"E. The research activities were carried out from July to September 2024. This research utilized four types of agroecosystems: monoculture Tomato (T) plants, monoculture Chili (C) plants, Tomato Polyculture (TP) plants, and Chili Polyculture (CP) plants. Fungicides containing the active ingredients Mancozeb 80% and Chlorothalonil 75% are commonly used on this agricultural land. In this experiment, no insecticide treatment was applied to the agricultural land. Polyculture is applied with 5 types of plants there is shallot (*Allium cepa* var. *aggregatum*), green onion (*Allium fistulosum*), *cilantro* (*Coriandrum sativum*), *pak choi* (*Brassica rapa* subsp. *Chinensis*), and red leaf lettuce (*Lactuca sativa* var. *crispa*). Pitfall traps and light traps were used to catch Staphylinidae. The placement of traps in monoculture and polyculture crops can be seen in Figure 1.

Procedures

This research was conducted in the tomato and chili crop centers in West Bandung District. The implementation used a descriptive-exploratory method, which included activities such as surveys, sample collection, field data gathering, and insect identification in the laboratory. Sampling was carried out in four agroecosystems: monoculture tomato, polyculture tomato, monoculture chili, and polyculture chili, using pitfall traps and solar light traps. A solar light trap is a device used for pest control in agriculture, utilizing light to attract insects and help manage pest populations in an environmentally. It consists of a lamp powered by a solar panel, enabling it to operate without an external power source. Solar light traps are placed in the agricultural fields of tomato and chili plants. In monoculture and polyculture planting, five solar light traps are placed diagonally for each of agroecosystems types. The traps were filled with a mixture of 1% soap solution in water with trap placement in a diagonal pattern for monoculture and polyculture plants. Sampling was conducted in the morning from 08:00 AM to 11:00 AM. In the morning, the optimal humidity conditions were present during the cold weather, and the peak insect activity occurred during midday, from 10:00 to 11:00 AM, when the weather was clear. The trapped insects were cleaned from the soapy water and then placed into clean tubes containing 70% alcohol or prepared as dry specimens for the Ordo Lepidoptera. The collected insects then identified at Pest Laboratory, Department o of Plant Pest and Diseases, Faculty of Agriculture, Universitas Padjadjaran, Bandung. Insect identified using identification keys from various textbooks and journals by examining specific morphological features under a microscope.

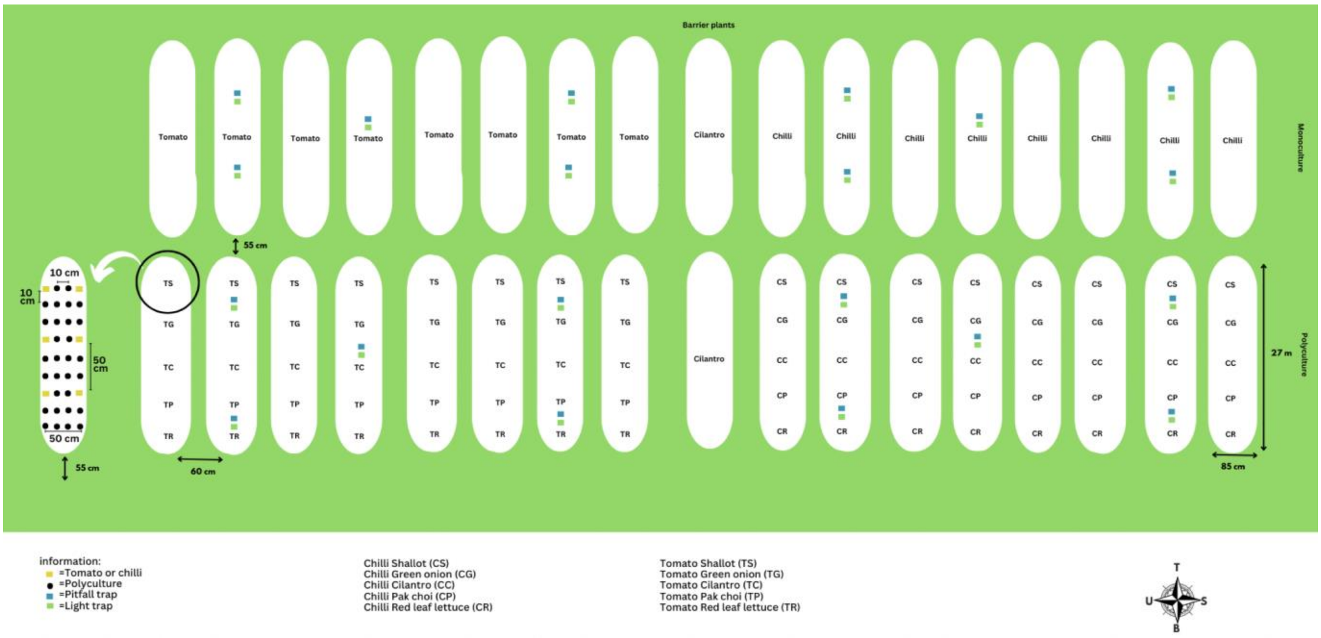

Figure 1. Plot of experimental fields for tomato-chili monoculture and polyculture

Data analysis

The data from the research were then analyzed to examine various variables such as species diversity, uniformity, dominance, and similarity using Microsoft excel 2019. The Shannon Diversity Index, also referred as the Shannon-Wiener Index, quantifies species diversity within a community. A higher H-value reflects greater species richness and evenness, whereas a lower H -value indicates reduced diversity. When H: 0, it signifies the presence of only one species in the community (Togonidze and Akhalkatsi 2015).

$$H' = -\sum_{i=1}^{n} \mathbf{P}i \, ln \, \mathbf{P}i$$

The Shannon Equitability Index is used to measure the evenness of species distribution within a community. Evenness describes how similar the population sizes of different species are in the community. This index ranges from 0 to 1, with a value of 1 representing perfect evenness (Kitikidou et al. 2024).

$$E = H'/lnS$$

Dominance index reflects the relative abundance of the most common species compared to others. Higher values indicate a greater dominance by a single or few species, suggesting lower overall diversity. The index ranges from 0 to 1, where values closer to 1 indicate higher dominance (Maisyaroh et al. 2021).

$$C = \sum (Pi)^2$$

The similarity index is used to compare the similarity of species communities in different agroecosystems. The index ranges from 0 to 1, where 0 indicates no similarity and 1 indicates perfect similarity. In principle, a higher similarity index indicates a greater resemblance between the two ecosystem (Haneda et al. 2024).

$$IS = 2C/(A+B)$$

RESULTS AND DISCUSSION

Results

In research at four agroecosystems with no chemical pest control, the diverse number and types of Staphylinidae predators found in the light traps placed in the field indicates that their large population is due to the absence of chemical pesticide use. The graph in Figure 2 compares the number of Staphylinidae. The x-axis represents the different insect species found, while the y-axis shows the number of insect individuals recorded in each agroecosystem. Several subfamilies of Staphylinidae were identified, including Oxytelinae, Aleocharinae, Paederinae, Staphylininae, and Xantholininae. Among these, Oxytelinae had the highest diversity of genera. The species *Oxytelus bengalensis*, belonging to the family Staphylinidae and subfamily Oxytelinae, was the most abundant in each agroecosystem.

A total of 18 species of Staphylinidae insects were identified in this research. Staphylinidae are generalist predators that feed on a variety of agricultural pests, including thrips, fungus gnat, and lepidoptera larvae (Cloyd and Herrick 2017). By actively hunting and consuming a wide range of pests, Staphylinidae help suppress populations of pest insect (Frank and Thomas 1999). The diversity of various morphological types of Staphylinidae found can be seen in Figure 3.

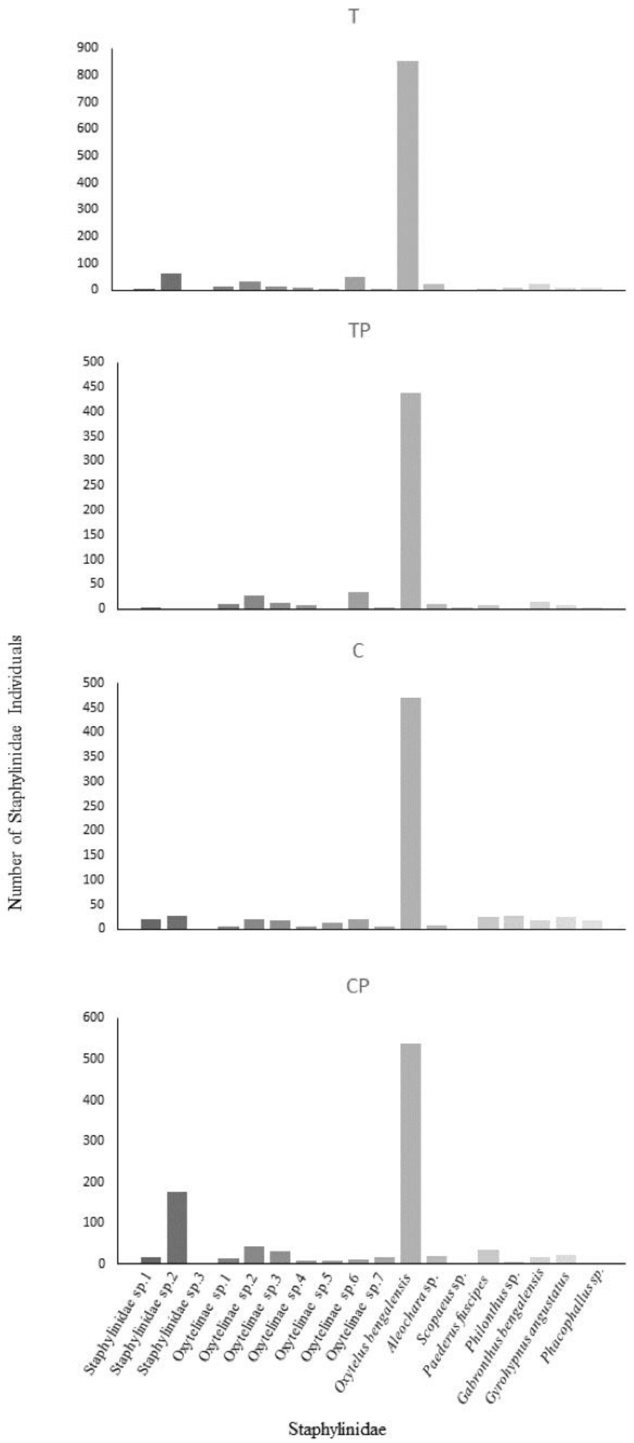

Figure 2. Comparison of Staphylinidae insect populations in Tomato (T), Tomato Polyculture (TP), Chili (C), and Chili Polyculture (CP) agroecosystems

The result of detailed data on the number of individual Staphylinidae species in four agroecosystems, as well as diversity parameters such as diversity (H'), dominance (D), and evenness (E), is shown in Table 1. *Oxytelus bengalensis* is the most dominant species in the agroecosystem with a total of 2,299 individuals from all sampling plots (67.7% of the total Staphylinidae individuals). The highest diversity was found in the CP agroecosystem with an H' value of 1.655, while the lowest was in the T agroecosystem with an H' value of 1.103. The highest evenness was recorded in the CP agroecosystem (E: 0.572), indicating a more even distribution of individuals among species. Monoculture agroecosystems, such as T (E: 0.398), have a more uneven distribution of individuals, reflecting the dominance of certain species. The highest dominance value was in T (D: 0.584), indicating the presence of a strong dominant species. In contrast, CP exhibited the lowest dominance value (D: 0.345), indicating a more balanced and diverse community.

The similarity index indicates the relationship between the agroecosystem of T, TP, C, and CP based on the similarity index of Staphylinidae communities. The similarity index values were calculated using Sorensen similarity index, which ranges from 0 (no similarity) to 1 (complete similarity). The results indicate: The highest similarity was observed between C and TP (index 0.84), indicating similar Staphylinidae communities in monoculture chili and polyculture tomato planting patterns. A relatively lower similarity was found between T and TP (index 0.66), possibly reflecting the impact of planting pattern diversification on the structure of insect communities (Table 2). Polyculture agroecosystems tend to provide more heterogeneous resources, enhancing diversity but not necessarily altering species identity.

13 species (72.2% of the total species) are found in all agroecosystems. This indicates the presence of a core community that can adapt to various cropping patterns and environmental conditions, both in monoculture and polyculture systems. Three species (16.7%) were found only in the chili and tomato agroecosystems. This indicates the presence of species that can adapt in both monoculture systems but not in polyculture. This may be due to limitations or more specific resources in the monoculture system. The figure also shows that 1 species (5.6%) was found exclusively chili polyculture and 1 species (5.6%) was found exclusively in tomato polyculture (Figure 4). This pattern indicates the presence of species that may require crop diversification to support their survival, indicating a positive effect of polyculture on certain species.

Discussion

Research conducted in four agroecosystems revealed the presence of various subfamilies of insects from the family Staphylinidae. The subfamilies identified were Oxytelinae, Aleocharinae, Paederinae, Staphylininae, and Xantholininae. Among these subfamilies, Oxytelinae exhibited the highest species diversity compared to the other observed subfamilies. There are differences in the number and types of insects on each plant, which is similar to the research by Puspasari et al. (2021), where the variation in plant types can influence the differences in the proportion of insect species found in the field. This diversity indicates that Oxytelinae has a greater ability to adapt to different environmental conditions within the agroecosystems (Chown and Nicolson 2004).

The family Staphylinidae plays a crucial role in agricultural ecosystems as a natural pest control agent and as an indicator of environmental changes (Niemelä and Spence 1994). In this study, several subfamilies were identified, including: Oxytelinae: This subfamily exhibited the highest species diversity and dominated various research locations; Aleocharinae: This subfamily plays a significant role as a natural predator, helping to control pest populations; Paederinae: Known for its role as a predator of various pest organisms; Staphylininae and Xantholininae: These subfamilies also contribute to ecosystem balance as components of predatory and predation dynamics in agricultural environments.

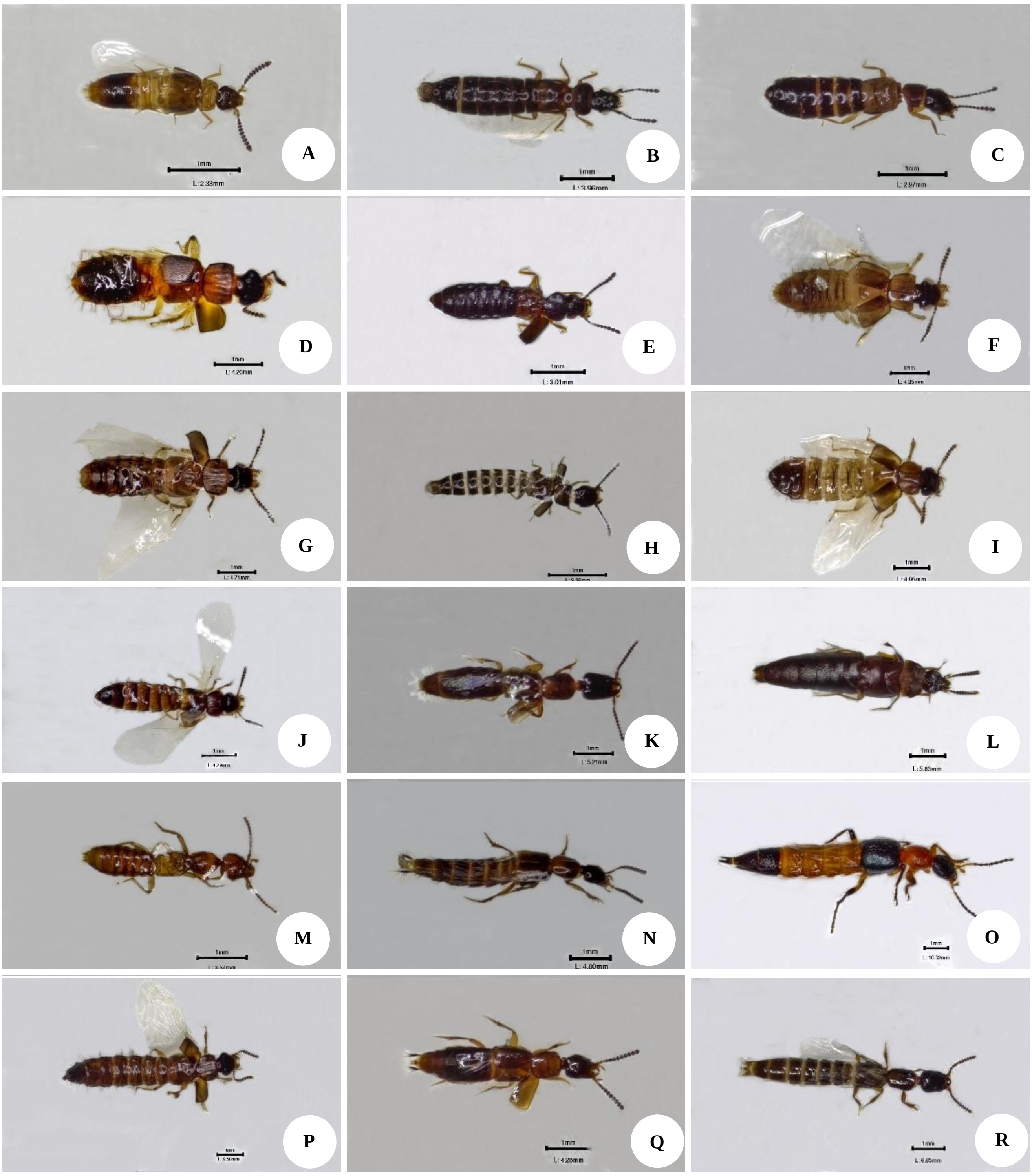

Figure 3. Types of Staphylinidae. A. Staphylinidae sp.1; B. Staphylinidae sp.2; C. Staphylinidae sp.3; D. Oxytelinae sp.1; E. Oxytelinae sp.2; F. Oxytelinae sp.3; G. Oxytelinae sp.4; H. Oxytelinae sp.5; I. Oxytelinae sp.6; J. Oxytelinae sp.7; K. *Phacophallus* sp.; L. *Aleochara* sp.; M. *Scopaeus* sp.; N. *Philonthus* sp.; O. *Paederus fuscipes*; P. *Oxytelus bengalensis*; Q. *Gabronthus bengalensis*; R. *Gyrohypnus angustatus*

Table 1. Diversity of Staphylinidae in Tomato (T), Tomato Polyculture (TP), Chili (C), and Chili Polyculture (CP) agroecosystems at Cikole Village, Lembang, West Bandung District, West Java, Indonesia

Insect	Agroecosystem type				Total
	T	TP	C	CP	
Staphylinidae sp.1	3	3	20	18	44
Staphylinidae sp.2	65	0	27	175	267
Staphylinidae sp.3	0	0	0	1	1
Oxytelinae					
Oxytelinae sp.1	16	10	6	13	45
Oxytelinae sp.2	31	26	20	43	120
Oxytelinae sp.3	13	13	18	33	77
Oxytelinae sp.4	8	7	5	10	30
Oxytelinae sp.5	2	0	14	10	26
Oxytelinae sp.6	50	34	19	11	114
Oxytelinae sp.7	2	2	5	18	27
Oxytelus bengalensis	854	438	470	537	2299
Aleocharinae					
Aleochara sp.	25	10	9	19	63
Paederinae					
Scopaeus sp.	0	1	0	1	2
Paederus fuscipes	3	8	24	34	69
Staphylininae					
Philonthus sp.	10	0	27	7	44
Gabronthus bengalensis	23	14	18	16	71
Xantholininae					
Gyrohypnus angustatus	11	8	25	22	66
Phacophallus sp.	9	1	18	3	31
N (∑ individuals)	1125	575	725	971	3396
H' (diversity)	1.102602577	1.073437756	1.562826536	1.655377641	
E (uniformity)	0.397679818	0.40675045	0.563670523	0.572721359	
D (dominance)	0.583879901	0.588077127	0.430068966	0.345113333	

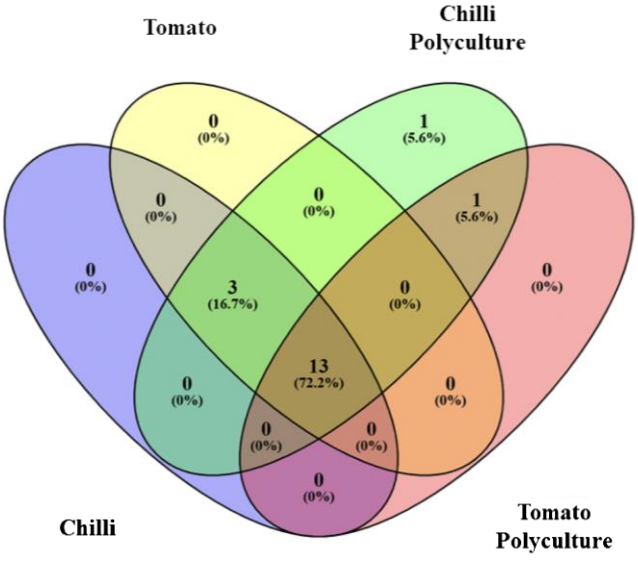

Figure 4. The number of insects in four agroecosystems in Cikole Village, Lembang, West Bandung District, West Java, Indonesia

Table 2. Similarity matrix of Staphylinidae community in Tomato (T), Tomato Polyculture (TP), Chilli Polyculture (CP) agroecosystems

Agroecosystem	Similarity index			
	T	TP	C	CP
T				
TP	0,66			
C	0,67	0,84		
CP	0,7	0,71	0,79	

These findings are consistent with the study by Kwon (2008), which demonstrated that environmental factors, agricultural practices, and environmental variations influence the diversity of Staphylinidae subfamilies. Among the various species in these subfamilies, the species *O. bengalensis* was identified as the most dominant in each agroecosystem location studied. *Oxytelus bengalensis* is a species within the Oxytelinae subfamily of the Staphylinidae family, functioning as a natural predator of various insect pests and playing an essential role in maintaining the population balance of organisms in agricultural ecosystems (Chown and Nicolson 2004).

The dominance of this species is illustrated in Figure 2, which compares the insect populations of the Staphylinidae family across different agroecosystems studied. According to the data presented in the figure, *O. bengalensis* had a higher population than other species in this subfamily. These findings support previous research identifying the presence of *O. bengalensis* as an important population indicator under various agricultural environmental conditions (Niemelä and Spence 1994). *Oxytelus bengalensis* plays a vital role in controlling pest populations by preying on various crop-damaging insects, thereby reducing reliance on chemical pesticides (Kwon

2008). Additionally, the presence of this species indicates a stable environmental balance and reflects a habitat that supports the activity of this insect as a natural predator. This study highlights that the Oxytelinae subfamily, particularly the species *O. bengalensis*, dominates the diversity of Staphylinidae insects in the agroecosystems studied. The presence of this species indicates its adaptability to various agricultural environmental conditions and its ecological importance in naturally controlling pest populations. This research provides insights into sustainable agricultural land management practices by integrating the diversity of predatory insects such as *O. bengalensis*.

Staphylinidae insects were found on tomato and chili plants, which aligns with the research by Qodri et al. (2016), who reported the presence of Staphylinidae on tomato plants, and the study by Thei et al. (2022), who found them on chili plants. In addition to being found on monoculture tomato and chili plants, Staphylinidae insects were also observed in polyculture systems. This is consistent with the research by Gobel et al. (2017), who discovered insects from the Staphylinidae family in polyculture systems of curly chili and horticultural crops, including head lettuce (*L. s.* var. *capitata*), lettuce (*L. sativa*), and cauliflower (*Brassica oleracea* var. *botrytis*).

Polyculture is with the complexity of an area is considered high if the area is composed of diverse vegetation. A diverse habitat, in the sense of having many types of plants in an area, provides resources that support the life of insects (Puspasari et al. 2016). This pattern is also observed in this study, where the CP agroecosystem shows the highest diversity and uniformity values, reflecting variety and a more balanced distribution. Monoculture systems such as T and C tend to support the dominance of certain species like *O. bengalensis*, which may benefit from the homogeneity of the environment. These results align with the findings of Aman (2020), who noted that monocultures often create conditions that favor certain insect species due to the availability of uniform resources.

The high similarity index between C and TP (0.84) can happen because the physiology of tomato and chili plants shares several similarities, such as canopy structure and growth patterns, which can influence soil moisture and the microclimate. These factors provide nearly identical conditions for the habitat of Staphylinidae, which are generally adapted to the humid environments beneath plant canopies (Cabon et al. 2024). Staphylinidae are opportunistic predators with a high capacity for adapting to various habitat conditions and high dispersal capability (Rojas et al. 2024). Tomato polycultures may offer a wider range of food sources in the form of small arthropods, while chili monocultures create a certain stability through the abundance of specific prey species. This adaptability allows many Staphylinidae species to thrive in both systems, despite differences in ecosystem structure (Tamburini et al. 2020). In general, the high similarity index value between monoculture C and TP may be attributed to several ecological factors, such as similarities in vegetation structure, food sources, and microhabitat conditions that support the presence of similar insect species. Additionally, the presence of companion plants in the intercropping system can enhance habitat diversity, which supports a greater number of Staphylinidae species (Bianchi et al. 2006). In the monoculture chili system, pest infestations such as aphids (Aphidoidea) are commonly found. In the monoculture chili system, pest infestations such as aphids (Aphidoidea) are commonly found. The presence of these pests is suspected to attract natural predators such as Staphylinidae, which play a role in biological control. On the other hand, the intercropped tomato system creates a more complex and diverse environment, supporting the presence of a similar community of natural predators. As a result, both monoculture chili, with its pest populations attracting predators, and intercropped tomatoes, which provide a diverse habitat for natural predators, harbor a similar Staphylinidae community. Cultivation practices applied to both agroecosystems may have similar management cycles, such as planting, maintenance, and harvesting schedules. This contributes to the resemblance in the presence of Staphylinidae, which typically adapt to seasonal changes in agroecosystems. This study shows that cropping patterns have a significant effect on the structure of the Staphylinidae insect community. Polyculture agroecosystems, especially chili polyculture, show advantages in increasing the diversity and balance of insect communities, while monoculture systems support the dominance of certain species. For sustainable agroecosystem management, polyculture can be a solution to increase the biodiversity of insects that have an important role in the ecosystem.

The Venn Diagram image represents the distribution of Staphylinidae species found in four agroecosystems: tomato, tomato poly, chili, and chili poly. 13 species (72.2% of the total species) are found in all agroecosystems. This indicates the presence of a core community that can adapt to various cropping patterns and environmental conditions, both in monoculture and polyculture systems. 3 species (16.7%) were found only in the chili and tomato agroecosystems. This indicates the presence of species that can adapt to both monoculture systems, but not in polyculture. This may be due to more specific habitat or resource limitations in the monoculture system. The image also shows that 1 species (5.6%) was found exclusively in chili poly, and 1 species (5.6%) was found exclusively in tomato poly. This pattern indicates the presence of species that may require plant diversification to support their survival, indicating a positive effect of polyculture on certain species. The vein diagram image also shows that no unique species were found in the tomato or chili agroecosystems, this confirms the importance of plant diversification in creating microhabitats that support certain species that may not be found in monoculture. Previous research by Andow (1991) identified that polyculture systems increase complex ecological interactions, providing more ecological niches for species that are less competitive in monoculture systems.

The species found in the four agroecosystems reflect high ecological flexibility. These species tend to be generalists, able to utilize resources from various types of plants and planting patterns. Species found exclusively in polyculture systems indicate that habitat diversification can create microecosystems that support the presence of certain species. According to Ghazali et al. (2016), it discusses the role of polyculture in enhancing the diversity of predatory insects compared to monoculture. The research shows that in polyculture fields, the diversity of predatory insects is higher because these habitats provide a variety of food sources.

The absence of exclusive species in the tomato and chili monoculture systems suggests that these habitats may be too homogeneous to support species with specialized ecological needs. This indicates that monocultures tend to favor the dominance of generalist species or species with high tolerance capabilities. The pattern of the presence of unique species in polyculture systems indicates the importance of plant diversity in supporting insect ecosystems. Plant diversification in polycultures results a variation in microclimate, habitat structure, and resource availability, all of which contribute to the presence of more diverse species (Andow 1991). Most of Staphylinidae species are generalists that can be found in all agroecosystems. Polyculture has an advantage in supporting the presence of unique species compared to monoculture. Diversification of cropping patterns in agroecosystems can increase biodiversity (Malézieux et al. 2022). Biodiversity increases both through species that are only present in polycultures and through increasing the sustainability of the core community.

These results support the use of polyculture as a sustainable approach to managing agroecosystems that are richer in biodiversity, support ecosystem stability, and reduce the risk of dominance of certain pest species. The results of this study have important practical implications for sustainable agricultural management including: (i) Increased biodiversity: Polyculture is more effective in supporting the diversity of predatory insects such as Staphylinidae. This can contribute to ecosystem stability and better biological control of pest populations. (ii) Mitigation of pest dominance: Monoculture tends to support the dominance of certain species, which risks increasing pest populations. Polyculture can be a solution to reduce this risk. (iii) Habitat management: Habitat diversification through polyculture systems allows the utilization of potential natural enemies, which reduces the need for chemical pesticides. (iv) Balanced ecosystems: Olsiviana et al. (2024) suggest that the use of refugia plants can increase the diversity of natural enemies, enhance crop yields, and improve ecosystem balance.

In conclusion, this study confirms that polyculture cropping patterns significantly benefit the diversity of Staphylinidae communities, particularly by creating habitats that support unique species and enhance more equitable species distribution. Monoculture, while efficient in production, tends to favor the dominance of certain species, which can limit biodiversity and increase the risk of ecosystem imbalance. Therefore, agroecosystem approaches based on polyculture need to be promoted to support environmental sustainability and agricultural productivity.

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