Arthropod Composition and Diversity in Polyculture System with Biopesticide of *Asystasia gangetica* and Eggshell

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Abstract

Excessive use of synthetic pesticides in agricultural systems has caused serious ecological problems, including soil and water pollution and biodiversity decline, so environmentally friendly alternatives such as botanical pesticides are urgently needed. This research aimed to evaluate the effect of a botanical pesticide combining Asystasia gangetica extract and eggshell on arthropod abundance, identity, and composition in a corn-peanut polyculture field at the Experimental Field, Faculty of Agriculture, Universitas Sriwijaya. The botanical pesticide was formulated from A. gangetica extract and eggshell at a 1:1 ratio and applied once every two weeks from 4 to 12 weeks after planting (WAP), corresponding to five application events at 4, 6, 8, 10, and 12 WAP, at four concentrations (0%, 5%, 10%, and 15%) under a split-plot factorial design. Data were analyzed using ANOVA followed by the HSD test at 5% significance in RStudio. Botanical pesticide concentration significantly influenced arthropod composition and dominance. Diptera dominated the community (68%), followed by Orthoptera (15%), Hymenoptera (8%), Coleoptera (6%), Araneae (2%), Lepidoptera (1%), and Hemiptera (<1%). The Shannon-Wiener index (H' = 1.88) indicated moderate diversity, the Simpson dominance index (D = 0.66) confirmed strong Diptera dominance, and the evenness index (E = 0.39) indicated an uneven distribution concentrated among phytophagous groups. These results show that application of the A. gangetica-eggshell botanical pesticide was associated with a community structure dominated by phytophagous arthropods across all tested concentrations, supporting its potential as a sustainable, eco-friendly alternative to synthetic pesticides in polyculture systems.

Keywords: *Biodiversity, eggshell, pesticide, polyculture, weed.*

INTRODUCTION

Modern agriculture now faces major challenges due to the excessive use of synthetic fertilizers and pesticides. While reliance on chemicals can rapidly increase yields, the long-term effects include soil and water pollution, reduced biodiversity, and the emergence of pest resistance. These impacts not only disrupt the balance of the agricultural ecosystem but also jeopardize the sustainability of crop production. Therefore, it is crucial to find innovations based on natural materials that can replace or reduce the use of chemical pesticides. One increasingly popular method is the use of plant-based pesticides, namely pesticides made from plant extracts or organic waste containing bioactive compounds (Damalas & Koutroubas, 2020).

A. gangetica is considered a nuisance or weed in the cultivation of primary crops. However, recent research has shown that this weed contains secondary metabolites, such as flavonoids, saponins, tannins, and phenolics, with potential as pest control agents (Barbaza et al., 2021). Furthermore, *A. gangetica* is a flowering weed that attracts pollinating insects and parasitoids. It serves a dual function in the agricultural ecosystem as a source of botanical pesticides and as a support for biodiversity. Furthermore, eggshell

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waste, rich in calcium carbonate, can be used as an additive in the production of botanical pesticides. The combination of the two not only reduces organic waste but also produces an environmentally friendly pest control product.

A study by Avesina *et al.* (2021) found that *Sonneratia alba* stem bark extract can reduce *Spodoptera litura* caterpillar populations by up to 86% at a dose of 8%. Another study by Widya *et al.* (2022) confirmed that plant phytochemicals contain various active compounds that can be used as botanical pesticides with lower toxicity to non-target organisms. In the context of weeds, Barbaza *et al.* (2021) also reported that *A. gangetica* possesses trichomes and flowers that attract parasitoids, thereby contributing to natural pest control. Hasan *et al.* (2021) identified bioactive compounds in this weed, including steroids, phenolics, flavonoids, and amino acids, supporting its potential as a botanical pesticide. Research by Noer *et al.* (2023) found that eggshell membranes exhibit antifungal activity against chili plant pathogens, so this waste can be used as an additive in pesticide formulations. However, many previous studies have focused on a single type of plant extract or organic waste, without combining the two in a single formulation. Furthermore, studies on the impact of botanical pesticides on arthropod populations in polyculture systems are still limited. Polyculture systems employ more complex cultivation systems that mimic natural ecosystems, making research findings in this context more relevant to sustainable agriculture. For example, polycultures of corn and peanuts not only increase yields but also create more diverse ecological interactions between plants, soil, and other living organisms. Therefore, testing botanical pesticides in polyculture systems will provide a more realistic picture of their effectiveness under field conditions.

The problems identified from the literature review include the potential of natural pesticides derived from the weed *A. gangetica* and eggshells to affect arthropod populations on corn and peanut plants. Furthermore, it is necessary to examine the effects of botanical pesticides on the diversity and composition of arthropod groups, including phytophages, decomposers, and natural enemies (Herlin *et al.,* 2025). The importance of this research lies in the negative effects of synthetic pesticides on the environment and human health, underscoring the urgent need for safer solutions. *A. gangetica*, often considered a nuisance plant, actually has bioactive potential that has not been fully utilized. By utilizing this weed as a base for botanical pesticides, it will gain added value from resources previously considered useless. In addition, eggshell waste, widely produced in households and the food industry, can be used as an additive, aligning with the principles of a circular economy and sustainable waste management. The main objective of this study was to assess the impact of botanical pesticides derived from the weed *A. gangetica* and eggshells on arthropod populations in a corn-peanut polyculture system. Specifically, this study aims to evaluate the ability of botanical pesticides to reduce the numbers of phytophagous arthropods, examine changes in the composition and diversity of arthropods resulting from their use, and identify arthropods in sustainable agricultural systems.

MATERIALS AND METHODS

Place and Time

This research was conducted at the Agro Training Center (ATC) Experimental Garden, Faculty of Agriculture, Universitas Sriwijaya, Indralaya, Ogan Ilir Regency, South Sumatra Province, Indonesia, from June 15, 2024, to July 26, 2025. The experimental field was situated at an altitude of approximately 50 m above sea level and was characterized by tropical climatic conditions with an average temperature of around 25°C and monthly rainfall ranging from 30 to 50 mm during the study period. The corn-peanut polyculture plots themselves constituted the source of vegetational heterogeneity relevant to this study, as the combined canopy structure and phenology of the two crops potentially provided alternative food resources, shelter, and breeding habitats for various insect species compared with either crop grown in monoculture (Altieri, 2019). Species identification was conducted at the Plant Pest and Disease Laboratory, Faculty of Agriculture, Universitas Sriwijaya.

Materials and Tools

The materials used consisted of insect adhesive glue, methyl eugenol attractant, water, and 70% ethanol for specimen preservation, as well as fresh *Asystasia gangetica* leaves, eggshell waste (combined at a 1:1 ratio), and methanol as the extraction solvent for preparation of the botanical pesticide formulation applied at four concentrations (0%, 5%, 10%, and 15%). These materials were employed to construct traps, prepare and apply the botanical pesticide treatments, and preserve fruit fly specimens

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collected during the observation period. The tools used in this study included 600-mL vial bottles, scissors, sweep nets, yellow plastic folders, ropes, gauze, and bamboo poles as trap supports, along with a maceration vessel, rotary evaporator, and manual sprayer for botanical pesticide extraction and field application. Additional equipment used for specimen identification included stereo microscopes and digital devices for documentation.

Research Method

This study employed a split-plot design arranged in a randomized complete block layout, with botanical pesticide concentration (0%, 5%, 10%, and 15%) as the main-plot factor, replicated four times. The botanical pesticide, formulated from *Asystasia gangetica* extract combined with eggshell powder at a 1:1 ratio, was applied by foliar spraying to the corn-peanut polyculture plots once every two weeks, beginning at 4 weeks after planting (WAP) and continuing through 12 WAP, corresponding to five application events at 4, 6, 8, 10, and 12 WAP. Following each pesticide application, purposive random sampling was used to determine trap installation sites within each plot, based on field conditions and observed fruit fly infestation intensity. A total of corn-peanut plants was selected as sampling units within each main plot. Three sampling methods were applied at each observation point as the subplot factor, namely Yellow Sticky Trap, Methyl Eugenol Trap, and Sweep Net. The use of multiple trapping techniques was intended to maximize fruit fly capture and improve species detection efficiency across the botanical pesticide concentration gradient.

Research Implementation

Each trapping method possessed distinct characteristics and functions. The Yellow Sticky Trap functioned as a visual trap by utilizing bright yellow coloration resembling young leaves, thereby attracting various insect species, including fruit flies, consistent with reports that yellow coloration is significantly more attractive to Bactrocera species than other trap colors (Ravikumar & Viraktamath, 2007). The trap was constructed from yellow plastic sheets measuring 20 × 15 cm coated with insect adhesive on both sides. The Methyl Eugenol Trap served as a chemical trap utilizing methyl eugenol as an attractant to capture male fruit flies, particularly species of the genus *Bactrocera*, since this compound selectively attracts male individuals of this genus (Shelly, 2010). The trap was constructed using a 600-mL plastic bottle with openings on the side to allow fruit fly entry. Gauze soaked in 0.15 mL methyl eugenol solution was suspended from the bottle cap. Sweep Net represented an active sampling method using a cone-shaped gauze net operated manually to capture flying insects around the crop canopy, following standard active-sampling procedures for flying insects (Southwood & Henderson, 1979). This method complemented passive trapping techniques by collecting actively moving individuals. Traps were installed in the morning between 06:00 and 08:00 Western Indonesian Time (WIB), corresponding to periods of peak fruit fly activity. Trap height ranged from 50 to 100 cm above ground level and was positioned within the canopy of corn-peanut plants. Observations were conducted weekly to record the number of fruit flies captured, and traps were replaced periodically to maintain trapping effectiveness throughout the study. All captured specimens were preserved in vials containing 70% ethanol and labeled according to sampling location, botanical pesticide concentration, and trap type. Fruit fly identification was conducted by examining morphological characteristics, including body coloration, wing patterns, and ovipositor morphology of female individuals, using the Picture Insect application and insect identification keys adapted from (Price, 1974).

Data Analysis

The observed variables included the number of fruit fly individuals captured by each trap type, species diversity, the percentage of damaged maize ears and peanut pods recorded weekly, and the presence of other insect species within the experimental field. Species diversity was quantified using the Shannon–Wiener Diversity Index (H'), calculated as $H' = -\Sigma(pi \ln pi)$, where pi represents the proportion of individuals belonging to the ith species. Species dominance was measured using the Dominance Index (D), expressed as $D = \Sigma pi^2$. Species evenness was assessed using the Evenness Index (E), calculated as $E = H'/\ln S$, where S denotes the total number of species recorded during sampling (Odum & Barrett, 2004).

The data were analyzed using Analysis of Variance (ANOVA) at a 5% significance level to determine the main effect of botanical pesticide concentration on arthropod abundance and community indices, the subplot effect of trap type on capture efficiency, and their interaction. When significant differences were detected, means were separated using the HSD test at 5% significance. Statistical analyses were performed using R Studio software. Field data were subsequently tabulated and visualized using tables

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and graphs to illustrate fruit fly population fluctuations and arthropod community responses across botanical pesticide concentrations during the observation period.

RESULTS AND DISCUSSION

Based on the application of botanical pesticides from *A. gangetica* and eggshell in corn-peanut polyculture fields, a total of 524 arthropod individuals belonging to 17 species were identified and classified according to their taxonomic orders and ecological roles (Table 1). The recorded arthropods comprised phytophagous insects, natural enemies, and decomposers, indicating the presence of diverse functional groups within the agroecosystem. According to Altieri (2019), diversified cropping systems often support a greater variety of arthropods by increasing habitat complexity and resource availability. The coexistence of multiple arthropod groups in the present study suggests that the corn-peanut polyculture system provided suitable habitats for organisms occupying different ecological niches. The occurrence of various arthropod taxa reflected the ecological interactions operating within the polyculture system, including herbivory, predation, and decomposition processes. Such interactions are essential for maintaining ecosystem stability and sustaining agricultural productivity. According to Beaumelle *et al.* (2021), agricultural landscapes with higher habitat diversity tend to promote beneficial arthropods and enhance ecosystem services, including biological control. Therefore, the arthropod community observed in this study may contribute to the ecological resilience of maize–peanut polyculture fields.

Table 1. Arthropods Found in Corn and Peanut Polycultures with Botanical Pesticides from *A. Gangetica* and Eggshell.

Order	Species Name	Number of Individuals	Role
Araneae	*Menemerus bivittatus*	10	Natural enemy
Coleoptera	*Aderatus sinicus*	18	Phytophagous
	Eutheola humilis	2	Decomposer
	Harpalus rupifes	5	Natural enemy
	Paederus fuspices	7	Natural enemy
Diptera	*Bactrocera carambolae*	205	Phytophagous
	Bactrocera dorsalis	123	Phytophagous
	Bactrocera umbrosa	22	Phytophagous
Hemiptera	*Lassus Lanio*	3	Phytophagous
	Leptocorisa oratorius	1	Phytophagous
Hymenoptera	*Cotesia glomerata*	3	Natural enemy
	Dolichodereus thoracicus	29	Natural enemy
	Lysiphlebus testaceipes	9	Natural enemy
	Polistes canandesis	1	Natural enemy
Lepidoptera	*Spodoptera frugiperda*	7	Phytophagous
Orthoptera	*Gryllodes sigillatus*	47	Decomposer
	Gryllus bimaculatus	32	Decomposer
Shannon–Wiener Index	H'		1.88
Dominance Index	C		0.39
Evenness Index	E		0.66

The dominance of the phytophagous groups presented in Table 1, particularly the high abundance of the genus *Bactrocera* (*B. carambolae* with 205 individuals and B. dorsalis with 123 individuals), and the presence of *Spodoptera frugiperda* directly correlate with functional morphological characteristics. Dominant species of the order Diptera, such as *Bactrocera* sp., boast high locomotion capabilities thanks

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to a pair of strong, membranous wings on the thorax. Their halteres, acting as balance organs during flight, facilitate their massive migrations to find host plants (Basol *et al.,* 2025). These characteristics are supported by the head structure, which features large compound eyes for visual orientation, and the modification of the tip of the female insect's abdomen into a sharply tapered ovipositor, a specialized appendage that effectively punctures plant tissue and lays eggs directly into fruit or vegetative tissue. This adaptive morphological characteristic is what drives the high population explosion of fruit flies in the field compared to other orders (Agustini *et al.,* 2019).

Morphological adaptation of the mouthparts is also a key factor in the successful exploitation of land by dominant phytophagous groups. Species such as *Lassus lanio* (Figure 1b) and *Leptocorisa oratorius* (Figure 1e) from the order Hemiptera utilize piercing-sucking (haustellate) mouthparts in the form of elongated stylets to penetrate plant tissues and extract cellular fluids. In contrast, larvae of *Spodoptera frugiperda* (Figure 1h) possess biting-chewing (mandibulate) mouthparts with strong mandibles that enable efficient feeding on plant foliage. The ecological success of phytophagous insects is often associated with their high reproductive capacity, mobility, and ability to efficiently utilize host plant resources (Jaenike, 1990). Furthermore, polyculture systems provide heterogeneous habitats and diverse food resources that may facilitate the persistence of herbivorous insects in agricultural ecosystems (Altieri, 2019). Although botanical pesticides may suppress pest populations, their effectiveness can vary depending on environmental conditions and the susceptibility of target organisms (Damalas & Koutroubas, 2020). On the other hand, groups of natural enemies and decomposers, which were less abundant according to Table 1, included the spider *Menemerus bivittatus* (Figure 1c), characterized by a fused cephalothorax, and the ant *Dolichoderus thoracicus* (Figure 1f). The relatively low abundance of these beneficial arthropods indicated limited natural regulatory capacity within the agroecosystem.

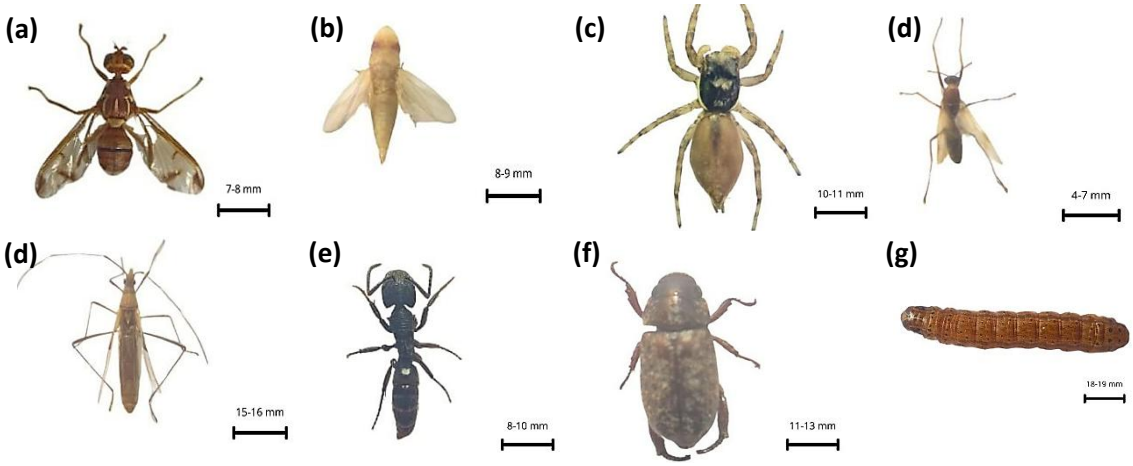


Figure 1. Dominant Arthropod Species in Corn and Peanut Fields: (a) *Bactrocera* sp., (b) *Lassus lanio*, (c) *Menemerus bivittatus*, (d) *Cotesia glomerata*, (e) *Leptocorisa oratorius*, (f) *Dolichoderus thoracicus*, (g) *Eutheola humilis*, and (h) *Spodoptera frugiperda*

The diverse arthropod community structure in the corn and peanut fields is characterized by distinct morphological variations among the dominant species. The structural features of these insects display clear taxonomic differentiation; for instance, the vibrant body coloration and specialized ovipositor structure of *Bactrocera* sp. are clearly illustrated in Figure 1a. This contrasts with the delicate larval or adult structures found in the parasitoid *Cotesia glomerata* (Figure 1d). Furthermore, the robust body form and heavily sclerotized exoskeleton of the beetle *Eutheola humilis* (Figure 1g) underscore the morphological diversity adapted to this agroecosystem. Consequently, natural enemy's populations may have been insufficient to exert adequate parasitizing pressure to counterbalance the high reproductive rate and mobility of phytophagous insects following the application of botanical pesticides formulated from *Asystasia gangetica* and eggshell mixtures.

The high population of *B. carambolae* confirms that fruit flies have broad adaptations and host preferences across horticultural commodities and surrounding food crops. This dominant pattern of phytophagous groups aligns with findings by Sembiring *et al.* (2025) , who reported that the Diptera order, particularly fruit flies, is often the most abundant insect group in an agroecosystem due to abundant food availability. Furthermore, this ecosystem exhibited active natural biological control mechanisms through

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the presence of natural enemies such as the black ant *Dolichoderus thoracicus* (29 individuals) and the spider *Menemerus bivittatus* (10 individuals), indicating that the corn-peanut polyculture system provided suitable habitats for beneficial arthropods. According to research by Altieri (2019), diversified cropping systems generally increase habitat complexity and support higher arthropod abundance and functional diversity in agroecosystems. The occurrence of these natural enemies may contribute to the suppression of phytophagous insects and help maintain ecological balance within the cropping system. Hatt *et al.* (2017) reported that natural enemies play an important role in regulating pest populations and enhancing ecosystem services in agricultural landscapes. In addition, decomposer groups such as *Gryllodes sigillatus* (47 individuals) and *Gryllus bimaculatus* (32 individuals) were abundant in the study area, suggesting active decomposition processes in the soil environment. These decomposer organisms accelerate the breakdown of organic matter and facilitate nutrient recycling, thereby maintaining soil fertility and supporting crop productivity. According to Sofo *et al.* (2020), soil macrofauna are essential for nutrient turnover and ecosystem functioning in sustainable agroecosystems.

Quantitative analysis of community structure showed a diversity index (H') value of 1.88, indicating a moderate level of arthropod diversity ($1 < H' < 3$). This condition suggests that the corn-peanut polyculture system provided relatively stable environmental conditions that supported various arthropod functional groups and ecological interactions. According to Magurran (2021), moderate diversity values generally reflect balanced ecosystems with sufficient resources and habitat heterogeneity to sustain multiple species. The presence of predators, decomposers, pollinators, and phytophagous insects in the present study further indicated the existence of a functionally diverse arthropod community. Such diversity may enhance ecosystem resilience and improve the sustainability of agricultural production systems.

The dominance index (D) value of 0.39 indicated that no single species overwhelmingly dominated the arthropod assemblage, although abundance tended to concentrate on certain taxa, particularly the fruit fly *B. carambolae*. Such dominance patterns are commonly observed in agroecosystems where host plants provide abundant food resources for specific herbivorous insects. According to Chalmandrier *et al.* (2015), moderate dominance values typically indicate that ecological communities remain relatively stable despite the higher abundance of certain species. The predominance of *B. carambolae* in the study area may be associated with the availability of suitable host plants and favorable environmental conditions that support its development and reproduction. Nevertheless, the moderate dominance value suggests that ecological interactions among arthropod groups remained balanced within the polyculture system.

Furthermore, the evenness index (E) value of 0.66 indicated a moderate distribution of individuals among species, suggesting that arthropod abundance was not evenly distributed across all taxa. Alroy (2025) reported that moderate evenness values generally reflect communities in which some species are more abundant than others but without causing severe ecological imbalance. Therefore, the observed community structure suggests that the corn-peanut polyculture system maintained arthropod diversity while allowing the coexistence of species with different ecological functions. This condition highlights the capacity of polyculture systems to support diverse arthropod assemblages and maintain ecosystem stability.

This phenomenon is supported by a study by Rusmawati *et al.* (2023) , which found that agroecosystems dominated by *Bactrocera* spp. tend to produce moderate to high dominance index values due to the very rapid reproduction rate of fruit flies. However, the evenness index (E) of 0.66 indicates that the distribution of individuals among species in these peanut and corn fields remains relatively even. Environmental pressure or fruit fly dominance has not yet severely suppressed other arthropod populations (Salman *et al.*, 2025). This maintains the functional balance among pests, predators, and decomposers in the soil. Consequently, the arthropod community in the study area remained capable of providing essential ecosystem services that support crop productivity.

Based on the quantitative data in Figure 2, the arthropod community structure in the research area was significantly influenced by the dominance of two Diptera species, namely *Bactrocera carambolae* and *Bactrocera dorsalis*. These two fruit fly species showed a very high number of individuals and contrasted with other species, indicating a population explosion (population outbreak) due to the abundant availability of host plants in the location. This dominance phenomenon is consistent with studies by Saputra *et al.* (2019). Holis *et al.* (2023) confirmed that Bactrocera spp. is the most abundant taxon in horticultural and food crops due to its rapid reproductive capacity and strong preference for fruit or plant tissue in the agroecosystem. In contrast, arthropod populations from the orders Araneae, Hemiptera, and Lepidoptera were recorded as relatively low. This indicates that these groups are in a normal population condition (background population) that is less significant in influencing overall population dynamics, possibly because they have lost competition for space or because of high specific environmental pressures in the observation area.

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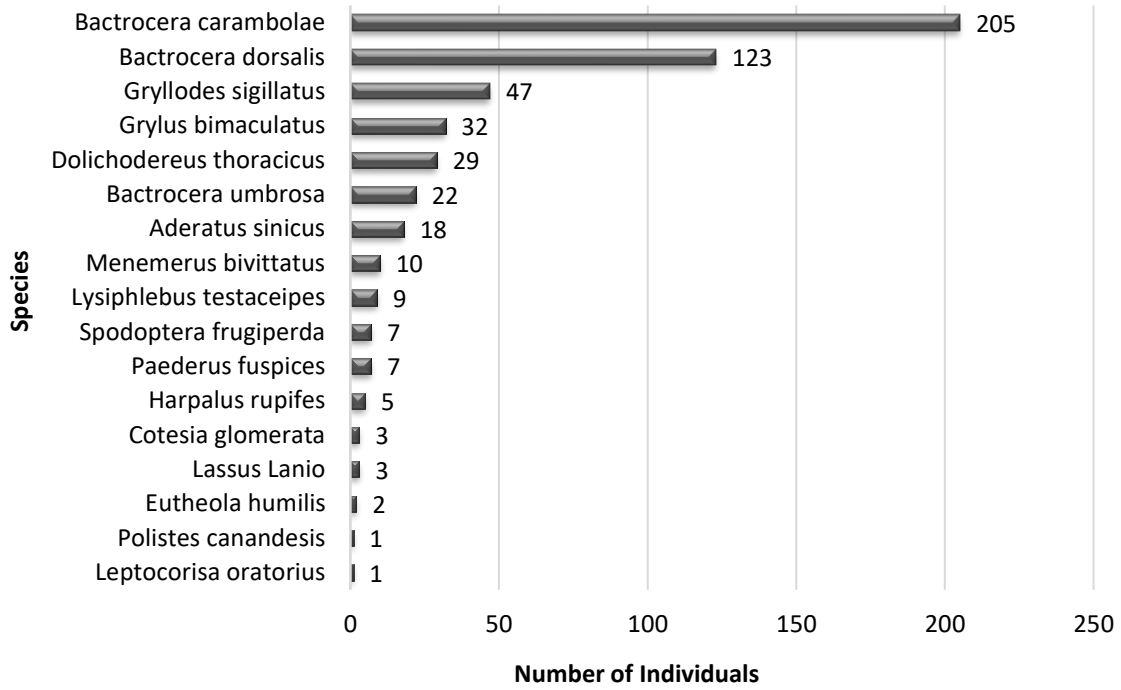


Figure 2. Distribution of Arthropod Individuals Found in Corn and Peanut Fields

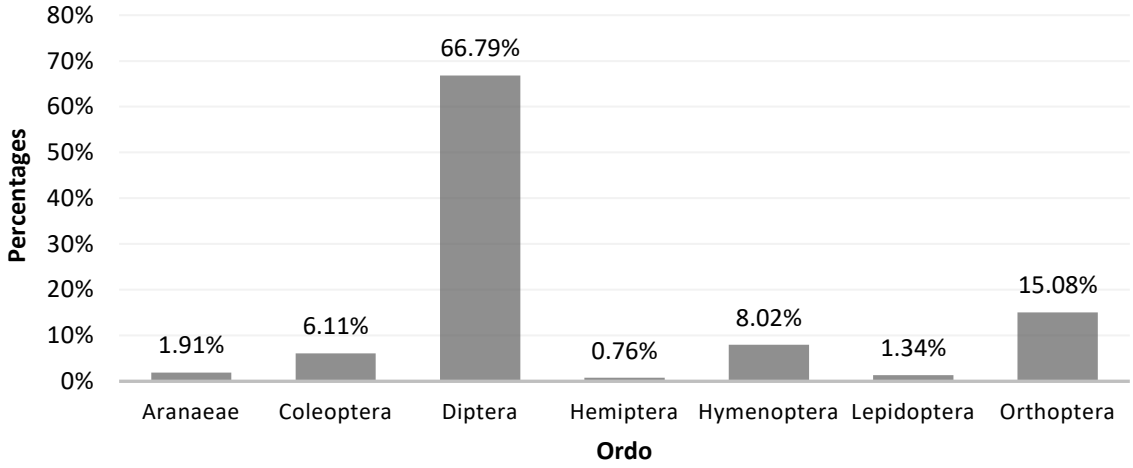


Figure 3. Percentages of Arthropods Based on Order Found in Corn and Peanut Fields

The community composition based on order-level taxonomy in Figure 3 emphasizes this dominance (Figure 3). The average number of Diptera is the highest percentage, at 66.79% of the total arthropod community. This distribution is followed by the Orthoptera order at 15.08% and Hymenoptera at 8.02%, indicating that these three groups play the most important functional roles in the land ecosystem. The high proportion of Diptera is driven by the presence of fruit flies, while Orthoptera and Hymenoptera make significant structural contributions as macro decomposers and biological control agents, respectively, through ants and parasitoids. These characteristics of the agroecosystem community structure are consistent with a scientific review of the role of arthropods by Haneda *et al.* (2017), which explains that orders with an abundance percentage above 10% generally control the main food web, both as massive herbivores and detritivores. On the other hand, the small contribution from the orders Araneae, Hemiptera, and Lepidoptera indicates that, although they fill ecological niches, their direct influence on energy circulation and food chains at the research site remains relatively minor.

The arthropod community structure in corn and peanut polyculture plots was significantly dominated by phytophagous, accounting for 72.33% (Figure 4). This high proportion indicates significant functional pest

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pressure, potentially reducing plant biomass productivity through massive consumption of vegetative and generative tissues. Decomposers, on the other hand, accounted for the second-largest proportion, at 15.46%, reflecting their significant role as macro detritivores in accelerating litter decomposition and facilitating soil nutrient cycling. However, the presence of natural enemies (predators and parasitoids) was the lowest, at only 12.21%. This low proportion of biological control agents indicates a trophic imbalance, in which the capacity of natural biological control is limited in suppressing the growth rates of phytophagy populations. This imbalance aligns with the findings of Thei *et al.* (2020), who explained that seasonal food-laden agroecosystems often exhibit extreme phytophagous species richness due to the abundance of food, which is not balanced by the instantaneous growth of natural enemy populations.

Based on the functional ecological analysis, the persistently high phytophagy dominance also demonstrates the effectiveness of applying botanical pesticides derived from the weed *Asystasia gangetica* combined with eggshells (Figure 4). This biotic intervention has been relatively incapable of providing significant improvements in restoring the balance of arthropod community structure in the field. This is evident in the persistence of phytophagous' dominance over functional natural enemies. Although botanical pesticides are known to be safe and do not leave long-term toxic residues like synthetic compounds, their mode of action, which tends to be repellent or slow to reduce appetite (*antifeedant*), limits their effectiveness in decimating large pest populations in open fields. The characteristics of the insect community's response to biopesticides are consistent with scientific reviews in research by Jaya *et al.* (2022); Hasyim *et al.* (2019), which confirm that the application of organic or botanical pesticides generally maintains a constant arthropod population rather than causing a drastic population reduction (knock-down effect). Therefore, the provision of botanical pesticides needs to be integrated with other Integrated Pest Management (IPM) strategies, such as conserving natural enemy habitats by planting refugia plants to restore the trophic balance of the polyculture agroecosystem.

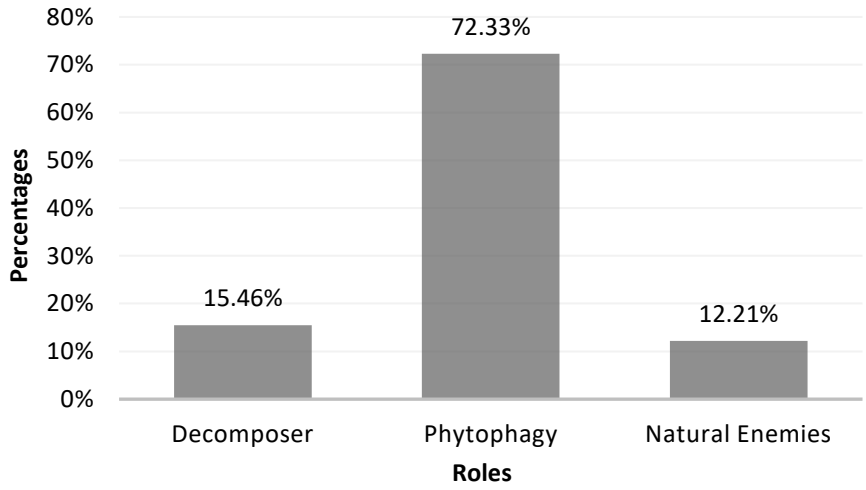


Figure 4. Percentages Ecological Role of Individual Arthropods in Corn and Peanut Fields

This polyculture area has relatively high pest pressure due to the dominance of phytophagous arthropods. Although decomposers help maintain soil fertility and natural enemies suppress pest populations, the proportions of both are still much smaller than those of phytophagous. This condition can affect the balance of the land ecosystem, potentially disrupting crop productivity if appropriate management interventions are not implemented. The application of a botanical pesticide made from the weed *Asystasia gangetica* and eggshells mixture showed relatively little impact on the arthropod community structure. This is evident in the continued dominance of phytophagous over natural enemies. Botanical pesticides tend to be more environmentally friendly and have a less significant impact than synthetic pesticides, but their effectiveness in suppressing pest populations in this area is more limited. Therefore, it can be concluded that the application of botanical pesticides has not shown a significant impact on improving the balance of the arthropod community. Therefore, additional management strategies, such as increasing the presence of natural enemies through habitat conservation or integrated pest management, are needed.

CONCLUSION

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The arthropod community in the corn-peanut polyculture area, recorded across the botanical pesticide concentrations tested (0%, 5%, 10%, and 15%), was dominated by *Bactrocera carambolae* and *Bactrocera dorsalis*, with the order Diptera accounting for 66.79% of all individuals collected. Phytophagous arthropods made up 72.33% of the community, compared with only 15.46% decomposers and 12.21% natural enemies, indicating persistently high pest pressure and a limited natural regulatory capacity within the system. Regarding the efficacy of the tested botanical pesticide, while its application was associated with a statistically detectable influence on arthropod composition and dominance, the community remained heavily skewed toward phytophagous taxa, particularly *Bactrocera* spp., regardless of concentration; this indicates that the *A. gangetica*-eggshell formulation, at the concentrations tested, did not achieve a meaningful reduction in pest arthropod dominance or restore ecological balance between phytophagous insects and natural enemies. This outcome suggests that the formulation's mode of action was more repellent or antifeedant than population-suppressive, consistent with the general behavior of botanical pesticides reported in the literature. Achieving effective pest arthropod control in this polyculture system therefore requires integrating botanical pesticide application with complementary Integrated Pest Management strategies, such as conserving or augmenting natural enemy populations through habitat management, rather than relying on the botanical pesticide alone.

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