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Assessment of arthropod diversity in selected farmlands in science village, Nnamdi Azikiwe University, Awka

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ABSTRACT
Arthropods play a significant role in agriculture. They enhance soil health, pollinate crops and control pest populations. They contribute to increase crop yield and reduce the reliance on chemical pest control methods. This study assessed arthropod diversity across selected farmlands in Nnamdi Azikiwe University focusing on rice, cassava and maize farmlands. Arthropods were collected using a combination of pitfall trap and sweep net. The study recorded a total of 884 arthropods, with an average abundance of 147.33±28.51 per site. The rice farm exhibited the highest mean abundance (236.5±13.5), followed by the maize (103.5±7.5) and cassava farms (102±5.0). Statistical analysis revealed significant differences in abundance across sites (F=67.90, P=0.0032). A total of 28 arthropod species were identified, with the akwapimcapenter ant (*Camponotus acvapimensis*) being the most prevalent and the rice farm again showing the highest species richness (11.0±1.0). While species richness was not significantly different across sites (F=2.64, P=0.2179), diversity indices indicated significant variation, with cassava (1.61±0.14) and rice farms (1.27±0.05) being more diverse compared to maize (0.96±0.02; F=13.55, P=0.0315). Functional guild analysis highlighted seven feeding categories, revealing that the rice farm supported the highest abundances of various groups, including carnivores and folivores. Overall, out of the 28 species, 9 were beneficial, 3 were non-agricultural pests, 11 were major agricultural pests, and 3 categorized as minor pests. These findings emphasize the ecological roles of diverse arthropod communities in agricultural systems, highlighting the importance of specific farming practices in enhancing arthropod diversity and functionality contributing to pest management, sustainability and agricultural productivity.

Keywords:
Arthropod diversity,
Cassava,
Rice,
Maize,
Farm

INTRODUCTION

Arthropods play a crucial role in agricultural ecosystems, contributing significantly to ecosystem services such as pollination, pest control, and nutrient cycling, while some species act as pests, posing challenges to crop productivity (Ounis *et al*., 2024). The diversity and abundance of arthropod communities are influenced by a myriad of factors, including crop type, farming practices, landscape structure, and environmental conditions (Marja *et al*., 2022).

Despite their importance, the diversity of arthropods in agricultural landscapes remains underexplored, particularly in the context of changing agricultural practices and environmental pressures.

Furthermore, there remains a gap in localized studies that assess how specific crop types and management regimes shape arthropod communities in diverse agroecological zones. Such knowledge is crucial for designing integrated pest management (IPM) strategies and enhancing ecosystem resilience in the face of environmental change (Samanta *et al*., 2024)

Recent studies indicate a substantial decline in arthropod populations, driven by factors such as pesticide use, habitat fragmentation, and climate change (Hailay, 2024; Boyle *et al*., 2025). This decline raises urgent questions about the sustainability of agricultural systems and the potential long-term impacts on food security and biodiversity.

As global agricultural intensification continues to alter natural habitats, understanding the dynamics of arthropod diversity on farmlands becomes imperative for developing sustainable agricultural practices that balance productivity with biodiversity conservation (Diyaolu and Folarin, 2024). Farmlands, as managed ecosystems, provide a unique setting to study arthropod assemblages due to their variability in habitat structure and management intensity. Different crops and agricultural practices create distinct microhabitats that can either support or hinder arthropod populations, influencing both beneficial and pest species (Landsman and Thiel, 2021; Danmusa *et al*., 2025).

This study aims to fill this gap by examining arthropod diversity in selected farmlands in Nnamdi Azikiwe University Awka, focusing on the relationship between land management practices, habitat structure, and arthropod communities. By examining species richness, functional guilds, and diversity metrics across these farmlands, this research seeks to elucidate the factors driving arthropod community structure and their implications for agricultural sustainability. The findings are expected to contribute valuable insights into the conservation of beneficial arthropods and the management of pest species, ultimately informing policies and practices for biodiversity-friendly farming systems

MATERIALS AND METHODS

Study Area

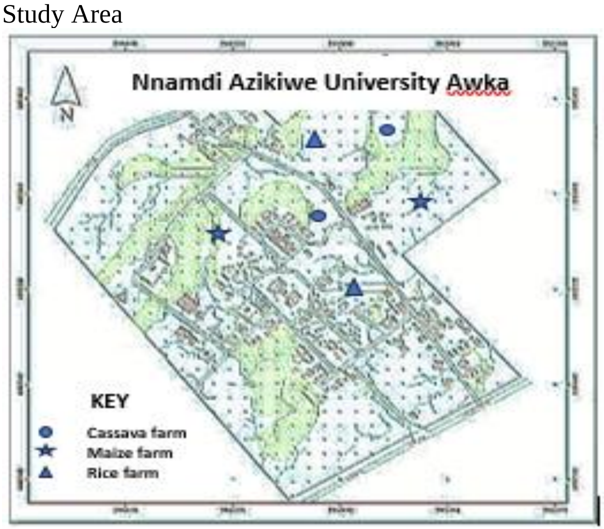

Fig 1. Map of the study area (Nnamdi Azikiwe University)

The research was conducted at Nnamdi Azikiwe University in Awka, Anambra State, Nigeria, located at geographical coordinates 6° 16' 0" North and 7° 3' 0" East. The university spans over 100 acres, featuring a rich variety of flora and fauna (Ogbodo et al., 2020). The area includes several streams, agricultural lands, numerous buildings, and forested regions. Awka is situated within Nigeria's tropical rainforest zone, experiencing two distinct seasons: the wet season from April to October and the dry season from November to March. The average temperature ranges from 28.5º C between June and December to 33º C from January to April (Okeke *et al*., 2021)

Sampling Design

The study employed a stratified sampling method. Farmlands were randomly selected based on their prevalence in the region, ecological significance, and relevance to local farming practices. In total, six farmlands were included in the study, comprising two cassava farms (*Manihot esculenta*), two rice farms (*Oryza sativa*), and two maize farms (*Zea mays*). Each farm measured 20 meters by 20 meters.

Experimental procedure

Arthropod sampling was performed using a combination of methods to capture a broad spectrum of diversity. Both the pitfall trap and sweep net were used.

The pitfall trap method was employed to sample ground-dwelling arthropods. Each trap consisted of a cylindrical white plastic container with a base diameter of 12 cm and a depth of 13 cm. The traps were positioned 3 meters apart and filled with 70% ethanol to a depth of 2 cm. A total of fifteen pitfall traps were utilized at each study site. The traps were collected 24 hours after deployment, and the arthropods collected were sorted and counted. All samples were identified in the laboratory of the Department of Crop Protection at the Faculty of Agriculture, Ahmadu Bello University, Zaria. Voucher specimens were preserved in the Ahmadu Bello University Insect Reference Museum, Department of Crop Science, Faculty of Crop Science, Ahmadu Bello University, Zaria.

For sampling arthropods on vegetation, a sweep net was utilized. Fifteen sweeps were conducted at random locations within each sample site. The sweeps were performed in a horizontal arc across the vegetation at various heights to ensure thorough coverage. Each sweep net comprised a 50 cm deep net bag made from fine mesh fiber, fitted into a circular frame with a diameter of 30 cm, and attached to a 1-meter-long handle. During each sampling session, fifteen sweeps were made across the vegetation, and the contents were emptied into a container. The catches were examined for flying arthropods after each sweep. All samples were identified in the laboratory of the Department of Crop Protection at the Faculty of Agriculture, Ahmadu Bello University, Zaria, with voucher specimens deposited at the Ahmadu Bello University Insect Reference Museum, Department of Crop Science, Faculty of Crop Science, Ahmadu Bello University, Zaria.

Data Analysis

Statistical analyses comparing differences in arthropod species diversity and abundance across sites were performed using SPSS 2020. Arthropod species diversity was evaluated with the Shannon Wiener diversity index (H), calculated as H = -Σ(pi * ln(pi)), where pi is the proportion of each species (Shannon and Weaver, 1949). Species richness (r) was determined for each habitat (Deitmers et al., 1999), while species evenness (E) was assessed using the Evenness Index (J′), calculated as J' = H'/H max, where H′ is the Shannon index and H max is the natural logarithm of the total number of species (Kiros et al., 2018). The Simpson Index (D), which measures the likelihood of two randomly selected individuals belonging to different species, was calculated using D = 1−Σn(n−1)/N(N−1), where n is the number of individuals of a species and N is the total number of individuals across all species (Gregorius and Gillet, 2008).

Ethical Considerations:

All sampling procedures were conducted in accordance with ethical guidelines for the treatment of arthropods, ensuring minimal harm and disruption to local ecosystems (McDonald and Simon, 2023).

RESULTS AND DISCUSSION

The result of the study on survey of arthropod diversity on farmlands is shown below

3.1 Arthropod abundance on farmlands.

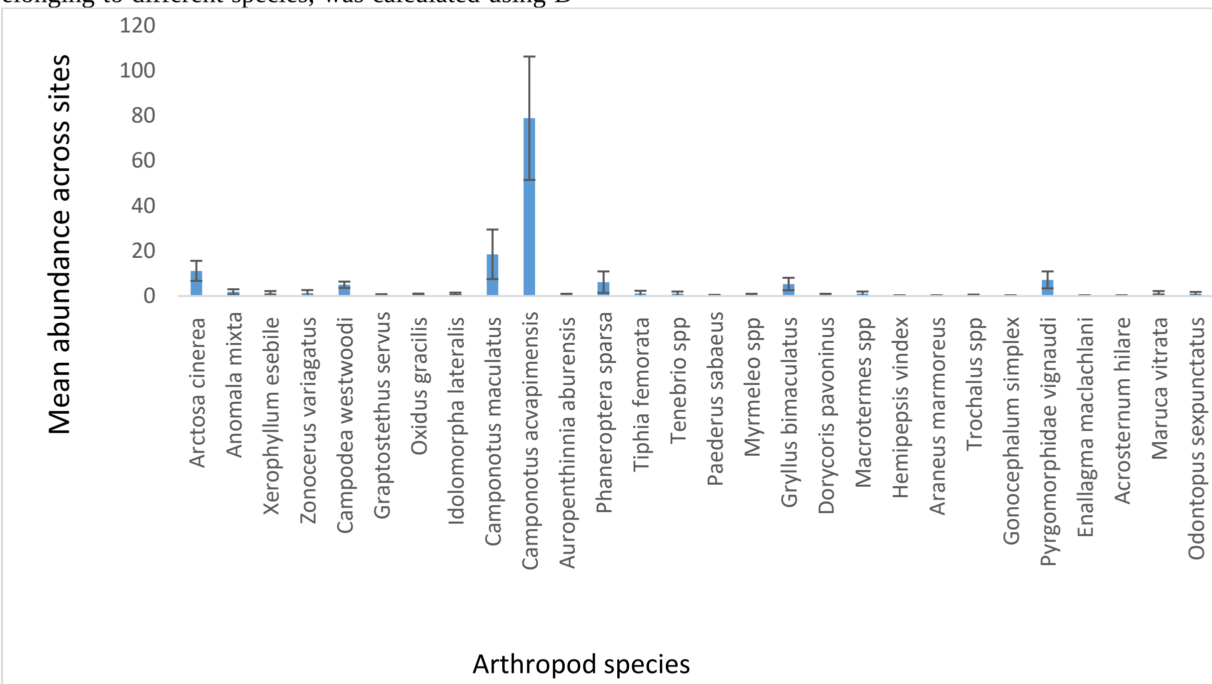

Fig 2. Arthropod species mean abundance in the study

A total of eight hundred and eighty-four (884) arthropods were recorded throughout the study, resulting in an average of 147.3333±28.50809 per site. The rice farm had the highest mean arthropod abundance at 236.5±13.5, followed by the maize farm at 103.5±7.5, while the cassava farm had the lowest mean abundance at 102±5.0. The analysis of variance revealed a significant difference in arthropod abundance among the sites (F=67.8966, P=0.003178, P<0.05). The akwapimcapenter ant (*Camponotus acvapimensis*) was the most common arthropod species, with a mean abundance of 78.83333± 27.35741, followed by the spotted sugar ant (*Camponotus maculatus*) at 18.5±10.987, ground spider (*Arctosa cinerea*) at 11.17±4.45 and gaudy grasshoppers (*Pyrgomorphidae vignaudi*) at 7.166667±3.75. The alien head mantis (*Idolomorpha lateralis*), spider wasp (*Hemipepsis vindex*), marbled orbweaver (*Araneus marmoreus*), dusty brown beetle (*Gonocephalum simplex*), bluet damselfly (*Enallagma maclachlani*), welwitschia bug (*Odontopus sexpunctatus*) and the green stink bug (*Acrosternum hilare*) had the lowest mean abundance at 0.167±0.167.

Arthropod specie richness on farmlands

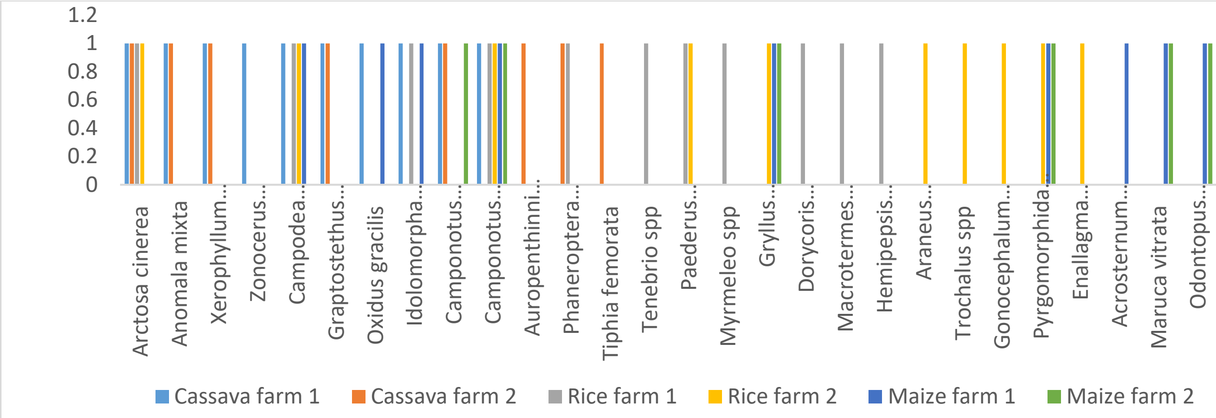

Fig. 3. Showing arthropod specie richness on farmlands

A total of twenty-eight arthropod species were identified during the study, with two pronged-bristle tail (*Campodea westwoodi*), akwapimcapenter ant (*Camponotus acvapimensis*), field cricket (*Gryllus bimaculatus*), and ground spider (*Arctosa cinerea*), being the most prevalent. The rice farm exhibited the highest average species richness at 11.0±1.0, followed by the cassava farm at 9.5±0.5. In contrast, the maize farm had the lowest average richness at 7.5±1.5. The analysis of variance for arthropod species richness across different sites showed no significant difference (F=2.6429, P=0.2179, P>0.05). The orders Hemiptera, Orthoptera and Hymenoptera were the most widely distributed, occurring in 100% of the samples each, while Araneae and Diplura had 83.33% occurrence rate each. Polydesmida, Odonota and Heteroceca with 33.33% and Isoptera with 16.67% were the least represented.

Arthropod diversity metrics on selected farmlands

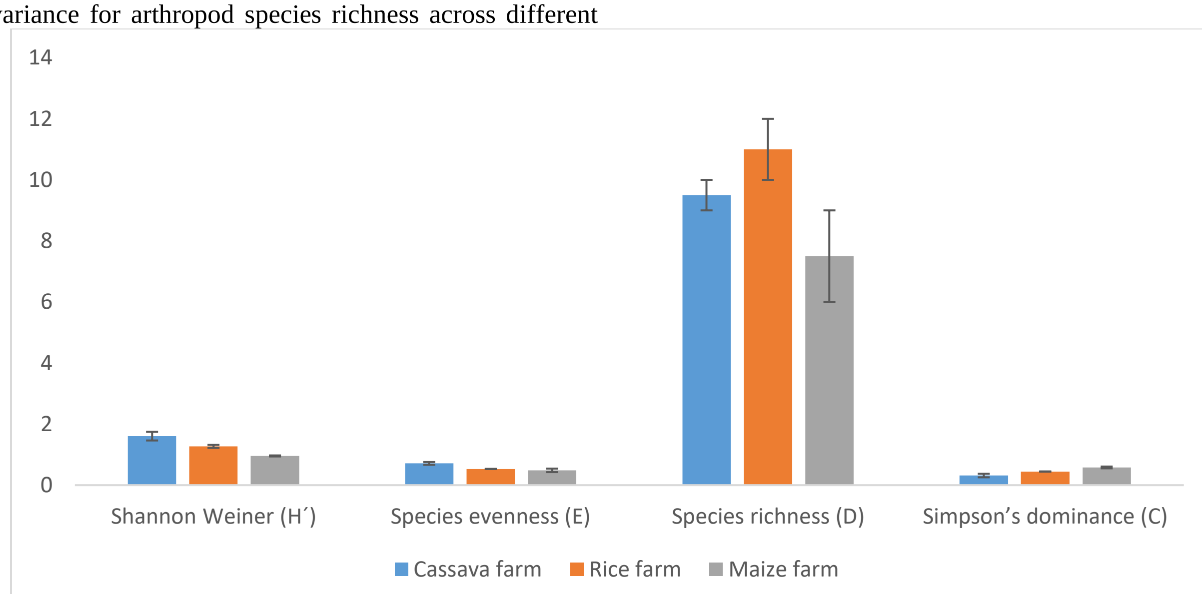

Fig. 4 showing Arthropod diversity metrics on selected farmlands

The cassava farm (1.6065±0.1415) and rice farm (1.27±0.05) displayed the highest diversity indices, whereas the maize farm (0.958±0.017) showed the lowest. The analysis of variance for the diversity index was significant (F=13.5528, P=0.03146, P<0.05). In terms of mean species richness, both rice farm (11.0±1.0) and cassava farm (9.5±0.5) ranked highest, while the maize farm (7.5±1.5) had the lowest. The variance analysis for species richness was not significant (F=2.6429, P=0.2179, P>0.05). Regarding the mean dominance index, the maize farm (0.5815±0.0295) and rice farm (0.448±0.004) exhibited the highest values, while the cassava farm (0.316±0.058) had the lowest. The variance analysis for dominance was significant (F=12.4389, P=0.0353, P<0.05). In terms of evenness, the cassava farm exhibited the highest value (0.713±0.046), followed by rice farm (0.5315±0.0025), while maize farm had the lowest value (0.486±0.058). The analysis of variance for evenness did not show significant differences (F= 7.8871, P=0.06388, P>0.05).

Arthropod feeding categories/guilds

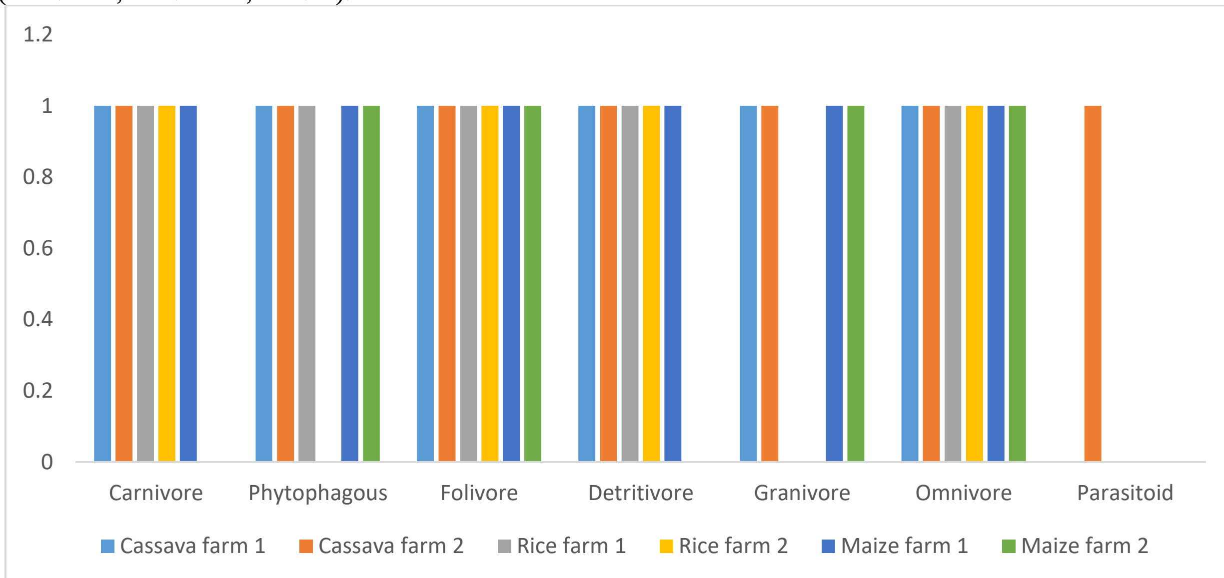

Fig. 5 showing arthropod feeding categories

To categorize the insects into functional guilds, we employed a functional traits analysis. This approach groups insects based on common functional traits or feeding behaviors that determine their ecological roles (Miller-ter Kuile et al. 2025). The research identified seven distinct feeding categories among the collected Carnivore, Phytophagous, Folivore, Detritivore, Granivore, Omnivore and Parasitoid. The Rice farm exhibited the highest mean abundance of carnivores (26±6), folivores (27.5±1.5), omnivores (167.5±10.5) and detritivores (11±3). It had the least mean abundance of granivores (1.5±1.5). The cassava farm had the highest mean abundance of phytophagous (7±1.0), granivore (5.5±4.5) and parasitoid (3.5±3.5). The maize farm had the least abundance of carnivores, folivores, granivores, detritivores and phytophagous insects. There was absence of granivores in the rice farm, and absence of parasitoids in the rice and maize farm.

Arthropod agricultural ecological role and significance

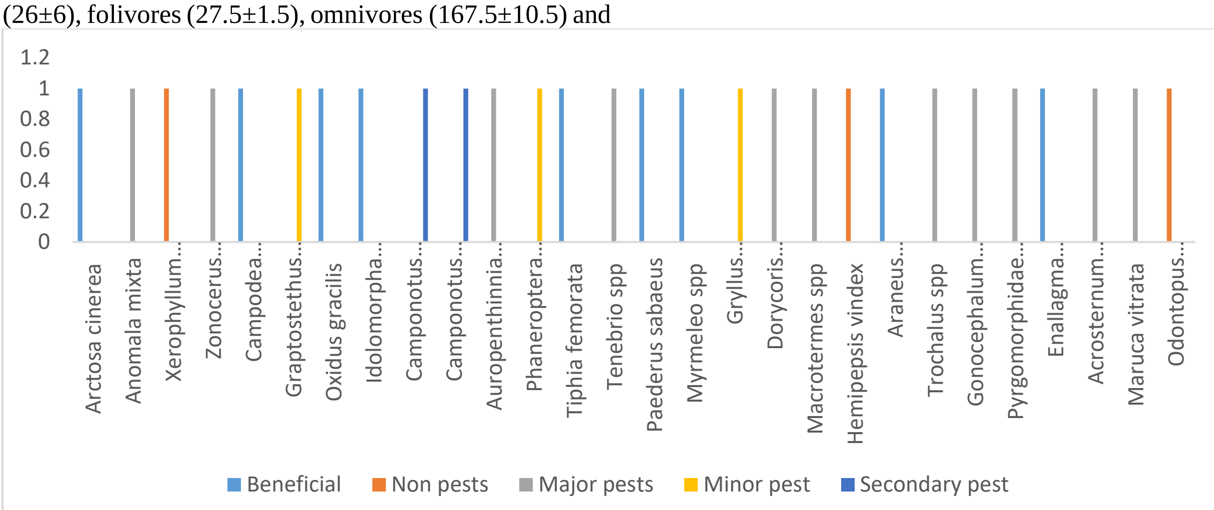

Fig. 6 showing Arthropod agricultural ecological role and significance

The research revealed a total of twenty-eight arthropod species, comprising nine beneficial ones, such as *Arctosa cinerea* (Ground spider), *Campodea westwoodi* (Two pronged-bristle tail), *Oxidus gracilis* (garden Millipede), *Idolomorpha lateralis* (Alien Head Mantis), *Tiphia* femorata (beetle-killing wasp), *Paederus sabaeus* (Charlie beetle), *Myrmeleo spp* (Antlion), *Araneus marmoreus* (Marbled Orbweaver) and *Enallagma* *maclachlani* (Bluet damselfly). Furthermore, three species were categorized as non-agricultural pests, including *Hemipepsis vindex* (Spider wasp), *Xerophyllum esebile* (pygmy grasshopper) and *Odontopus sexpunctatus* (Welwitschia bug). Eleven species were recognized as major agricultural pests: *Anomala mixta* (shining leaf chafers), *Zonocerus variagaus* (variegated grasshopper), *Auropenthinnia aburensis* (True bug), *Dorycoris pavoninus* (stink bug), *Macrotermes spp* (Termite), *Trochalus spp* (chafers beetles), *Gonocephalum simplex* (dusty brown beetle), *Acrosternum hilare* (green stink bug), Tenebrio spp (Darkling beetle), *Pyrgomorphidae vignaudi* (gaudy grasshoppers) and *Maruca vitrata* (legume pod borer). Three species were categorized as minor pests: *Graptostethus servus* (Bindweed Seedeating Bug), *Gryllus bimaculatus* (Field cricket) and *Phaneroptera sparsa* (Sickle-bearing Leaf Katydid). Finally, two species were categorized as secondary pest, *Camponotus acvapimensis* (Akwapimcapenter ant) and Camponotus maculatus (Spotted Sugar Ant)

The assessment of arthropod diversity in selected farmlands provides critical insights into the ecological dynamics and pest management potential within these agricultural systems. A total of 884 arthropods were recorded, averaging 147.3±28.5 per site. The rice farm exhibited the highest mean abundance (236.5±13.5), significantly outperforming both maize (103.5±7.5) and cassava (102±5.0). These findings reinforce the notion that environmental conditions and agricultural practices, such as crop type and management practices, significantly impact arthropod communities (Galli *et al*., 2025). The higher abundance in rice fields can be attributed to the structural complexity of wetland environments, which provide better habitat and resources for diverse arthropod populations (Ou *et al*., 2024).

In terms of species richness, a total of 28 species were identified, with the rice farm again showing the highest average at 11.0±1.0. While the cassava farm (9.5±0.5) also supported considerable diversity, maize (7.5±1.5) demonstrated significantly lower species richness. These results correlate with findings from other studies suggesting that monoculture systems, like maize, often lead to reduced biodiversity due to simplified habitats and the potential for increased pest outbreaks (Fan *et al*., 2024; Kaur *et al*., 2024).

The diversity indices revealed that the cassava (1.61±0.14) and rice farms (1.27±0.05) exhibited higher diversity compared to maize (0.96±0.02), suggesting that the ecological balance in cassava and rice farms is more favorable for maintaining diverse arthropod communities. High diversity indices are often linked to increased ecosystem functionality and resilience against pests and diseases, highlighting the importance of crop management strategies that promote biodiversity (Jayaramaiah *et al*., 2024).

Furthermore, the functional guild analysis identified seven feeding categories, revealing that omnivores were predominant in rice fields (167.5±10.5). This supports the assertion that omnivores play vital roles in nutrient cycling and pest control, contributing to the sustainability of agroecosystems (Miller-ter Kuile et al., 2025). The presence of beneficial species, including ground spiders and predatory wasps, suggests a robust natural pest control mechanism, underscoring the necessity for integrated pest management strategies that harness the ecological roles of these organisms (Zhou *et al*., 2024; Reddy *et al*., 2025).

The study illustrates the importance of ecological diversity in agricultural landscapes, not only for maintaining ecosystem health but also for enhancing agricultural productivity. The presence of major agricultural pests alongside beneficial arthropods indicates a critical need for practicing sustainable agricultural methods that foster arthropod diversity to mitigate pest pressures and support ecosystem services.

CONCLUSION

In conclusion, this study highlights the critical role of arthropod diversity in agricultural ecosystems, demonstrating that varied crop management practices can significantly influence arthropod communities, thereby impacting pest management strategies and overall ecosystem health. Future research should focus on exploring the long-term effect of diverse cropping systems, such as crop rotation and intercropping and implementing practices that promote biodiversity. This knowledge can inform the development of sustainable integrated pest management strategies that leverage natural ecological interactions with agroecosystems.

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