https://doi.org/10.17576/serangga-2026-3101-16

UNCOVERING THE INSECT ABUNDANCE AND DIVERSITY IN SWEET POTATO (*Ipomoea batatas*) FIELD IN BESUT, TERENGGANU

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Received: 9 February 2026; Accepted: 16 April 2026; Published: 27 April 2026

ABSTRACT

Sweet potato (*Ipomoea batatas*) is a vital crop, but its production is often threatened by insect infestations, causing significant yield losses. However, abundance and diversity of both pest and beneficial insects in a sweet potato field remain underexplored, hindering the development of effective pest management strategies. This study aims to identify pest and beneficial insects associated with sweet potatoes, determine their population abundance and diversity, and analyze their relationship with abiotic factors. Insect sampling was conducted in a one-hectare sweet potato field at UniSZA Besut Campus, Terengganu, using three Malaise traps, five pitfall traps, and five yellow pan traps. Insects were collected weekly for 10 weeks (August–October 2024) and identified in the laboratory. A total of 10,642 individual insects from nine orders with 52 families were successfully collected. Among them, 34 families were beneficial insects, while 18 families were pests. Hymenoptera had the highest number of beneficial insects (16 families), while Lepidoptera had the most pest collected (six families). The overall insect diversity (H' = 2.361) showed a low diversity level. Rainfall and temperature were significantly correlated ($P<0.05$) with insect abundance. These findings highlight the diverse insect community in sweet potato fields and emphasize the importance of beneficial insects in regulating pest populations. Understanding insect diversity and its relationship with environmental factors is crucial for developing sustainable pest management strategies, reducing pesticide reliance, and maintaining a balanced agroecosystem.

Keywords: Insect diversity; beneficial and pest insects; *Ipomoea batatas;* sustainable pest management

ABSTRAK

Ubi keledek (*Ipomoea batatas*) merupakan tanaman penting, namun pengeluarannya sering terancam oleh serangan serangga perosak yang menyebabkan kehilangan hasil yang ketara. Walau bagaimanapun, kelimpahan dan kepelbagaian serangga perosak serta serangga berfaedah di ladang ubi keledek masih kurang diterokai, sekali gus menghalang pembangunan strategi pengurusan perosak yang berkesan. Kajian ini bertujuan untuk mengenal pasti serangga perosak dan serangga berfaedah yang berkaitan dengan tanaman ubi keledek, menentukan kelimpahan dan kepelbagaian populasinya, serta menganalisis hubungannya dengan faktor abiotik. Persampelan serangga telah dijalankan di ladang ubi keledek seluas satu hektar di UniSZA Kampus Besut, Terengganu, menggunakan tiga perangkap Malaise, lima perangkap lubang jatuh, dan lima perangkap dulang kuning. Serangga dikumpulkan setiap minggu selama 10 minggu (Ogos–Oktober 2024) dan dikenal pasti di makmal. Sebanyak 10,642 individu serangga daripada sembilan order dan 52 famili telah berjaya dikumpulkan. Daripada jumlah tersebut, 34 famili merupakan serangga berfaedah manakala 18 famili adalah serangga perosak. Order Hymenoptera mencatatkan bilangan serangga berfaedah tertinggi (16 famili), manakala Lepidoptera mempunyai bilangan spesies perosak tertinggi (enam famili). Kepelbagaian serangga keseluruhan (H' = 2.361) menunjukkan tahap kepelbagaian yang rendah. Taburan hujan dan suhu didapati mempunyai hubungan signifikan (*P<0.05*) dengan kelimpahan serangga. Dapatan ini menonjolkan kepelbagaian komuniti serangga di ladang ubi keledek serta menekankan kepentingan serangga berfaedah dalam mengawal populasi perosak. Pemahaman terhadap kepelbagaian serangga dan hubungannya dengan faktor persekitaran adalah penting bagi membangunkan strategi pengurusan perosak yang mampan, mengurangkan kebergantungan kepada racun perosak dan mengekalkan keseimbangan agroekosistem.

Kata kunci: Kepelbagaian serangga; serangga berfaedah dan perosak; *Ipomoea batatas*; Pengurusan perosak mampan

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is one of the most important root crops globally, contributing significantly to food security, rural livelihoods, and agro-based economies, particularly in tropical and subtropical regions. The crop is valued for its adaptability to marginal soils, short growth cycle, and high nutritional content, including carbohydrates, dietary fibre, vitamins, and antioxidants (Sapakhova 2021). In Malaysia, sweet potato cultivation has received increasing attention as part of national strategies to diversify staple food sources (Rusli et al. 2023). The crop was highlighted by the government at the outset of the Eleventh Malaysia Plan (11^{th} MP), in line with the National Agrofood Policy (NAP 1.0: 2011–2020), and this emphasis has continued under the Twelfth Malaysia Plan (12^{th} MP) and NAP 2.0 through initiatives aimed at enhancing productivity and developing value-added products (Rusli & Noor 2023). Sweet potato has been prioritised due to its role as a cash crop, offering relatively rapid economic returns to farmers (Rusli & Noor 2023).

Despite its agronomic advantages, sweet potato productivity is still uncertain due to various factors, one is pest problems that are often not detected early, which can reduce the yield and quality of the tubers. For example, leaf feeders such as *Spodoptera frugiperda*, *Spodoptera litura*, and *Bedellia somnulentella* which cause defoliation, as well as soil-dwelling insects such as *Cylas formicarius*, and *Monocrepidius falli* which damage roots and tubers (Cabral et al. 2024; Wang et al. 2023). Among them, *C. formicarius* remains the paramount biotic threat to sweet potato production globally, capable of causing yield losses exceeding 90% by boring into tubers and inducing the production of bitter terpenes that render the crop unmarketable (Cabral et al. 2024). In Malaysia, this pest acts as a primary constraint on food security, prompting recent national research to pivot toward sustainable management strategies, including the use of biopesticides and nano-fertilizers to bolster plant resilience against infestation (Adnan et al. 2025). Localized surveys in the state of Terengganu have identified the Besut district as a critical hotspot for weevil infestation, where the pest's cryptic feeding behavior inside the root makes detection and control particularly difficult for smallholder farmers (Zol et al. 2019).

Effective management of sweet potato pests relies on Integrated Pest Management (IPM) strategies that combine biological, cultural, and technological controls to reduce reliance on broad-spectrum insecticides. However, the practical implementation of these IPM frameworks faces substantial obstacles in specific agroecosystems like Terengganu, primarily due to a critical scarcity of localized ecological data. Although global models exist, there are still significant knowledge gaps regarding the abundance and diversity of beneficial insects and native pests on Malaysian sandy coastal ridges, which hinders the design of precision biological control programs (Hua et al. 2026). This challenge is compounded by the complex relationship between insects and abiotic factors; for example, tropical temperature fluctuations and rainfall patterns in areas directly affect insect abundance and thus the interactions are still lacking. Without updated, region-specific pest phenology maps, smallholder farmers often struggle to time interventions effectively, leading to continued reliance on chemical inputs despite the availability of sustainable alternatives (Hua et al. 2026). Thus, understanding insect community structure within sweet potato fields is essential for identifying key pest species, conserving beneficial insects, and enhancing natural biological control. Therefore, this study aims to identify pest and beneficial insects associated with sweet potatoes, determine their population abundance and diversity, and analyze their relationship with abiotic factors. The findings of this study provide baseline ecological information essential for strengthening IPM programs in sweet potato agroecosystems. By elucidating the balance between pest and beneficial insect communities, this research contributes to the development of sustainable pest management strategies that minimize pesticide dependence while promoting biodiversity conservation and agroecosystem stability.

MATERIALS AND METHODS

Sampling Area and Time

The study was carried out in a one-hectare sweet potato (*Ipomoea batatas*) cultivation field at Universiti Sultan Zainal Abidin (UniSZA) Besut Campus, Terengganu, Malaysia (5.7573°N, 102.6228°E), at an elevation of approximately 7 m above sea level. The field was managed under conventional farming practices. Insect sampling was conducted weekly, beginning one week after planting and continuing for approximately two and a half months, until two weeks prior to harvest.

Sampling Method

Three types of traps were used to collect insect samples namely three Malaise traps, five pitfall traps and five yellow pan traps. Malaise and yellow pan traps were used to trap flying insects while pitfall trap was used to trap ground-dwelling insects. The distance between each Malaise trap was approximately 50 m while 20 m between each yellow pan trap and pitfall trap (Muniruddin et al. 2022). This trap arrangement followed a systematic spatial distribution resembling a line transect approach to ensure representative sampling coverage across the study plot. Malaise traps were placed at three corners of the sweet potato field while both yellow pan and pitfall traps were placed in between the roles of sweet potato plantation. All traps were placed randomly in the study plot. Insect samples were collected weekly for 10 weeks (August-October 2024) starting from one week after transplanting until two weeks before harvesting time. Each samples collected were placed into specimen bottles containing 70% ethanol for preservations before it being identified. Abiotic data such as rainfall, temperature and humidity during the sampling period were obtained from the nearest weather station of the Malaysian Meteorological Department.

Insect Identification

All insect samples collected from each trap were brought to the Entomology Laboratory, Faculty of Bioresources and Food Industry (FBIM), UniSZA Besut Campus, for the sorting and identification process. Specimens were sorted and identified to the order and family levels using a stereomicroscope (Olympus SZ51, Japan) based on morphological characteristics and standard insect identification keys by Triplehorn and Johnson (2005), Goulet and Huber (1993), alongside updated entomological references and online taxonomic databases (GBIF 2024; iNaturalist 2024). Insect abundance and diversity within the sweet potato field were subsequently determined. In addition, insects were classified into beneficial and pest categories based on their ecological roles following Integrated Pest Management principles (Jansson & Raman 1992; Landis et al. 2000).

Data Analysis

One-way analysis of variance (ANOVA) was applied to evaluate differences in insect abundance at a 95% confidence level. The relationship between insect abundance and abiotic factors was examined using Pearson's correlation analysis. All statistical analyses were conducted using MINITAB version 17. Insect diversity was assessed using the Shannon–Wiener Diversity Index (H′), calculated with Paleontological Statistics (PAST) software version 4.0.

RESULTS

Identification of Pests and Beneficial Insects in Sweet Potato Field

Over a 10-week sampling period, a total of 10,642 insect specimens were collected from the sweet potato field. These represented nine insect orders and comprised 52 families (Table 1). Of these families, based on their ecological roles, 34 were classified as beneficial insects (predators, parasitoids, pollinators, decomposers) and 18 were identified as pest insects. Among the beneficial insects, 34 families from nine orders were recorded, including families in Diptera (e.g., Tachinidae, Drosophilidae, Culicidae), Coleoptera (e.g., Cicindelidae, Ptinidae, Coccinellidae), and Hymenoptera (e.g., Braconidae, Formicidae, Megalyridae). Additional beneficial families were documented from Blattodea, Odonata, Neuroptera, and Hemiptera. In contrast, 18 insect pest families were identified across five orders, including Diptera (Tephritidae), coleopteran pests such as Elateridae, and Lepidoptera pests including Noctuidae and Pyralidae.

Table 1. Insect abundance at sweet potato field

Order	Family	Number	Role
Diptera	Tachinidae	2548	Beneficial Insect
	Drosophilidae	1665	Beneficial Insect
	Culicidae	803	Beneficial Insect
	Stratiomyidae	4	Beneficial Insect
	Bombyliidae	1	Beneficial Insect
	Tephritidae	32	Pest Insect
Lepidoptera	Noctuidae	1246	Pest Insect
	Pyralidae	1327	Pest Insect
	Hesperiidae	218	Pest Insect

Order	Family	Number	Role
	Nymphalidae	16	Pest Insect
	Sphingidae	15	Pest Insect
	Erebidae	5	Pest Insect
Coleoptera	Cicindelidae	702	Beneficial Insect
	Ptinidae	74	Beneficial Insect
	Coccinellidae	62	Beneficial Insect
	Staphylinidae	8	Beneficial Insect
	Dermestidae	2	Beneficial Insect
	Mycetophagidae	2	Beneficial Insect
	Hydrophilidae	3	Beneficial Insect
	Elateridae	141	Pest Insect
	Cerambycidae	7	Pest Insect
	Scrabaeidae	5	Pest Insect
	Brentidae	3	Pest Insect
	Chrysomelidae	2	Pest Insect
Hymenoptera	Braconidae	309	Beneficial Insect
	Formicidae	101	Beneficial Insect
	Megalyridae	79	Beneficial Insect
	Pompilidae	48	Beneficial Insect
	Mutillidae	29	Beneficial Insect
	Proctotrupidae	32	Beneficial Insect
	Vespidae	26	Beneficial Insect
	Apidae	13	Beneficial Insect
	Trigonalyidae	8	Beneficial Insect
	Chalcididae	6	Beneficial Insect
	Bethylidae	5	Beneficial Insect
	Eurytomidae	3	Beneficial Insect
	Chrysididae	3	Beneficial Insect
	Ichneumonidae	1	Beneficial Insect
	Crabronidae	1	Beneficial Insect
	Evaniidae	1	Beneficial Insect
Hemiptera	Berytidae	1	Beneficial Insect
	Aphididae	971	Pest Insect
	Coreidae	23	Pest Insect
	Pentatomidae	4	Pest Insect
Orthoptera	Gryllidae	27	Pest Insect
	Acrididae	15	Pest Insect
	Tettigoniidae	1	Pest Insect
Neuroptera	Chrysopidae	8	Beneficial Insect
	Myrmeleontidae	2	Beneficial Insect
Odonata	Libellulidae	3	Beneficial Insect
	Protoneuridae	1	Beneficial Insect
Blattodea	Anaplectidae	25	Beneficial Insect
Total		**10642**	

Abundance of Insects in the Sweet Potato Field

A total of 10,642 insect individuals were collected during the 10-week sampling period (Table 2). The insects were classified into nine orders, with Diptera recording the highest abundance (n = 5,053; 47.50% of total individuals). This was followed by Lepidoptera (n = 2,830; 26.60%), Coleoptera (n = 1,013; 9.52%), Hemiptera (n = 999; 9.39%), and Hymenoptera (n = 659; 6.19%). The remaining orders were recorded in much lower numbers, including Orthoptera (n = 43; 0.40%), Blattodea (n = 25; 0.23%), Neuroptera (n = 10; 0.09%), and Odonata, which showed the lowest abundance (n = 4; 0.04%).

Mean abundance values differed significantly [$F (1, 898) = 34.03$, $P<0.05$] among insect orders, with Diptera showing the highest mean abundance (505.3±152.6 individuals per sampling period), followed by Lepidoptera (280.0±31.5). Orders with lower total abundance exhibited significantly lower ($P<0.05$) mean values. These results indicate a clear dominance of Diptera and Lepidoptera within the insect community of the sweet potato field.

Table 2. Insect abundances between orders that were collected

Order	Mean±SE	Total	Percentage (%)
Diptera	505.3±152.6[a]	5053	47.50
Lepidoptera	280.0±31.5[b]	2830	26.60
Coleoptera	104.3±15.5[c]	1013	9.52
Hemiptera	99.9±73.4[c]	999	9.39
Hymenoptera	65.9±3.2c[d]	659	6.19
Orthoptera	4.2±75.1[d]	43	0.40
Blattodea	2.5±1.2[d]	25	0.23
Neuroptera	1.0±1.9[d]	10	0.09
Odonata	0.5±0.9[d]	4	0.04
	Total	**10642**	**100**

Means with the same letter in different rows are not significantly different ($P>0.05$)

Insect Diversity in the Sweet Potato Field

The diversity, richness, and evenness of insects collected from the sweet potato field are presented in Table 3. The Shannon–Wiener diversity index (H′) recorded was 2.361, indicating a low level of insect diversity in the study area. A total of 52 insect families were recorded, with a Margalef's richness index (R′) value of 5.201, indicating relatively high species richness. However, the evenness index (E′ = 0.255) was low, suggesting that insect individuals were unevenly distributed among the recorded taxa, with a small number of families dominating the community.

Table 3. Shannon-Weiner Diversity Index, Evenness Index and Margalef's Richness Index of insect abundance in sweet potato field

Index	Value
Diversity (H')	2.361
Richness (R')	5.201
Evenness (E')	0.255

Relationship of the Insect Abundance and Abiotic Factor

During the sampling period (August–October 2024), as summarised in Table 4, the study area experienced typical tropical climatic conditions characterised by relatively stable temperature and consistently high humidity. The mean weekly temperature ranged from 27.6 to 28.9 °C, indicating minimal thermal variation throughout the study. In contrast, rainfall exhibited substantial temporal variability, with weekly totals ranging from as low as 0.6 mm (Week 9) to a peak of 147.2 mm (Week 6), while the highest daily precipitation (75.6 mm) was recorded in early September. Relative humidity remained persistently high, ranging from 75.9% to 80.7%. Overall, the climatic pattern reflects late-monsoon conditions, characterised by intermittent heavy rainfall events interspersed with short dry periods.

Table 4. Weekly summary of abiotic factors during sampling period (August–October 2024)

Week	Period	Average Rainfall (mm)	Average Temperature (°C)	Average Relative Humidity (%)
1	Aug 1–7	77.0	28.0	78.7
2	Aug 8–14	12.4	28.5	79.3
3	Aug 15–21	85.3	28.4	78.0
4	Aug 22–28	92.4	28.0	78.4
5	Aug 29–Sep 4	83.3	28.9	75.9
6	Sep 5–11	147.2	28.1	77.1
7	Sep 12–18	112.8	27.9	77.7
8	Sep 19–25	141.8	28.1	80.7
9	Sep 26–Oct 2	0.6	28.6	79.1
10	Oct 3–9	76.4	28.3	79.5
11	Oct 10–16	51.6	28.1	79.4
12	Oct 17–23	57.2	27.9	80.3
13	Oct 24–31	55.4	27.6	79.9

These environmental parameters were used in correlation analysis with insect abundance (Table 5). Pearson correlation analysis revealed that temperature and rainfall were significantly correlated (*P<0.05*) with total insect abundance, whereas humidity showed no significant relationship (*P>0.05*). Both rainfall (r = −0.647) and temperature (r = −0.121) exhibited negative correlations with total insect abundance, indicating that increases in these variables were associated with a decrease in the overall number of insects collected during the sampling period.

Table 5. Pairwise Pearson correlation (r) between total populations of insect abundance at sweet potato field with abiotic factor

	Total	Humidity	Temperature
Humidity	0.598		
Temperature	-0.121*	-0.639	
Rainfall	-0.647*	-0.393*	-0.361

*Correlation is significant at 0.05 levels

DISCUSSION

Identification of Pests and Beneficial Insects in Sweet Potato Field

The collection of 10,642 insect specimens over a 10-week period indicates that the sweet potato agroecosystem in this study supports a high abundance and diversity of arthropods. The richness of 52 families across nine orders suggests a complex ecological network where interactions between herbivores and natural enemies are robust. The dominance of beneficial insect diversity (34 families) compared to pest diversity (18 families) aligns with recent ecological studies suggesting that low-input sweet potato fields often function as reservoirs for generalist predators and parasitoids, which naturally suppress pest outbreaks (Cabral et al. 2024). Similarly, Renaldi et al. (2025) found that the high presence of natural enemies in Nagara sweet potato fields indicates that the sweet potato ecosystem is relatively stable and can control pests naturally.

The recording of Braconidae (Hymenoptera) is particularly significant, as members of this family serve as primary parasitoids attacking the larval stages of herbivorous pests, including Lepidoptera such as Noctuidae, specifically armyworms (*Spodoptera* spp.) in agricultural systems. For instance, Mahmood and Parwes (2024) has listed 75 Braconidae species attacking *S. furgipeda*. In this study, Noctuidae recorded the highest abundance of lepidopteran pests, a favourable host for hymenopteran parasitoids, as well as for Dipteran parasitoids (Tachinidae). Likewise, the presence of generalist predators such as Formicidae (ants) and Coccinellidae (lady beetles) suggests active natural enemy guilds. Predatory ants have been documented consuming pest eggs and larvae in root and vine crops (Choate & Drummond 2011). For example, predatory fire ants (*Solenopsis* spp.) have been documented as effective biological control agents against homopteran and coleopteran pests in the sweet potato field (Rashid et al. 2013).

While the pest families were less diverse (18 families), their potential for economic damage remains high. The identification of Noctuidae (Lepidoptera) was expected, as many noctuid species are well documented as major defoliators and pests of a wide range of crops, including polyphagous armyworms and other caterpillars that feed on foliage and reduce plant vigor. In addition, Elateridae (Coleoptera) is a critical finding. The larval stages of click beetles or known as wireworms are soil-dwelling pests that feed on roots and tubers of root crops and other vegetables, creating tunneling damage that not only reduces marketable quality but can also predispose tubers to secondary infections even at relatively low densities (Lorenzo et al. 2025). Wireworms are increasingly recognized as hidden yield killers because their damage tends to lower the commercial value of tubers due to cosmetic defects and downgrading at harvest, making them economically significant even when overall field populations appear low (Bohinc et al. 2025). Similarly, the presence of Tephritidae (fruit flies) and Pyralidae (snout moths) indicates threats to both the vines and the tubers. Pyralid larvae, such as the sweet potato vine borer (*Omphisa anastomosalis*), damage the stem flow, while tephritids may act as secondary pests in rotting tissues or directly attack exposed roots (Qurnain et al. 2025).

Abundance of Insects in the Sweet Potato Field

The dominance of Diptera (47.50%) in the sweet potato field is consistent with findings from other agricultural ecosystems, where dipteran insects often represent a substantial proportion of total insect abundance due to their high reproductive rates, short life cycles, and adaptability to disturbed habitats. This might be responding to specific biotic resources such as decaying organic matter and lush foliage. The overwhelming abundance of Diptera is likely attributed to the presence of both saprophytic and herbivorous families. Previous research has identified that saprophytic flies, particularly Drosophilidae, often surge in sweet potato fields where they are attracted to fermenting sugars in exposed or damaged tubers (Stahr et al. 2024). Phillips et al. (2025) stated that Drosophilidae is an emerging pest within sweet potato storage facilities because of their ability to mechanically transmit a fungal pathogen of sweet potato roots.

Lepidoptera ranked the second-highest abundance (26.60%), consistent with their role as important defoliators in root crop systems. Similarly, Uwaidem et al. (2018) reported that Lepidoptera accounted for approximately 24% of insect pests in sweet potato fields. The main contributors included the sweet potato butterfly (*Acraea acerata*), leaf folders (*Brachmia* and *Helcystogramma* spp.), and sweet potato armyworms (*Spodoptera* spp.), all of which are important foliage feeders that exploit the vigorous vine growth typical of local cultivars (Cabral et al. 2024). The presence of these moth larvae underscores the importance of Lepidoptera in shaping insect community structure in intensively managed sweet potato fields.

Interestingly, Coleoptera, which contains the sweet potato weevil (*Cylas formicarius*) recorded significantly lower abundance (9.52%) than Diptera and Lepidoptera. This discrepancy is likely due to the cryptic behaviour of weevils, which spend the majority of their life cycle inside the tuber or stem, making them less susceptible to interception by standard sweep-netting or passive trapping compared to free-flying moths and flies (Zol et al. 2019). However, this order also includes beneficial predators such as Coccinellidae (lady beetles), whose presence is vital for suppressing whitefly populations (Kavallieratos et al. 2024).

Overall, the insect abundance pattern observed in this study reflects a community dominated by a few highly abundant orders, typical of intensively managed agroecosystems. Adoption of sustainable practices such as reduced pesticide application, habitat diversification, and Integrated Pest Management (IPM) could help promote a more balanced insect community structure and enhance ecosystem services in sweet potato production systems.

Insect Diversity in the Sweet Potato Field

The ecological indices calculated for the study area reveal a community structure typical of intensively managed agroecosystems: high species richness but low evenness. The Shannon–Wiener diversity index (H' = 2.361) suggests a moderate-to-low level of functional diversity. While agricultural fields often exhibit lower H' values compared to natural forests due to monoculture cropping and frequent anthropogenic disturbance (e.g., weeding, fertilization), this value indicates that the ecosystem still retains a baseline of biodiversity. However, the interpretation of this diversity must be contextualized by the Evenness index (E' = 0.255), which is notably low.

The contrast between the high Margalef's richness index (R' = 5.201) and the low Evenness index is a critical finding. It implies that while the sweet potato field attracts a wide variety of insect families (52 families), likely due to the lush vegetative cover and availability of rotting tubers, the insect community is not balanced. Instead, it is numerically dominated by a few abundant families. This aligns perfectly with the earlier observation where Diptera and Lepidoptera accounted for nearly 75% of all individuals. In ecological terms, this low evenness is a characteristic of disturbed habitats. According to Kirk et al. (2025), terrestrial invertebrates provide essential ecosystem services, and there is concern that their contribution could be compromised by population declines due to agricultural intensification, including pesticide use.

A community dominated by a few taxa is often less resilient to pest outbreaks because natural enemies (predators and parasitoids) may not be abundant or functionally diverse enough to suppress dominant herbivores under disturbance and simplified conditions. As monoculture sweet potato plots become simplified in structure and management, pest populations such as weevils or vine borers can surge disproportionately, skewing the evenness index and compromising the stability of natural regulation mechanisms. Furthermore, the presence of many taxa that occur only transiently (reflected in high richness but low evenness) suggests the inclusion of non-resident insect species that pass-through crops without forming stable, functionally significant populations, thereby contributing to overall richness but not necessarily to ecological stability or effective pest control (Cabral et al. 2024).

Relationship of the Insect Abundance and Abiotic Factor

Overall, the results highlight the importance of climatic variability in regulating insect abundance in the sweet potato agroecosystem. Among the abiotic factors analysed, rainfall emerged as the most influential variable, showing a significant correlation with insect abundance ($r = -0.647$, $P<0.05$). This indicates that periods of high precipitation were associated with reduced insect populations, suggesting that rainfall acts as a natural suppressive force. Such effects are well documented in tropical agricultural systems, including those typical of the East Coast of Peninsular Malaysia (e.g., Terengganu), where heavy rainfall can physically dislodge larvae and adults from plant surfaces and inhibit the flight activity of delicate insects such as parasitoid wasps (Hymenoptera) (Muniruddin et al. 2023).

In contrast, temperature showed a weaker but still significant relationship with insect abundance ($r = -0.121$, $P<0.05$). Although insects are ectothermic and generally exhibit increased activity under warmer conditions, the observed decline in abundance at higher temperatures may reflect behavioural avoidance of thermal stress. In sweet potato agroecosystems, elevated temperatures can induce movement of soft-bodied insects, such as aphids and larvae, into cooler and more sheltered microhabitats beneath leaves or within the soil, thereby reducing their detectability during sampling (Qurnain et al. 2025). This form of behavioural thermoregulation may contribute to lower recorded abundance during periods of higher temperature (Hua et al. 2026).

Meanwhile, relative humidity exhibited a non-significant relationship with insect abundance, indicating a limited direct influence on temporal population dynamics within the study period. Despite the lack of statistical significance, high humidity remains biologically important in tropical environments, as it reduces desiccation stress and supports the development of microbial resources that attract certain insect groups, such as saprophytic Diptera (Stahr et al. 2024). The absence of a significant relationship in this study may be attributed to the relatively narrow range of humidity values observed or limitations in sample size. Collectively, these findings demonstrate that rainfall is the primary abiotic driver shaping insect population dynamics, exerting strong suppressive effects, while temperature plays a secondary role through behavioural responses, and humidity provides supportive environmental conditions with limited direct influence on abundance patterns.

CONCLUSION

In conclusion, the study revealed that the sweet potato field supported a diverse assemblage of insect species across multiple orders and families, with a predominance of beneficial insects, especially Hymenoptera alongside several economically important pest groups. Although a relatively high species richness and overall insect abundance were recorded, the insect community exhibited low diversity and evenness, indicating dominance by a limited number of species, particularly Diptera and Lepidoptera. This uneven distribution suggests that the agroecosystem favours certain insect groups while limiting others, potentially due to crop characteristics and field management practices. Insect abundance was significantly influenced by abiotic factors, with both rainfall and temperature showing significant correlations with total insect populations, whereas humidity had no significant effect. These findings highlight the combined influence of biotic composition and environmental factors on insect community structure in sweet potato agroecosystems and provide baseline information that may support future studies such as to evaluate seasonal variations, longer-term population dynamics, and the effects of different pest management practices on insect diversity and functional roles to better support sustainable pest management in sweet potato agroecosystems.

ACKNOWLEDGEMENTS

The authors would like to extend their gratitude to the Universiti Sultan Zainal Abidin (UniSZA) for research facilities and staff of FBIM Farm Management Center for their assistance in preparing the sweet potato plots for this study.

AUTHORS DECLARATIONS

Funding Statement

The authors thank Universiti Sultan Zainal Abidin (UniSZA) for funding this research under the Dana Penyelidikan Universiti (UniSZA/2023/DPU 2.0/23) and DMB Kembara Sdn. Bhd. for support through the Dana Industri (UniSZA/2023/PPL/DMB/040).

Conflict of Interest

All authors declare that they have no conflicts of interest to influence the findings reported in this paper.

Ethics Declarations

Ethics declarations are not applicable for this research.

Data Availability Statement

This manuscript has no associated data.

Authors' Contributions

Mohamad Akmal Aliff Karim conducted field sampling and specimen identification. Salmah Mohamed and Norhayati Ngah analysed and discussed the results and prepared the first draft of the manuscript. Nur Athiqah Md Yusof assisted with insect identification. Mohammad Hailmi Sajili and Mohd Fahmi Abu Bakar provided research materials, and Hafizan Juahir contributed data interpretation and relevant references.

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