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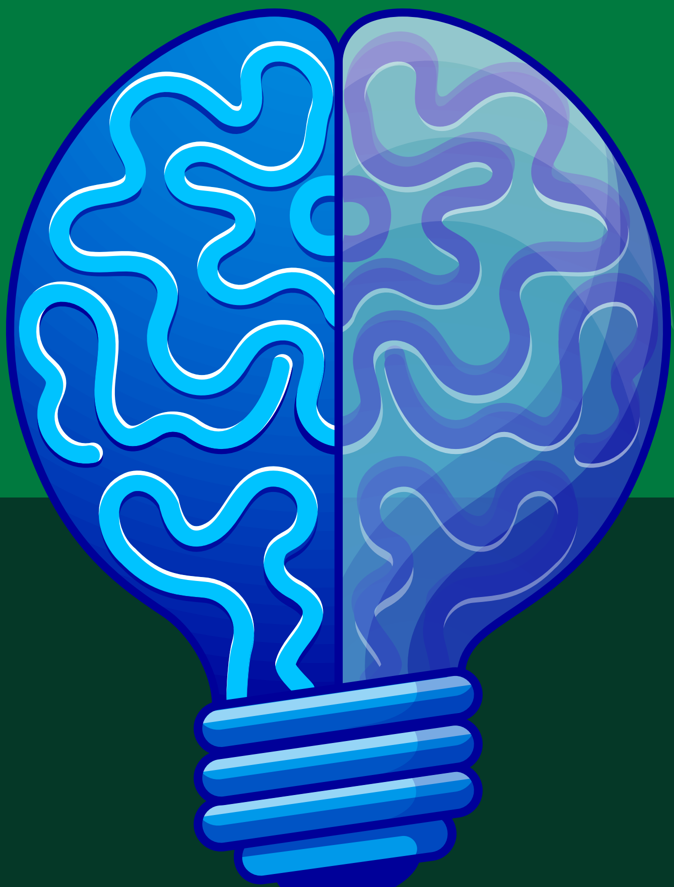

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EDITORS
Pn. Rosliza Ali
Pn. Nunshaimah Salleh
Pn. Norsakina Zurina Zulkifli
Pn. Adibatul Husna Fadzil
Pn. Yanti Yaacob
Pn. Lili Widarti Zainuddin

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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

Lastly, we would like to express our gratitude to all of the authors for the tremendous help in preparing the articles, without which this undertaking would not have been completed.

Editors

Rosliza Ali
Nunshaimah Salleh
Norsakina Zurina Zulkifli
Adibatul Husna Fadzil
Yanti Yaacob
Lili Widarti Zainuddin

Universiti Teknologi MARA
Perak Branch Tapah Campus
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INFLUENCE OF PITFALL TRAP FUNNEL ORIENTATION ON INSECT ABUNDANCE IN TRAP CROP

Nadia Nisha Musa*, Husna Zulkipli, Alisha Umairah Md Norizzan, Nur Alya Natasha Azhari, Hazwani Husna Mukhtar, Muhammad Redzuan Zulkifli, Aniq Hassif Arif, Nurul Ameera Ahmad Fauzi

Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch Tapah Campus, 35400 Tapah Road, Perak, Malaysia

*E-mail: nadianisha@uitm.edu.my

Abstract: Pitfall trap is a widely used method in ecological research for passive sampling of ground-dwelling insects. The efficiency of a pitfall trap can be influenced by many physical factors, including the trap design. The present study was conducted to determine the influence of funnel orientation of the pitfall trap for the insect collection at a banana crop site, a type of trap crop, at Universiti Teknologi MARA, Perak Branch, Tapah Campus. The sampling was performed using different designs of funnel orientations, i.e., upward funnel, downward funnel and multiple funnels, with the standard design without a funnel served as the control group. The abundance of collected insects was analysed using Microsoft Excel 2007. Based on the results, the pitfall trap effectively captured a diverse assemblage of insect orders, with Orthoptera (40%), Hymenoptera (21%) and Diptera (13%) being the most common orders. Overall, 21 families representing 11 orders were recorded, with Gryllidae (20.51%), Acrididae (10.99%) and Formicidae (10.79%) identified as the most common families. The influence of different funnel orientations indicated that the downward funnel captured a higher abundance of insects than the other funnel orientations. However, the result also indicated that the control group of the pitfall trap (no funnel) captured more insects than the treatment groups. These findings suggest that optimisation in trap design can further improve data accuracy in ecological studies. This study provides practical suggestions for the improvement of biodiversity monitoring techniques in tropical ecosystems.

Keywords: *passive sampling, biodiversity, ground-dwelling arthropods, trap crop*

INTRODUCTION

Pitfall traps are the best-known passive sampling technique and most often used inventory method for ground-dwelling insects. They have been widely used to explore the habitat quality (Ramalingam & Dharma Rajan, 2020) and for measuring nature conservation values (Jelaska, 2022). Pitfall traps usually consist of a beaker that is buried so that the lip of the beaker is level with the ground surface. This trap operates on the principle that once insects fall into the trap, they are unable to escape by climbing the trap walls and are subsequently preserved in the alcohol placed at the base. In previous study by Woodcock (2005), pitfall traps efficiently collect certain insect orders, i.e., rove beetles (Coleoptera: Staphylinidae), wandering spiders (e.g. Aranae: Lycosidae and Clubionidae), and ants (Hymenoptera: Formicidae). A major challenge in ecological and entomological studies is the lack of standardization across pitfall trap designs. Reviews have documented extensive variation in trap diameter, depth, preservative fluid, cover presence and spacing (Brown et al., 2016). This heterogeneity reduces comparability among studies and may introduce sampling biases (Conway & Hohbein, 2018). Additionally, one of the other parameters that has received relatively little attention is the funnel orientation of the pitfall trap. Differences in orientation may alter the probability of capture or escape, thereby biasing abundance estimates.

Without an empirical understanding of how funnel orientation affects capture efficiency, sampling data may be inconsistent, unreliable, or non-comparable across experiments or locations. Gaining insights into how trap design affects sampling efficiency is therefore essential for enhancing the accuracy and reliability of ecological monitoring in trap cropping systems. It is hypothesised that different funnel orientations will affect the number of insects captured in pitfall traps, with certain orientations enhancing trap efficiency compared to the standard design. Therefore, the objectives of the present study were to: i) determine the insect abundance within the trap crop, and ii) compare the influence of different funnel orientations of the pitfall trap on insect abundance.

METHODOLOGY

Sampling site

The field study was carried out at a banana crop site located within Universiti Teknologi MARA, Tapah Campus, Perak (Figure 1). The banana crop functioned as a trap crop and served as the focal site for insect sampling. The sampling was conducted every week from November to December 2024 (n=8 sampling sessions).

Figure 1 Sampling site at Universiti Teknologi MARA, Tapah Campus, Malaysia

Pitfall trap design

The pitfall traps were developed based on the proposed design by Woodcock (2005), as in Figure 2, with modifications to incorporate different funnel orientations. Four treatments were tested, i.e., no funnel (control), upward funnel, downward funnel, and multiple funnels. Each trap was assembled using readily available materials, including water bottles, bamboo sticks, duct tape, cable ties, hot glue and scissors. The water bottles served as the main trap body and were cut and shaped according to the required funnel orientation. The components were secured using duct tape, cable ties, and hot glue to ensure stability and durability in the field. Pitfall traps were deployed in a linear sequence consisting of 5 traps positioned at intervals of 1.5 to 2 m as proposed by Egorov et al. (2024).

Data analysis

The collected insects from each sampling session were counted and morphologically identified using stereomicroscope to the order and family level with reference to available taxonomic keys and relevant literature (Heckman, 2006; Gibb & Oseto, 2019). Data analysis was conducted using Microsoft Excel 2007 to address the study objectives.

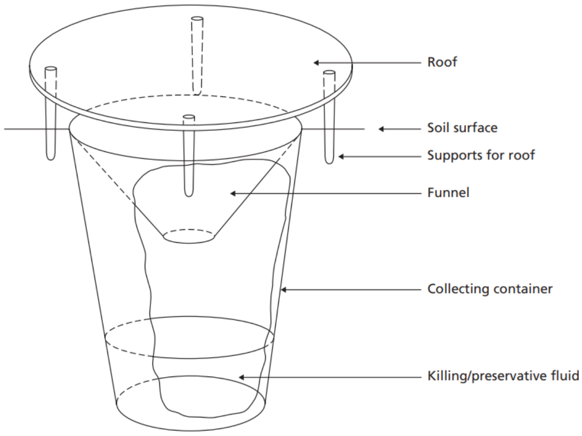

Figure 2 Pitfall trap with funnel (Woodcock, 2005)

FINDINGS

A total of 1,019 insects were captured from the banana crop site during the eight sessions over the two-month sampling period. The finding shows that the most common orders were Orthoptera (40%), Hymenoptera (21%) and Diptera (13%). In total, 21 families representing 11 orders were recorded, with Gryllidae (20.51%), Acrididae (10.99%) and Formicidae (10.79%) being the most common families (Figure 3). The diverse of insect orders collected from the banana crop can be attributed to several ecological and environmental factors. Banana plants provide an ideal habitat with dense foliage and complex structural features, offering shelter from predators and create suitable microhabitats for oviposition, both of which are crucial for their survival and reproduction (Padmanaban & Mani, 2022). Moreover, the availability of food resources within the area of the banana crop site plays a crucial role in supporting insect populations, particularly Gryllidae (crickets) and other Orthoptera. The banana plants themselves serve as a primary food source, offering tender leaves and decaying plant matter that are rich in nutrients. These insects are known to feed on various parts of the banana plant, including the leaves, flowers, and fruits, which provide essential sustenance for their growth and reproduction (Sarkar et al., 2018).

Apart from the abundance of insects, the abiotic metadata were also being recorded throughout the sampling sessions. Across the eight sessions, the temperature ranged from 28 °C to 34 °C, with an average of 31.38 °C. Light intensity values ranged from 6 to 10 lux, while humidity levels varied between 81.90% and 94.54%, with an average of 89.28%. Additionally, atmospheric pressure ranged from 1009.7 to 1012.2 hPa, while the average rainfall over the sampling period was 247.9 mm, with a maximum of 399.8 mm recorded. In previous study, the microclimatic conditions found in banana plantations are marked by a high humidity and stable temperatures, which are particularly conducive for the growth and development of crickets (Kuo & Fisher, 2022). With an average temperature of 31.38 °C and humidity levels around 89.28% in the present study, these conditions help maintain moisture levels that are essential for the physiological needs of these insects.

Furthermore, variations were observed in the abundance of insects representing different ecological roles within the banana trap crop. The collected insects were categorised into six ecological roles, i.e., beneficial insects, biocontrol agents, decomposers, pests, pollinators and predators. Most of the insects were classified as decomposers (445 individuals), followed by pests (239 individuals) and predators (221 individuals). In terms of ecological guilds, herbivores, i.e., crickets, grasshoppers and honeybees were the most abundant, followed by detritivores, including millipedes, earthworms, flies and termites and omnivores such as ants and spiders. The remaining insects were categorised as carnivores, consisting mainly of predatory beetles (e.g., Carabidae) and wasps.

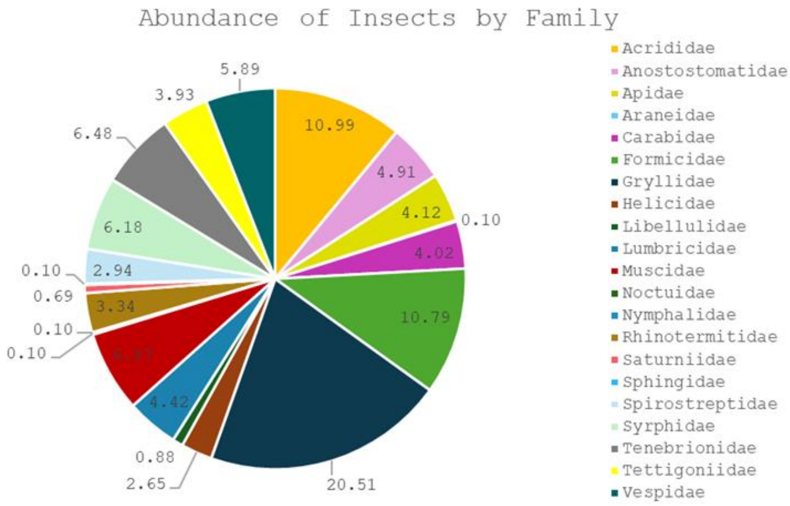

Figure 3 Abundance of insects by family

Moreover, the abundance of insects captured in pitfall traps varied with funnel orientation (Figure 4). As a result, 405 insects were captured from the control trap (no funnel), 256 insects from the downward funnel, 204 insects from the upward funnel and 154 insects from multiple funnels. The absence of a funnel in the control trap provided an open and unrestricted trap entrance, making it easier for a wide range of insects to fall in (Brown & Matthews, 2016). Next, by evaluating the different funnel orientations, the pitfall trap with a downward funnel successfully collected the highest abundance of insects, indicating superior trapping efficiency. This orientation likely capture success by guiding insects into the trap while preventing the entry of larger insects and reducing escape rates (Ahmed et. al, 2023). The upward funnel followed, capturing 204 insects, which represents a moderate abundance. The reduced capture rate in this orientation may be attributed to the narrow upper opening, which likely limited entry for certain insect taxa. In contrast, the multiple-funnel trap recorded the lowest abundance, with only 154 insects collected. The lower capture rate in this design could be due to the structural complexity of multiple funnels, which may have restricted access to the trap entrance and impeded insect entry (Hohbein & Conway, 2018).

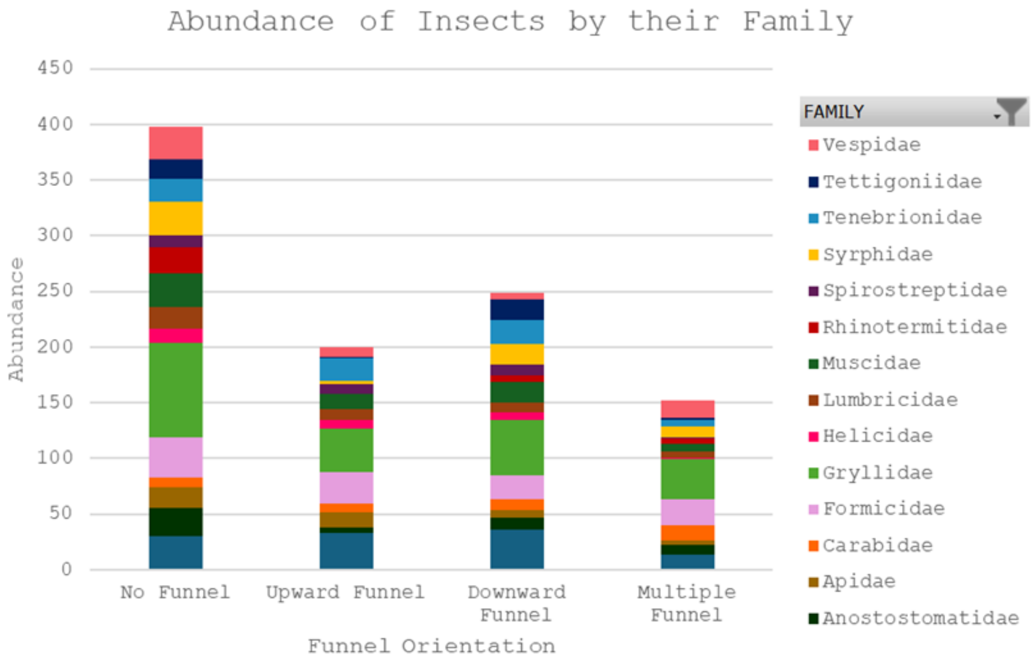

Figure 4 Abundance of insects by different funnel orientation

CONCLUSIONS

This study revealed that funnel orientation influences the efficiency of pitfall traps in capturing ground-dwelling insects within a banana trap crop system. Different insect orders used the banana crop as their preferred habitat due to the complexity of the landscapes and the suitable climatic conditions, which promote the survival of the insects. Among the treatments, the downward funnel successfully captured relatively more insects than other funnel orientations; however, the conventional pitfall trap without a funnel (control group) recorded the highest overall abundance. This suggests that additional funnel structures may alter insect movement and accessibility to the trap entrance, thereby affecting capture efficiency. Orthoptera, Hymenoptera, and Diptera were the dominant orders, indicating that the traps effectively sampled a broad range of insect taxa typical of tropical agroecosystems. Future studies should extend sampling across multiple crop types, assess additional trap design parameters such as colour, size, and preservative type, and incorporate behavioural observations to better understand insect responses to trap geometry. Integrating pitfall traps with complementary sampling methods could also enhance data accuracy and provide a more comprehensive understanding of insect communities in tropical agricultural systems, especially in the trap crop site.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

REFERENCES

Ahmed, D. A., Beidas, A., Petrovskii, S. V., Bailey, J. D., Bonsall, M. B., Hood, A. S. C., Byers, J. A., Hudgins, E. J., Russell, J. C., Růžičková, J., Bodey, T. W., Renault, D., Bonnaud, E., Haubrock, P. J., Soto, I., & Haase, P. (2023). Simulating capture efficiency of pitfall traps based on sampling strategy and the movement of ground-dwelling arthropods. *Methods in Ecology and Evolution*, *14*(11), 2827–2843. https://doi.org/10.1111/2041-210x.14174

Brown, G. R., & Matthews, I. M. (2016). A review of extensive variation in the design of pitfall traps and a proposal for a standard pitfall trap design for monitoring ground-active arthropod biodiversity. *Ecology and Evolution*, *6*(12), 3953–3964. https://doi.org/10.1002/ece3.2176

Egorov, L. V., Dedyukhin, S. V., Alekseev, S. K., Trushitsyna, O. S., Ruchin, A. B., Sazhnev, A. S., Nikolaeva, A. M., Esin, M. N., & Khapugin, A. A. (2024). Regional Coleoptera Fauna: Applying different methods to study species diversity in a single region. *Insects*, *15*(12), 917. https://doi.org/10.3390/insects15120917

Gibb, T. J., & Oseto, C. (2019). *Insect collection and identification: techniques for the field and laboratory*. Academic Press.

Heckman, C. W. (2006). *Encyclopedia of South American aquatic insects: Odonata–Anisoptera: Illustrated keys to known families, genera, and species in South America*. Dordrecht: Springer Netherlands.

Hohbein, R. R., & Conway, C. J. (2018). Pitfall traps: A review of methods for estimating arthropod abundance. *Wildlife Society Bulletin*, *42*(4), 597–606. https://doi.org/10.1002/wsb.928

Jelaska, L. Š. (2022). Ecology and conservation of the Dutch ground beetle fauna–Lessons from 66 years of pitfall trapping. *Nature Conservation*, *49*, 189-192.https://doi.org/10.3897/natureconservation.49.89861

Kuo, C., & Fisher, B. L. (2022). A literature review of the use of weeds and agricultural and food industry by-products to feed farmed crickets (Insecta; Orthoptera; Gryllidae). *Frontiers in Sustainable Food Systems*, 5. https://doi.org/10.3389/fsufs.2021.810421

Padmanaban, B., & Mani, M. (2022). Pests and their management in banana. *Trends in Horticultural Entomology*, 577–603. https://doi.org/10.1007/978-981-19-0343-4_18

Ramalingam, R., & Dharma Rajan, P. (2022). Habitat quality and edge area of fragments determine insect diversity in a heavily used landscape: Implications for forest landscape restoration. *Biotropica*, *54*(6), 1440-1456.https://doi.org/10.1111/btp.13027

Sarkar, S. C., Wang, E., Wu, S., & Lei, Z. (2018). Application of trap cropping as companion plants for the management of agricultural pests: A Review. *Insects*, *9*(4), 128. https://doi.org/10.3390/insects9040128

Woodcock, B. A. (2025). Pitfall trapping in ecological studies. In R. L. Simon (Ed.), *Insect Sampling in Forest Ecosystems* (pp. 37–57). Australia: Blackwell Publishing.

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Timbalan Ketua Pustakawan

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Setuju.

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