

Diversity insect in the Vegetative Phase of *Arenga pinnata* (wurmb) merr. in Tanjung Miring Village, Muara Enim

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ABSTRACT

One of the factors that support the growth of sugar palm plants was the presence of insects that indirectly play an important role in the ecosystem of these plants. The study aimed to determine the abundance, diversity, and role of insects associated with young sugar palm plants (vegetative) in Tanjung Miring Village. The method used was purposive random sampling by setting yellow sticky traps and pitfall traps. Data collection techniques were obtained through direct observation in the field by setting two traps and interviews with sugar palm plant farmers using a questionnaire. The results showed that there were 21 insect species belonging to 18 families from 8 orders. Three important insect groups consisted of 9 types of pollinating insects, 7 types of herbivorous insects, and 5 types of decomposing insects. The abundance of pollinating and decomposing insects was dominated by the orders Hymenoptera and Diptera with a total of 338 individuals. The highest insect species diversity was found in the yellow trap with 13 species and a Shannon-Wiener diversity index (H') of 2.17. While pitfall traps, only 8 species of insects were found with an H' value of 1.43. The high diversity and abundance of yellow traps showed the dominance of active flying insects, especially pollinators, with the highest relative abundance ($Di=2.43$). The complex ecosystem of the sugar palm groves is an important habitat for various insects with complementary ecosystem functions.

Keywords: *Arenga pinnata*, insect, population, pitfall trap, yellow sticky trap

INTRODUCTION

The rapidly developing plantation sector in Indonesia was the aren plant. Aren plants were spread almost throughout the entire archipelago, especially in hilly areas (Ghozali et al., 2022). This plant was spread across various islands, and most of its population still exists as wild plants that grow abundantly and were naturally dispersed in various types of forests (Purwanto et al., 2020). Aren was generally found in areas with low elevation. According to the research by Sherwani et al. (2021), it was stated that aren could grow well at low land elevations up to 1400m above sea level. Continuing with Nirawati et al. (2020), the climate suitable for the growth of aren was a temperate to humid climate

with an annual temperature ranging from 19-27°C, with a relatively high rainfall level reaching 1,200-3,500 mm/year (Muda & Awal, 2021), which will affect the crown formation in aren. In addition, plants from the Aracaceae family thrive at elevations with a pH range of 5-8 (Ilyas et al., 2021). Generally, at that pH, the soil contains abundant minerals, which greatly aid the growth and development of the aren tree (Haryoso et al., 2020).

The aren plant was one of the sap-producing plants that relies on natural cross-pollination with the help of pollinating insects such as honeybees and beetles (Aliyu et al., 2023). However, the presence of pollinator insects was increasingly declining due to various factors, including excessive pesticide use, loss of natural habitats,

climate change, and land conversion (Jayawardana et al., 2023). Research in Nagari Lubuk Gadang Selatan, Sangir District, shows that insects from the order Hymenoptera, particularly the family Apidae, play an important role in the pollination process of aren plants (Mujetahid et al., 2023). Unfortunately, the decline in the population of these insects disrupts the pollination process, which affects the low productivity of the aren plant. The decrease in effective pollination could hinder the production of sap (Imraan et al., 2023). Furthermore, the aren plant has not yet been widely cultivated on a large scale, as its very slow growth makes people uninterested in planting aren. Aren takes time to start producing when it reaches 10-15 years of age (Bahrain et al., 2022).

Based on the research conducted by (Herlin et al., 2024), a study has been carried out on the pollinator insects associated with the generative phase of the aren plant. Several orders that play a role as pollinators include Hymenoptera, Diptera, Lepidoptera, and Coleoptera (Withaningsih et al., 2021). The role of insects that are phytophagous, such as rhinoceros beetles, sago beetles, and grasshoppers, which attack the young shoots of the aren plant, has also been found (Muda et al., 2024). Based on that background, Studies on the diversity of insects associated with young (vegetative) sugar palm plants were still limited. Therefore, further exploration was needed to determine the diversity of insect species associated with young palm plants and the environmental factors that affect the abundance of these insects. The objective of this research was to determine the abundance and role of insects associated with young aren plants in Tanjung Miring village.

MATERIALS AND METHODS

Preparations

The research was conducted in Tanjung Miring village, Sungai Rotan sub-district, Muara Enim district, South Sumatra. This research method uses purposive random sampling technique. The data collection techniques used consist of primary data and secondary data. Primary data was obtained through research and direct observation in the field by installing several traps on the aren trees. Secondary data

was obtained through interviews with aren farmers using a questionnaire to get an overview of the aren cultivation land that will be studied.

Implementation

A total of 40 young Aren plants in the vegetative growth phase were selected as samples in this study. Each plant was equipped with four pitfall traps and four yellow sticky traps, which were installed at the periphery of the leaf canopy in the four cardinal directions. All traps were deployed for a duration of 24 hours (Figure 1).

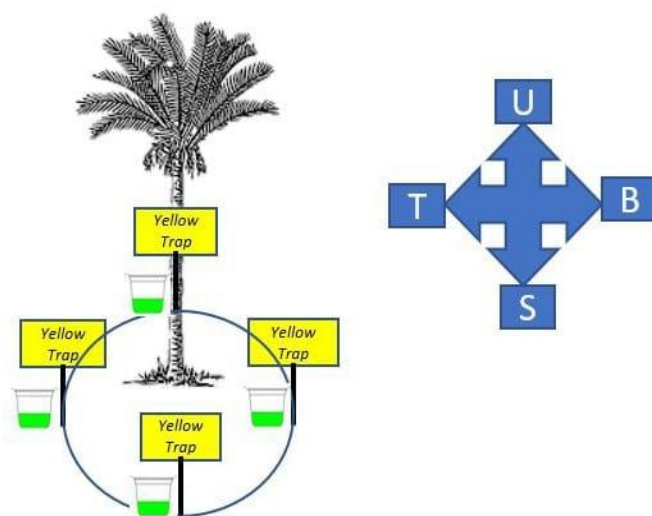


Figure 1. yellow sticky trap and pitfall trap

The installation of pitfall traps was done by inserting the traps into the ground using plastic cups with a diameter of approximately 10 cm. Then the trap was filled with water up to $\frac{3}{4}$ of the plastic cup, which has been mixed with detergent. The yellow sticky trap was installed using a 150 cm bamboo pole. Then, a yellow sticky trap was attached to the bamboo. The insects that were collected were then placed into vials containing 70% alcohol. Each vial was labeled according to the trap on each plant. The insects were then taken to the laboratory for identification.

Insect identification was carried out by photographing the insect using a smartphone camera and assisted by a macro lens to observe the morphological shape of the insect. After understanding the morphological characteristics of the obtained insect, it was then matched with several literatures such as insect identification books and other literature like online journals to determine its species.

Data Analysis

Data on the composition and abundance of insect species were used to analyze the Shannon species diversity index (H'), the Berger-Parker species dominance index (d), and the species evenness index (e) (Ludwig & Reynolds, 1988; Riyanto et al., 2011). The processing of insect population data was analyzed using NCSS software.

RESULTS

The research was conducted on the land owned by Mr. Redi Kuswoyo, located in Tanjung Miring Village, Sungai Rotan District, Muara Enim Regency, South Sumatra. The aren plants grew on an area of 10,000m² using local varieties (Table 1).

The results of insect observations on young (vegetative) aren plants consisted of 8 orders: Hymenoptera, Orthoptera, Blattodea, Hemiptera, Diptera, Coleoptera, Entomobriomorpha, and Isoptera. 18 families of insects with a population of 535 in the yellow sticky trap and 532 in the pitfall trap, with a total population of 1057 (Table 2). Observations using yellow sticky traps showed higher results than pitfall traps in terms of abundance, richness and diversity of insect

species. The diversity indices (H') were 2.17 and 1.43 respectively, both of which were within the range of $1 < H' < 3$, indicating moderate diversity (Table 3).

Table 1. Description of the aren plant land in Tanjung Miring village

Research Land Condition	
Name of farmer	Redi Kuswoyo
Land size	1 Ha (10.000 m ²)
Farm location	Bank of lematang river
variety	Local
Planting method	None
	Plant grow wildly
Pesticide application	None
fertilization	None
Surrounding	North: rubber plantations and
vegetation	rice fields
	South: community house
	East: rubber plantation,
	West: river

The insect population obtained during each observation based on each order of insects on young (vegetative) aren plants. Observations were conducted weekly with a total of 6 observations starting from week 1 to week 6. The insect order that appeared most frequently in each observation was the Hymenoptera order, while the order that appears the least in each observation was the Orthoptera order (Figure 2).

Table 2. Insect species diversity in the young aren plant ecosystem

Ordo	Family	Species	Trap		Total	Role
			Yellow trap	Pitfall trap		
Hymenoptera	Formicidae	<i>Formica rufa</i>	0	108	108	Pollinator
		<i>Campnotus japonicus</i>	90	0	90	Pollinator
		<i>Campnotus chartifex</i>	65	0	65	Pollinator
		<i>Solenopsis gemminate</i>	0	63	63	Pollinator
	Apidae	<i>Trigona spp.</i>	2	0	2	Pollinator
Blatodea	Tenthredinidae	<i>Aglaostigma sp.</i>	1	0	1	Fitofag
	Ectobiidae	<i>Loboptera decipiens</i>	0	20	20	Dekomposer
Isoptera	Rhinotermitidae	<i>Coptotermes Curvignatus</i>	0	22	22	Dekomposer
	Termitidae	<i>Macrotermes malaccensis</i>	0	12	12	Dekomposer
Coleoptera	Erotylidae	<i>Languria mozardi</i>	13	0	13	Fitofag
	Curculionidae	<i>Spenophorus parvulus</i>	30	22	52	Fitofag
	Cryptophagidae	<i>Cryptophagus sp.</i>	62	0	62	Fitofag
Hemiptera	Miridae	<i>Lygus lineolaris</i>	4	0	4	Fitofag
	Cydnidae	<i>Cydnus aterrimus</i>	10	0	10	Fitofag
Orthoptera	Grillidae	<i>Acheta domesticus</i>	0	3	3	Dekomposer
	Acrididae	<i>Valanga sp.</i>	0	1	1	Fitofag
Entomobriomorpha	Entomobryidae	<i>Collembola sp.</i>	0	281	281	Dekomposer
	Culicidae	<i>Anopheles sp</i>	108	0	108	Pollinator
Diptera	Muscidae	<i>Musca domestica</i>	27	0	27	Pollinator
	Tipulidae	<i>Holorusia sp.</i>	57	0	57	Pollinator
	Dolichopodidae	<i>Chrysotus spp.</i>	66	0	66	Pollinator
Total (N)			535	532	1067	

Table 3. Abundance and diversity of insect species in sugar palm plant

Diversity	Yellow sticky trap	Pitfall Trap
Species Abundance	2.43	1.69
Species Diversity Index (H')	2.17	1.43
Equality Index (E)	0.85	0.65
Species Richness Index (R)	1.91	1.27
Dominance Index (D)	0.13	0.34

Observations were conducted by installing yellow sticky traps to capture flying insects and pitfall traps to capture insects active on the soil surface in the vegetative phase of the aren plant. Based on the percentage of insects obtained from both traps, in the yellow sticky trap, the majority of the trapped insects belonged to the order Diptera 48%, Hymenoptera 29%, Coleoptera 20%, and Hemiptera 3%. Meanwhile, in the pitfall trap, the insects obtained were dominated by the order Entomobriomorpha 53%, Hymenoptera 32%, Isoptera 6%, Blattodea 4%, Coleoptera 4%, and Orthoptera 1% (Figure 3).

In the ecosystem of the aren plant, three roles of insects were identified, namely as pollinators, decomposers, and phytophages. The population of the three roles of insects in the aren plantations were considered unbalanced. This was because no insects that act as natural enemies were found (Figure 4).

All data obtained were analyzed using NCSS software. The number of insects caught showed significant differences among trap types and insect orders but did not show significant

differences based on the week of observation or individual plants. Graph (a) showed that the first type of trap (yellow sticky trap) captured a significantly higher number of insects than the other traps, with a $p\text{-value} < 0.01$. Similarly, graph (b) demonstrated a significant difference in insect numbers between orders, with the Hymenoptera order dominating, also indicated by a $p\text{-value} < 0.01$. In contrast, graph (c) displayed fluctuations in insect numbers each week, but the differences were not significant ($p\text{-value} = 0.97$). Likewise, in graph (d), the number of insects caught on each individual plant appeared to vary but was not statistically significant ($p\text{-value} = 0.99$) (Figure 5).

Based on the results of insect identification obtained through the use of pitfall traps and yellow sticky traps on sugar palm plants, 21 insect species were found. The insect species consisted of pest insects, pollinators, and decomposers. Pest insect groups identified included grasshoppers and several insects from the hemiptera order such as borer beetles. Meanwhile, pollinator species found included bees, and the decomposer insect group was represented by termites. This diversity reflects the existence of a complex insect community structure in the palm oil plantation environment, with complementary ecological functions (Figure 6).

Figure 2. Insect population by order in Tanjung Miring Village

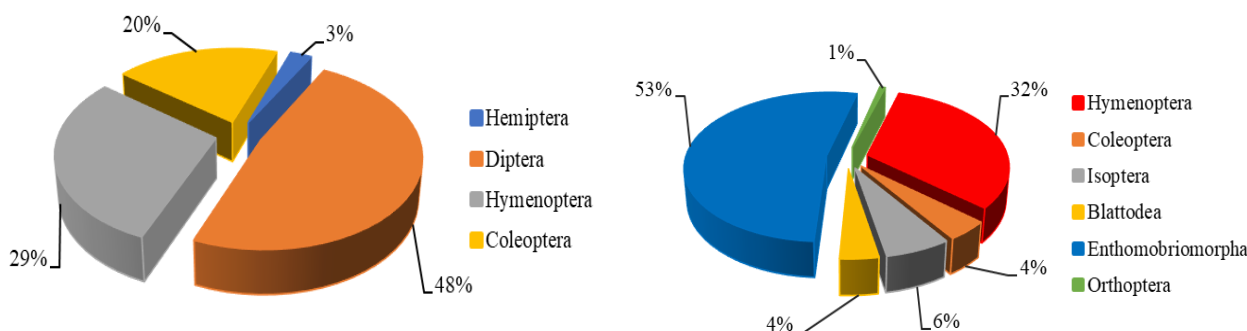


Figure 3. Comparison of insects based on traps in Tanjung Miring Village; a) yellow trap, b) pitfall trap

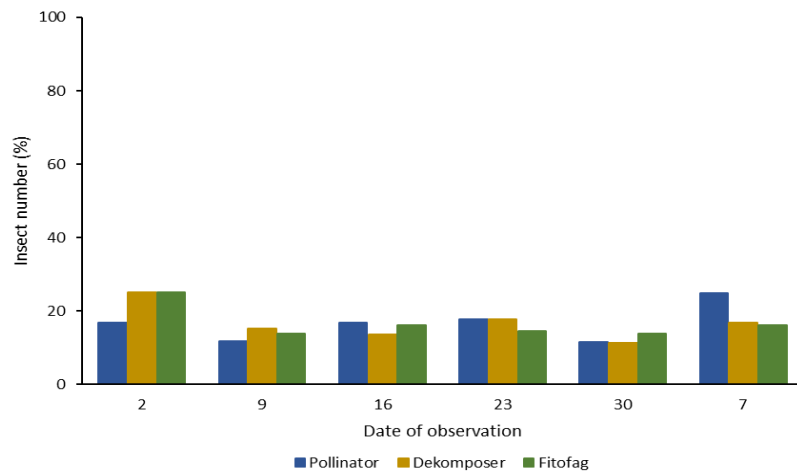


Figure 4. Insect population based on their role in aren plants in Tanjung Miring Village

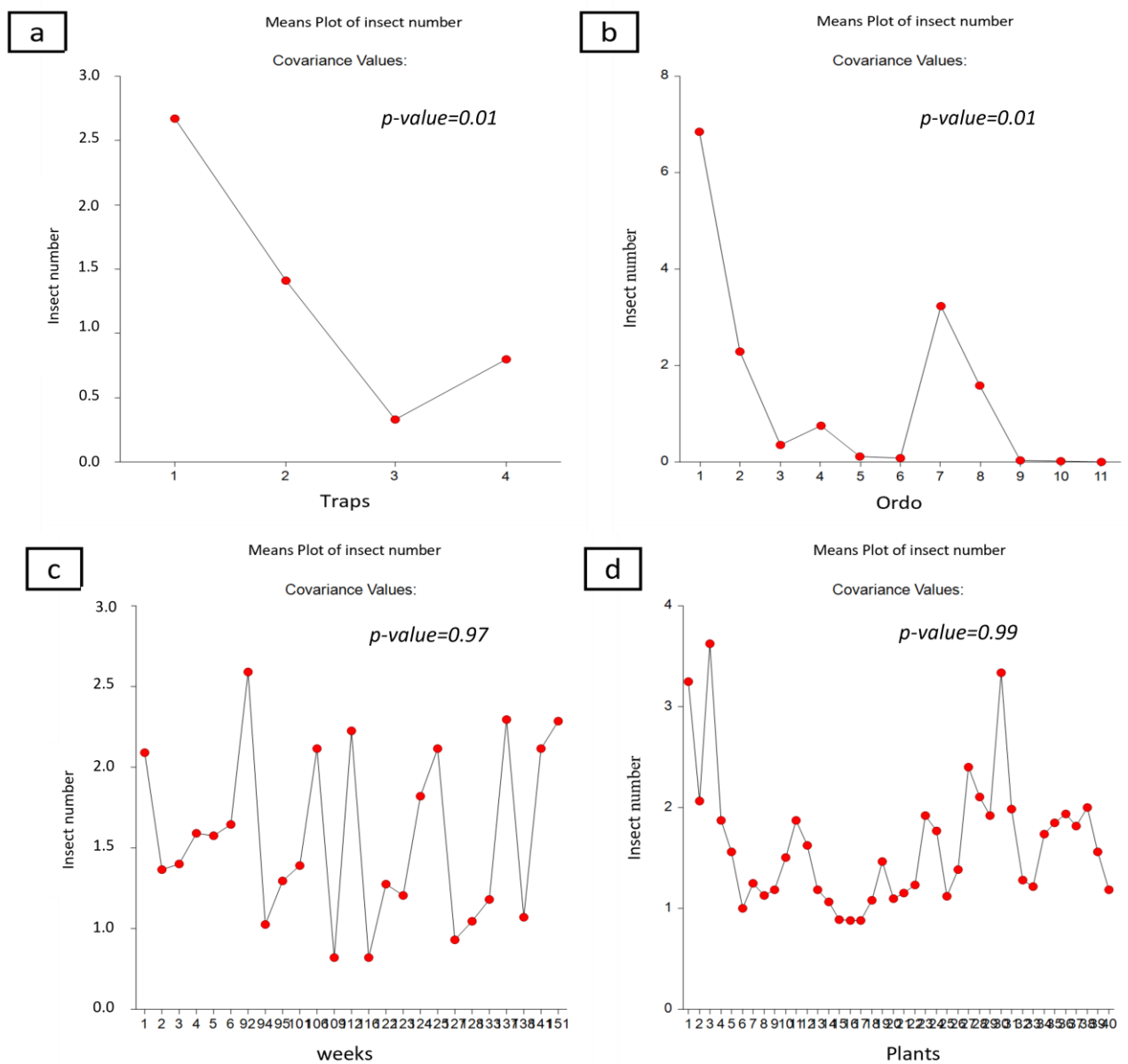


Figure 5. Results of NCSS software analysis on various observations; a) relationship between traps and the number of insects, b) relationship between orders and the number of insects, c) relationship between observation weeks and the number of insects, d) relationship between plants and the number of insects.

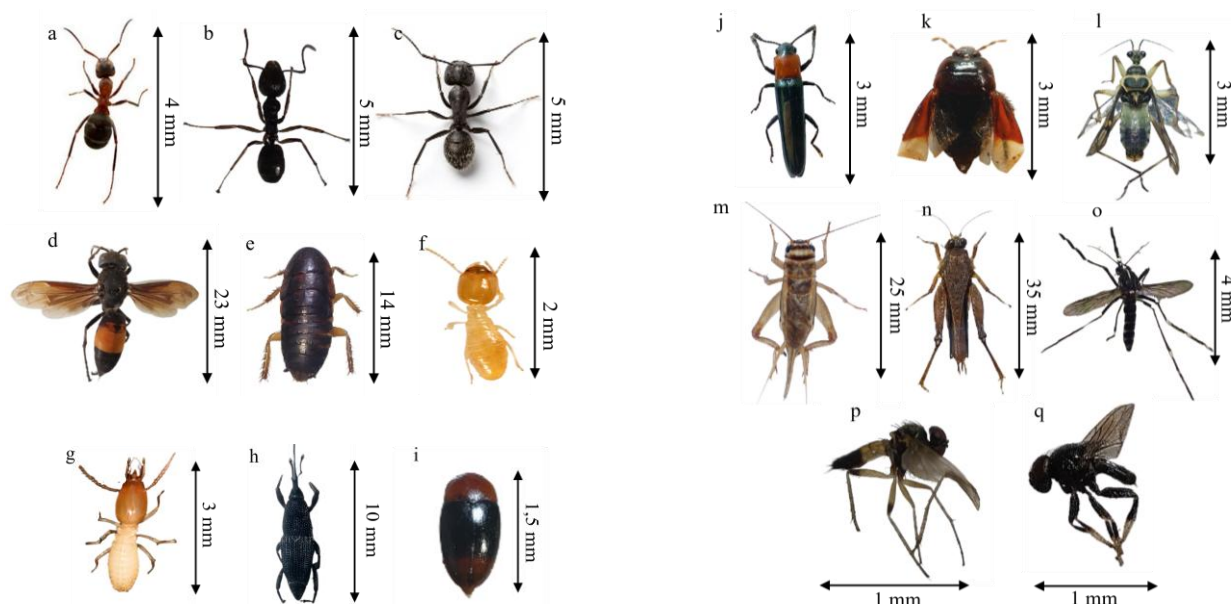


Figure 6. Inset population in sugar palm: *Formica rufa* (a), *Solenopsis gemminate* (b), *Camponotus japonicus* (c), *Vespa affinis* (d), *Loboptera decipiens* (e), *Captotermes curvignatus* (f), *Solenopsis gemminate* (g), *Spenoporus parvulus* (h), *Cryptophagus* sp. (i), *Languria mozardi* (j), *Cydnus aterrimus* (k), *Lygus lineolaris* (l), *Acheta domesticus* (m), *Valanga* sp. (n), *Chrysotus* spp. (o), *Holorusia* sp. (p), *Anopheles* sp. (q).

DISCUSSION

Trap selection is one of the things that must be considered. The results showed that the yellow sticky trap captured more insects than the pitfall trap. This is due to the attractiveness of the yellow color to insects, as it reflects light waves that are more attractive to many types of insects (Lidia & Aleksander, 2022). When insects are attracted and approach the trap, they will stick to the adhesive layer that has been applied to the surface of the trap. Based on the observations, the Diptera order is the group of insects most trapped in yellow sticky traps, with a percentage of 48%, followed by the Hymenoptera order 29% and the Coleoptera order 20%. Meanwhile, pitfall traps were more effective in capturing insects from the Entomobryomorpha order, which dominated with a percentage of 52%, followed by the Hymenoptera order at 32%. The difference in the composition of insects caught in these two types of traps shows that the characteristics of the trap greatly affect its effectiveness in capturing certain types of insects (Ong & Høye, 2024).

The species dominance index value in the young sugar palm plantation ecosystem was low in both types of traps used, namely yellow sticky trap $D = 0.13$ and pitfall trap 0.34. Both values were within the range of $0 < D < 0.5$, indicating

that no insect species dominated significantly. This low level of dominance indicates that the insect population in the ecosystem of young palm trees is more evenly distributed, with no one species having a much higher number of individuals than other species. This relatively even diversity of insect species reflects that the location is diverse, both in terms of food availability, shelter, and breeding sites. Various plant species were also found around the study site, such as rubber (*Hevea brasiliensis*), senggani (*Melastoma malabathricum*), ferns, banana trees (*Musa* sp.), and various types of grass. The existence of this diverse vegetation plays an important role in providing food sources and shelter for various types of insects. In addition, the analysis also showed that the insect species evenness index (E') in yellow sticky trap was 0.85, while in pitfall trap it was 0.65. This value shows that the evenness of insect species in the ecosystem of young palm trees is classified as stable, with the distribution of species that are not too dominated by certain groups. In this ecosystem, the orders Hymenoptera and Diptera have important roles as decomposers and pollinators, which help in the process of decomposition of organic matter and pollination of plants. This confirms that young sugar palm plantations support the sustainability of a

balanced ecosystem with a fairly good level of insect diversity (Sampson et al., 2021). The insect diversity index in the two types of traps used has a significant difference. In the yellow sticky trap, a diversity index value of $H' = 2.172$ was obtained, while in the pitfall trap, the value obtained was $H' = 1.431$. Based on the diversity index criteria, both are in the range of $1 < H' < 3$, which indicates that insect diversity in the sugar palm plantation ecosystem is included in the medium diversity category.

The moderate level of diversity found in this study was influenced by various factors, one of which was the agricultural activities carried out by farmers around the sugar palm fields. Land management practices that have not fully considered aspects of environmental sustainability can cause changes in the composition of insects living in the ecosystem (Ordoñez-Araque et al., 2022). In addition, environmental factors also play a role in determining insect diversity. The location of sugar palm plantations on the banks of the Lematang River makes this land vulnerable to flooding. Waterlogging due to flooding can disrupt insect habitats, causing some species to migrate or even experience population decline. Analysis on NCSS software showed that there was a significant difference between the types of traps used and the number of insects trapped. A p-value of < 0.01 indicated that the type of trap had a significant effect on the number of insect populations caught.

The results indicate that pitfall traps are more effective than yellow sticky traps in capturing insects. This discrepancy is likely influenced by the environmental conditions surrounding the sugar palm (*Arenga pinnata*) plantation. The surrounding vegetation is not dominated by fruit-bearing plants, thereby reducing the effectiveness of visual attractants such as yellow sticky traps. Conversely, pitfall traps are more efficient at sampling ground-dwelling insect fauna, which are abundant in this area due to the accumulation of leaf litter that provides favorable microhabitats. Additionally, insect abundance within the plantation ecosystem is influenced by several ecological factors, including vegetation composition and the extent of chemical inputs. Notably, the limited use of synthetic pesticides in the area contributes to higher insect diversity and

population density by allowing various species to persist and reproduce (Sánchez-Bayo, 2021).

CONCLUSION

The yellow sticky trap was more effective for capturing flying insects (*Diptera*, *Hymenoptera*, *Coleoptera*), while pitfall traps captured more soil insects (*Entomobryomorpha*, *Hymenoptera*). Both traps showed low dominance, indicating an even distribution of insect populations. Vegetation diversity around the plantation provided food, shelter, and breeding sites, supporting insect abundance. A total of 338 individuals were recorded, dominated by pollinators and decomposers from Hymenoptera and Diptera. The Shannon-Wiener index indicated moderate diversity ($H' = 2.17$), influenced by agricultural practices, land management, and environmental conditions near the flood-prone Lematang River.

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