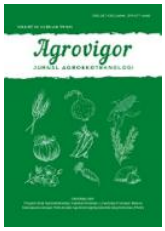
Open Access & Available Online

Agrovigor: Jurnal Agroekoteknologi

ISSN: 1979-5777 (*Print*), 2477-0353 (*Online*)

Journal homepage: https://journal.trunojoyo.ac.id/agrovigor



Article

Impact of Sugar Palm Agroecosystems on Herbivorous Pests and Predatory Insects

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ARTICLE INFO

Article history
Received: March 3rd, 2024
Revised: September 26th, 2025
Accepted: December 7th, 2025
Published: June 3rd, 2025

Keywords
agroecosystem;
management;
predatory insect;
sugar palm;
sustainable agriculture

DOI:
https://doi.org/10.21107/agrovigor.v18i1.25358

ABSTRACT

The main product of the palm plant is sap, which results from tapping the male flowers into palm sugar, soft drinks, vinegar, and alcohol. Apart from that, sugar palm plants can also produce food products such as palm fruit from female fruit, sugar palm flour for food in the form of cakes, bread, and biscuits, which comes from processing the pith of the plant stem and can be used as a source of bioethanol production. However, there is limited research on how sugar palm agroecosystems influence the dynamics of herbivorous pests and predatory insect populations, making it essential to understand these interactions for sustainable plantation management. This research aimed to study the influence of sugar palm agroecosystems on the presence of herbivorous insect pests and predatory. The research was conducted in Nagari Labuah Gunung, Lima Puluh Kota Regency, West Sumatra Province. Observations were conducted on stretches of sugar palm plants aged 7-8 years or already producing. The sample plants were determined using purposive sampling, and labels were given to each tree that was part of the sample plants. Identify herbivorous and predatory insects obtained from the field and calculate the attack level. From the research carried out, it was found that management of sugar palm plants affects the presence of herbivorous and predatory insect pests, where no herbivorous insect pests were found on sugar palm plantations, and no herbivorous insect pest attacks were found on sugar palm plants on people's plantation land. Many types of predatory insects are found in sugar palm plantations, including Hymenoptera, Coleoptera, Orthoptera, Mantodea, Dermaptera, and Diptera. These findings contribute to a deeper understanding of the ecological balance within sugar palm agroecosystems, emphasizing the potential role of natural predators in maintaining pest-free plantations and supporting sustainable agricultural practices.

INTRODUCTION

The sugar palm plant (*Arenga pinnata* Merr.) belongs to the palm family and has many functions, including conservation and economics, because almost all the sugar palm trees can be used. Sugar palm plants (*Arenga pinnata* Merr.) quickly adapt well to agro-climates, from the lowlands to 1400 m above sea level (Maliangkay, 2007). Palm trees belong to the same family as coconut, date palm, oil palm, and sago, which are important crops in tropical areas (Harjadi, 1986). The main product of the palm plant is sap, which results from tapping the male flowers into palm sugar, soft drinks, vinegar, and alcohol. Apart from that, sugar palm plants can also produce food products such as palm fruit from female fruit, sugar palm flour for food in the form of cakes, bread, and biscuits, which comes from processing the pith of the plant stem and can be used as a source of bioethanol production (Alam & Baco, 2004). The use of sugar palm as a source of carbohydrates, sugar, alcohol, and biofuels is becoming increasingly widespread; it is feared that there will be a shortage of plants, considering that the harvest life is quite long, around 7-12 years (Manaroinsong, 2006).

Sugar palm is a type of palm plant that is very widely distributed in Indonesia, with an area of 62,009 ha, consisting of Sumatra with an area of 15,802 ha, Java 19,757 ha, Bali 587 ha, NTB 1,816 ha, Kalimantan 5,401 ha, Sulawesi 16,951 ha and Maluku 1,696 ha (Dirjenbun, 2009). Several areas are starting to cultivate it by carrying out good nurseries. However, sugar palm plants generally grow naturally, including rare and multi-purpose plant species, because almost all parts of the plant can be used, have economic value, and can be used as a source of livelihood for the community. With such potential economic value, it is hoped that it can be developed by applying correct cultivation techniques and improving product processing to provide added economic value to society (Tenda et al., 2010).

West Sumatra, one of the sugar palm production center provinces, has the potential to increase its production. Sugar palm production in West Sumatra in 2020-2021 reached 1,593 tons. Lima Puluh Kota Regency is one of the central areas for sugar palm production in West Sumatra. Sugar palm production in Lima Puluh Kota Regency 2020 reached 404 tons with an area of 389 ha. Sugar palm production in 2018-2021 in Lima Puluh Kota Regency is unstable (Directorate General of Plantations, 2020).

One of the main problems that causes production failure or low production of sugar palm plants is the attack of PPO (Plant Pest Organisms). PPO is a problem caused by plant cultivation that must be controlled. PPOs include several species of pests, pathogens, and weeds, which can arise due to various factors. However, many are present due to errors in land management and excessive use of pesticides and fertilizers (Hamdani & Susanto, 2020).

One significant challenge in sugar palm cultivation arises from attacks by herbivorous insect pests, which must be identified and studied due to their close ecological relationship with predatory insects that naturally control their populations. The presence of these pests and their predators is closely linked to the agroecosystem conditions surrounding sugar palm plants. This highlights the importance of understanding the ecological interactions between herbivorous pests, their natural predators, and the surrounding agroecosystem to develop effective and sustainable pest management strategies

Apart from that, a large-scale increase in the area planted for a commodity will undoubtedly accelerate the increase in production. However, this condition provides abundant food for pests. Hence, the threat of pest and disease attacks is very worrying due to the abundance of pests, food availability, and a suitable climate for them to grow. Proliferation and lack of anticipation of pest attacks. This condition is exacerbated by the status of sugar palm plantations, most of which (>80%) are community plantations, so intensive maintenance of sugar palm plants will be difficult due to limited funds and low knowledge, especially farmers' mastery of pest and disease control technology. The lives of herbivorous insect pests and predatory insects depend significantly on the existence and density of their populations. The existence of herbivorous insects and their population density is closely related to environmental factors, both biotic and abiotic factors. Of course, the environment is one of the factors determining its abundance (Syarif, 1986).

MATERIALS AND METHODS

Field research was carried out in Nagari Labuah Gunuang, Lima Puluh Kota Regency, and continued with identification at the Pest Laboratory of Andalas University Campus III Dharmasraya. The research was carried out from August to November 2023.

They determined the Research Location based on the criteria for the largest area of sugar palm plantations. The research location was carried out in Nagari Labuah Gunuang, which has the largest area of sugar palm plantations as a research location compared to other Nagari in Limapuluh Kota Regency. Three jorongs were designated as research sites in Nagari Labuah Gunuang: Jorong Talaweh, Jorong Dusun Nan Anam, and Jorong Kayu Tanam. This research is in the form of a survey. Sample plants were taken at random (purposive random sampling).

Before the research is carried out, a survey will be conducted to review the research location. Information on the location points reviewed was obtained from interviews with the Mayor of Nagari, several Heads of Jorong, and several Heads of Sugar Palm Farmers Groups in Nagari Labuah Gunuang.

Sugar palm plants are determined to meet the criteria on each land: plants 7-8 years old or already produced on people's palm plantation land. Sampling was taken as much as 50% of the total plant population. At the next stage in the field, observations are made of the types of herbivorous insect pests that attack plants by paying attention to the symptoms of the attack and the level of attack caused to the sample plants.

Furthermore, to find out the type of herbivorous insect pests on sugar palm plants, it is necessary to determine by selecting the sample plants to be observed at the observation location, randomly selected, and then given a label to each tree that is part of the sample plant. The selected sample trees were applied with insecticides containing the active ingredients chlorpyrifos and cypermethrin. After 10 minutes, samples of herbivorous insect pests were collected, and a white cloth was spread on the ground under the sugar palm tree to make it easier to collect the insects. Insects belonging to herbivorous pests were collected in sample bottles filled with 70% alcohol and tightly closed. Next, the results of the insect collection that have been obtained are identified in the laboratory under a microscope.

RESULTS AND DISCUSSION

The research was conducted in Nagari Labuah Gunuang, Lareh Sago Halaban District, Limapuluh Kota Regency, from August to November 2023. Nagari Labuah Gunuang was chosen as the research location based on information about the most significant area where people plant many palm trees. Information was obtained from several nagari guardians, several jorong heads, and several heads of farmer groups in Limapuluh Kota Regency. Nagari Labuah Gununag is at the coordinates of 00 0 19'40''LS-00 0 16'15''LS and 100 0 41'20 BT-100 0 41'50''E, with an average temperature of 240C and high from sea level, namely 480 masl. The boundaries of Nagari Labuah Gununag are to the north bordering Nagari Batu Payung, to the west bordering Nagari Sungai Kamuyiang, to the east bordering Nagari Sitanang, and to the south bordering Nagari Tanjung Gadang. Nagari Labuah Gunuang is divided into seven jorongs, including Jorong Simpang Empat, Jorong Simpang Empat Balai Jariang, Jorong Kayu Tanam, Jorong Dusun Nan Anam, Jorong Banjar Sari, Jorong Talaweh, and Jorong Lareh Nan Panjang. Among the several jorongs in Nagari Labuah Gunuang, the research sample points were taken from Jorong Talaweh, Jorong Dusun Nan Anam, and Jorong Kayu Tanam. The determination of jorongs for research sampling was based on a survey that had been carried out by exploring jorongs in Nagari Labuah Gunuang with extensive sugar palm plantation conditions.

Research that was carried out in Jorong Talaweh, Jorong Dusun Nan Anam, and Jorong Kayu Tanam, after going through the research methods that had been determined, did not find any herbivorous insects at all in the sugar palm plants that were already producing. The sugar palm plants' age was 7-8 years old. This is possible due to the management of the sugar palm agroecosystem, which is carried out at the three research sites without any maintenance, meaning that the sugar palm cultivation techniques carried out after being moved to the field are left in the same condition as in nature. The reason is that palm trees are forest plants that do not require land clearing and special cultivation techniques or pest and disease management. This reason is in line with what was put forward by Benhard (2007).

This reason can be strengthened by the predatory insects researchers found in the field when taking research samples. The presence of predatory insects can control sugar palm plants' pests, especially those of herbivorous insects. Some of the predatory insects found in the field are as follows:

Table 1. Predatory insects on mature sugar palm plantations in Nagari Labuah Gunung Lima Puluh Kota Regency

Ordo	Family	Sub Family	Genus	Species
Hymenoptera	Formicidae	Ponerinae	Pseudoponera	*Pseudoponera stigma*
	Formicidae	Ponerinae	Dolichoderus	*Dolichoderus thoracicus*
	Formicidae	Formicinae	Camponotus	*Camponoyus ligniperda*
Coleoptera	Coccinellidae	Coccinellinae	Propylaea	*Propylea* sp.
Orthoptera	Tettigonidae	Conocephalinae	Heminicsara	*Heminicsara* sp.
	Gryllidae	Gryllinae	Gryllus	*Gryllus* sp.
Mantodea	Mantidae	Mantinae	Archimantis	*Archimantis* sp.
Dermaptera	Chelisochidae	Chelisochinae	Chelisoches	*Chelisoches* sp.
Diptera	Dolichopodidae	Dolichopodinae	Chrysotus	*Chrysotus neglectus*

Predatory insects found based on the table above, according to Triplehorn et al. (2005), can prey on pests in the wild. Therefore, it is natural that in this research, there were no pests that attack sugar palm plants, let alone those that can reduce sugar palm yields. Based on observations at each sampling point, no damage was found to the leaves, stems, and fruit by pests.

In contrast to sugar palm plants in nurseries, they are usually more susceptible to pest attacks. The pests that attack sugar palm plants in nurseries include horn beetles, sago beetles, and grasshoppers. Horn beetles cause damage in the larval stage by cutting and tearing plant parts because their mouthparts are a chewing-biting type. Horn beetles can eat the growing point of the host plant, which causes a decrease in the number of palm fruits and can even cause death (Siregar, 2016). The main sugar palm pests, such as the horned beetle (*Oryctes rhinoceros*), attack the treetops until they enter the upper trunk and penetrate the base of the young leaf midribs. The young tissue is crushed, the liquid is sucked out, the leaves used to crush it look like they have been cut into pieces (Effendi, 2010).

Furthermore, the sugar palm damage caused by sago beetles can reach 100%, causing plant death (Edrus, 2007). Sago beetles damage plants by making cracks in the stems to look for young tissues that contain lots of water. Damage to young plants occurs in the roots, stems, and shoots, whereas in mature plants, only the shoots are attacked. The cracking of the stem causes damage to the plant. The burrows, fiber, and dirt remain, and red-brown mucus often occurs on young plants (Directorate General of Plantations, 2009). The following pest that attacks nurseries is grasshoppers. Locust pests (Sexava sp.) can damage the leaves of sugar palm plants that have reached the perfect growth stage (old) and attack young leaves, fruit skin, and flowers. In the dry season, there is a high level of grasshopper attacks in both nymph and imago forms (Hasibuan, 2020). If grasshoppers eat all the leaf midribs evenly, there will be increased damage to the leaf crown from the top to the bottom.

Severe damage to leaf sheaths is more focused on young leaf sheaths because insects do not get enough food on old leaf sheaths; grasshoppers can also damage fruit (Darwis, 2006). If sugar palm plants that are not yet producing are attacked by this pest on an ongoing basis, their growth will be hampered, production will be slow or not produced, and the plants will die (Hasibuan, 2019). Grasshoppers are herbivorous insects from the suborder (Caelifera) within the order (Orthoptera). This insect has antennae that are almost always shorter than its body and a short ovipositor. The sounds made by some species of grasshoppers are usually produced by rubbing the hind femurs against the forewings or abdomen and flapping the wings while flying. The hind femur is generally long and robust, which makes it suitable for jumping. These 14 insects generally have wings, although sometimes their wings cannot be used to fly. Female grasshoppers are generally more giant than male grasshoppers (Rosyada, 2021).

CONCLUSION

This study demonstrated that the management of sugar palm agroecosystems significantly influences the presence of herbivorous and predatory insect species. Notably, no herbivorous insect pests or their attacks were detected on sugar palm plants in the observed community plantations, suggesting effective natural pest resistance within the agroecosystem. In contrast, a diverse range of predatory insects, including species from the orders Hymenoptera, Coleoptera, Orthoptera,

Mantodea, Dermaptera, and Diptera, were prevalent in the plantations. These findings emphasize the ecological balance present in sugar palm agroecosystems, where natural predatory populations may play a key role in suppressing pest populations. This highlights the importance of sustainable agroecosystem management to maintain and enhance the ecological services provided by natural predators, ultimately contributing to the long-term productivity and resilience of sugar palm cultivation.

ACKNOWLEDGMENT

The author would like to thank PNP Faperta-Universitas Andalas for funding this research activity with the basic research in 2023 and a contract number: 6 /PL/SPK/PNP/FAPERTA-Unand/2023

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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