

Inventory and Pest Attack Rate on Sugar palm Plantation (*Arenga pinnata* Merr.) in Limapuluh Kota Regency, Indonesia

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Abstract: Sugar palm (*Arenga pinnata* Merr.) has long been used as a raw material for industry and food. However, the productivity of sugar palm plants is often limited by pest infestation. This study aims to obtain data on the type and level of pest attacks that graze sugar palm plants on people's plantation land in Limapuluh Kota Regency. The survey method was applied in three sub-districts using purposive random sampling to select sugar palm plants that are more than five years old. Observations show that there are four main types of pests of sugar palm plants, namely horn beetles (*Oryctes rhinoceros* L.), sago beetles (*Rhynchophorus* sp.), bats (Chiroptera), and ferrets. The highest percentage of attacks on horn beetle pests with an average of 68.88%, while the lowest is the sago beetle with an average of 6.66%. This study suggests proper pest control in sugar palm plants to maintain the productivity of sugar palm plants.

Keywords: *Arenga pinnata*; Attack rate; Sugar palm plantations; Limapuluh Kota.

1. INTRODUCTION

Sugar palm tree (*Arenga pinnata* Merr.) is a plant that is an ingredient for industries such as sugar making, household industry and as a food source including kolang-kaling, brown sugar, starch flour, vinegar, sap, and bioethanol. Sugar palm is one of the versatile plants, because almost all parts of the sugar palm tree (stems, leaves, fruits, and sugar palm oil) can be used for various kinds of human needs (Lempang, 2013). There is an increase in the need for sugar palm for food and industry, so efforts are needed to increase sugar palm production in Indonesia.

Sugar palm plants are spread across various regions of Indonesia. The sugar palm production center areas include North Maluku, Papua, North Sumatra, West Java, Central Java, Banten, North Sulawesi, South Sulawesi, Southeast Sulawesi, Bengkulu, South Kalimantan, Nangroe Aceh Darussalam and West Sumatra with a total area in 2013 reaching 99,251,859 ha, this plant is managed by smallholder plantations (BPS, 2013).

West Sumatra as one of the provinces with sugar palm production centers has the potential to increase its production. Sugar palm production in West Sumatra in 2020-2021 reached 1,593 tons. Limapuluh Kota Regency is one of the central areas of sugar palm plant production in West

Sumatra. The production of sugar palm plants in Limapuluh Kota Regency in 2020 reached 404 tons with an area of 389 ha. Sugar palm production in 2018-2021 in Lima Puluh Kota Regency was unstable. In an effort to increase sugar palm production in Limapuluh Kota Regency, many obstacles are faced (Ditjenbun, 2021). One of them is the attack from Plant Disrupting Organisms.

OPT attacks on sugar palm plants have a direct impact on damage. This is because the parts of plants that are attacked by pests such as leaves, stems, and fruits will cause a decrease in sugar palm production and quality. The decrease and increase in production every year is suspected to be caused by sugar palm plant pests (Ditjenbun, 2021).

Pest attacks on sugar palm trees can reduce production by up to 70%, another loss caused by pest attacks is the increase in production costs that must be incurred to restore plant conditions (Hakiki, 2018). Pests can cause plants to be unhealthy, their growth is not good, such as pale or yellowish leaves, stems are not straight, and are attacked by pests (Personal, 2022).

As for what can interfere with the health of sugar palm plants are pests. Until now, there are still many unknown pests on sugar palm plants because sugar palm plants are still little cultivated and cared for. One of the important pests that attack sugar palm plants is *Oryctes rhinoceros* and *Rhynchoporus* sp. which attack tree tops until they enter the upper trunk of the base of young leaf fronds, besides that grasshoppers (*Sexava* sp.), Weasels and Bats (Siregar, 2016) are also found. The existence of information about the type and level of pest attacks in an area is expected to increase farmers' vigilance by preventing pest attacks in sugar palm cultivated land.

Until now, there is still little information about pest attacks on sugar palm plants in Limapuluh Kota Regency. The purpose of this study is to obtain data on the type and level of pest attacks that attack sugar palm plants on plantations owned by the people in Limapuluh Kota Regency. This research is expected to be additional information that is useful for farmers, extension workers, and agricultural agencies in an effort to increase the production of sugar palm plants.

2. METHOD

This research has been carried out on sugar palm oil lands owned by the people in 3 sub-districts, namely Gunuang Omeh, Bukik Barisan, and Mungka, Lima Puluh Kota Regency. The research was carried out from June to August 2023.

The materials used in this study are sugar palm plants in people's plantations which were used as samples in Limapuluh Kota Regency. The tools used in this study were raffia rope, knives, label paper, scissors, wood, and stationery. For research documentation, cameras are used as a documentation tool.

2.1 Research Procedure

1. Determination of Research Location

This research was carried out by survey. The determination of the research location is based on the largest area of sugar palm plantation. The selected research locations are three sub-districts, namely Gunuang Omeh, Bukik Barisan, and Mungka Districts, Limapuluh Kota Regency (Appendix 3). Sample plants were randomly selected (*purposive random sampling*). In each sub-district, each of the nagari is determined to have one nagari whose land has (± 30 sugar palm plants) that are more than 5 years old. The countries that are sampled are Nagari Koto Tinggi (Gunuang Omeh District), Nagari Baruah Gunuon (Bukik Barisan District), and Nagari Talang Maua (Mungka District).

2. Preliminary Survey

This research was conducted by surveying the research site and conducting interviews with farmers who manage sugar palm land. The interview aims to find out information about the condition of the sugar palm land, the results of the interviews are collected using a questionnaire at each sample location.

2.2 Research Implementation

1. Determination of Sample Crops

On each land, sugar palm plants that meet the criteria are determined, namely 5-year-old plants. Sampling is 50% of the total plant population. The determination of the sample plants to be observed at the observation location was carried out randomly selected and then labeled on each tree that is part of the sample plant.

2. Inventory and Measurement of Pest Attack Rates

After obtaining the location and observation point of the sample crops, observations of the types of pests that attack the plants are carried out by paying attention to the symptoms of attack and the level of attack on each sample plant. For the inventory and symptoms of pest attacks, references are used (Karmanah *et al.*, 2022) and for guidelines for good sugar palm cultivation, references are used (Ditjenbun, 2014).

3. Data Analysis

a. Percentage of plants affected

The percentage of plants attacked is the number of plants attacked out of the total number of plants observed. The percentage of infested plants can be calculated by the following formula:

$$P = \frac{n}{N} \times 100\%$$

Information:

P = Percentage of plants infested

n = Number of plants affected

N = Number of plants observed

b. Percentage of plant parts attacked

The percentage of plant parts affected is the number of twigs or fruits affected compared to the number of twigs or fruits observed. The percentage of parts of the plant can be calculated with the following formula:

$$Pb = \frac{A}{B} \times 100\%$$

Information:

Pb = Percentage of twigs or fruits affected

A = Number of twigs or fruits infested

B = Number of twigs or fruits observed

c. Attack intensity

Attack intensity is the attack rate or rate of fruit damage caused by pests with attacks and calculated by the scoring system. Category of score damage level (Table 1). In the calculation of the score, the formula is used, namely:

$$I = \frac{\sum(nixvi)}{N \times Z} \times 100\%$$

Information:

I = Intensity of attack

ni = Number of samples in the damage category

vi = Score on sample

N = Total number of samples

Z = Highest score of the attack category

Table 1. Category of fruit damage rate (Manurung, 2010)

Scale	% Fruit Attacked	Category
1	Fruit affected 25%	Light
2	Fruit affected 25-50%	Keep
3	Fruit affected 50-90%	Heavy
4	Fruit affected 90%	Very Heavy

3. RESULTS AND DISCUSSION

A. Agroecosystem Conditions

The research has been carried out in 3 sub-districts in Lima Puluh Kota Regency. The sub-district and each nagari that are used as a research site include; Gunung Omeh District (Nagari Koto Tinggi), Mungka District (Nagari Talang Maua), and Bukik Barisan District (Nagari Baruah Gunuon).

Sugar palm plants in Limapuluh Kota Regency grow on people's plantation land, the growth of sugar palm plants is mostly spreading. Sugar palm plants can grow side by side with other plants such as banana, coconut, orange, and cocoa trees. Therefore, the planting or cultivation of sugar palm plants in Limapuluh Kota Regency has good hopes or prospects in the future.

Sugar palm plants do not receive enough attention to be cultivated seriously by various parties. The sugar palm tree population spread across Limapuluh Kota Regency has not received attention from the community or the local government. The community or government needs to take policy steps to carry out sugar palm plant development efforts.

The condition of sugar palm plantations in Limapuluh Kota Regency has not been well maintained. Every observation land still sees a lot of weeds growing around sugar palm plantations. In addition to weeds, there are also sugar palm seeds that fall will grow into seedlings that are also not noticed, so that they will grow large and compete with the mother plant. Pests that attack sugar palm plants in Limapuluh Kota Regency are horn beetles, sago beetles, bats, and ferrets. Observations and direct interviews with sugar palm farmers in Limapuluh Kota Regency, namely in Gunuang Omeh, Mungka and Bukik Barisan Districts, show that sugar palm plant

cultivation has not been carried out properly such as knowing the age of the plant, planting system, fertilization, pruning, sanitation, fruit harvest, and sap harvest (Table 2).

Table 2. The condition of sugar palm plantation land in Limapuluh Kota Regency.

Observation Variables	Gunung Omeh District	Mungka District	Bukik Barisan District
	Nagari Koto Tinggi	Nagari Talang Maua	Nagari Baruah Gunuong
Plant Age	± 5 years	± 5 years	± 5 years
Planting System	Polyculture (bananas, coconuts, oranges, and cocoa)	Polyculture (coconut)	Polyculture (coconut)
Fertilization	No fertilization	No fertilization	No fertilization
Fruit Harvest	Once (at age 5)	Once (at age 5)	Once (at age 5)
Harvest Nira	2 times a day	2 times a day	2 times a day
Trimming	Not done	Not done	Not done
Sanitation	Not done	Not done	Not done
Pest	Not done	Live capture	Live capture

Sugar palm plantations in 3 sub-districts in Limapuluh Kota Regency are on average ±5 years old. Many sugar palm plants grow naturally with irregular planting distances and there are some that farmers try to grow naturally with other crops (polyculture). After the sugar palm plant dies, population recovery occurs naturally with little human intervention, including thinning if the plants grow close together.

Fertilization of sugar palm plants in Limapuluh Kota Regency is not carried out due to the lack of public understanding of the importance of fertilizer in sugar palm trees. Sugar palm fertilization is generally carried out twice a year at the beginning and end of the rainy season. Young and productive sugar palm plants can be fertilized with organic fertilizers. Fertilization is done for plants to grow faster. Fertilization is carried out on plants aged 1-3 years by providing such as Urea fertilizer, NPK, manure and KCl which are sown around the trunk of sugar palm trees that have been loosened (Lasut, 2012). For pruning sugar palm plants, it is done by pruning the surrounding plants that may shade sugar palm plants, but in surveys that have been carried out by the community or farmers, they do not prune sugar palm plants.

Sanitation on sugar palm plants is carried out after the plant is more than 5 years old which is recommended to harvest sugar palm trees that are already black and attached to the stems, so that the growth of the stems is not hampered which results in decreased sap production. In the surveys that have been carried out, sanitation on sugar palm plants owned by the people was not carried out in each sub-district due to the lack of public understanding of the sanitation process so that the production of sugar palm plants in each sub-district was unstable.

In sugar palm harvesting, correct harvesting techniques are needed so that sugar palm trees can produce fruit and sap. Sugar palm plants can only bear fruit once in their growing period. For harvesting the fruit on the sugar palm plant is carried out when the fruit enters the ripe period with characteristic yellowish fruits with a reddish mixture. For sap harvesting on sugar palm plants, it is carried out 2 times a day, namely in the morning and evening.

In Nagari Koto Tinggi pest capture is not carried out due to lack of understanding of pest control of sugar palm plants, while in Nagari Talang Maua and Nagari Baruah Gunuong there is direct pest capture by hand.

B. Percentage of plants infested by pests

Plants attacked by pests have a diverse percentage of observation results in each land. The difference in data is influenced by farmers' lack of understanding of pest control on sugar palm plants (Table 3).

Table 3. The percentage of sugar palm plants attacked by pests in Limapuluh Kota Regency.

Pests	Percentage			Average (%)
	Koto Tinggi (%)	Baruah Gunuon (%)	Talang Maua (%)	
Horn beetle	93,33	53,33	60,00	68,88
Sago beetle	13,33	0	6,67	6,66
Bat	46,67	20,00	33,33	33,33
Musang	6,67	33,33	20,00	20,00

The horn beetle pest attack was higher than other pest attacks in 3 Nagari in Limapuluh Kota Regency. The highest horn beetle attack was found in Nagari Koto Tinggi (93.33%) and the lowest in Nagari Baruah Gunuon (53.33%). The lowest pest attack was found in the sago beetle pest with an average of 6.66%. The highest percentage of sago beetle attacks was found in Nagari Koto Tinggi (13.33%) and the lowest in Nagari Baruah Gunuon (0%).

The main pests of sugar palm plants such as the horn beetle (*Oryctes rhinoceros* L.) attack plants by burying unopened fronds starting from the base of the fronds, especially in young plants. The horn beetle will eat the growth point of the host plant causing a decrease in the number of fruits produced, a heavy attack can lead to the death of the plant.

Horn beetle pests were observed directly in the field by observing the symptoms of attack on the sample plants. The symptoms of horn beetle pest attacks are the appearance of cutouts or pieces on newly opened leaves such as the letter "V" (Figure 1).

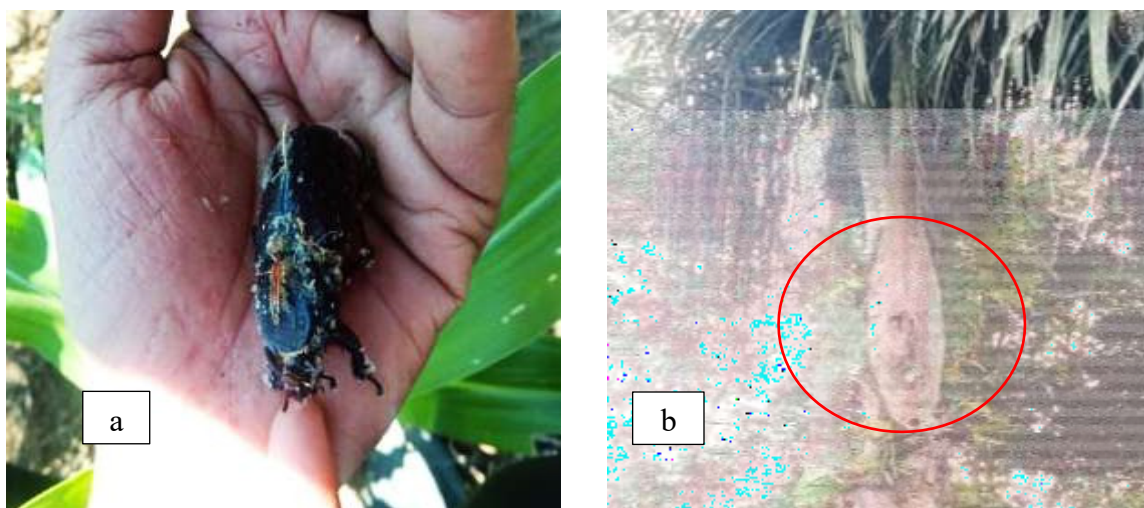


Figure 1. Sugar palm plant pests. a) Horn beetle, b) Symptoms of horn beetle attack

The highest sago beetle pest attack was found in Nagari Koto Tinggi (13.33%) where the sago beetle attacked the horn beetle and the lowest percentage of attacks in Nagari Baruah Gunuon (0%) due to mechanical pest control.

The sago beetle (*Rhynchophorus* sp.) is a pest on sugar palm plants, this pest attacks the stem or growth point of the plant that has been attacked by the horn beetle (*Oryctes rhinoceros* L.) and enters through mechanical wounds such as frond cutting marks. The rate of damage caused by the sago beetle can reach 100% which can lead to plant death.

The sago beetle damages plants by making a stirring on the stems to look for young tissues that contain a lot of water. Friction on the stem results in damage to the plant. The sago beetle pest is observed directly by observing the symptoms of the attack in the field. Symptoms of attack are in the form of graft burrows coming out the remains of fibers and dirt, in young plants often comes out red-brown mucus (Figure 2).



Figure 2. Sugar palm plant pests. a) Sago beetle b) Symptoms of beetle infestation

The highest bat pest attack in Nagari Koto Tinggi (46.67%) is due to the garden-shaped land that causes bats to land from one plant to another and lack of pest control, the lowest bat attack in Nagari Baruah Gunuon (20.00%) because the growing sugar palm plants spread.

Bats (*Chiroptera*) attack sugar palm plants by sucking sap on sugar palm plants. The sap in the roof absorbed by bats is never exhausted, but only a little. Bats forage for food at night, bats can be used as indicators in the assessment of an ecosystem. Bat pests also act as natural enemies for insects and pollinators, due to their function in regulating and controlling ecosystems. So losing one of those roles of bats will cause the balance of the ecosystem to be disturbed.

Bat pests on sample plants are observed directly by looking at the presence of bats and symptoms of their attack. Symptoms of bat attacks include bats sucking sap in sugar palm sap barns, but the sap water sucked by bats is never exhausted but only partially (Figure 3).

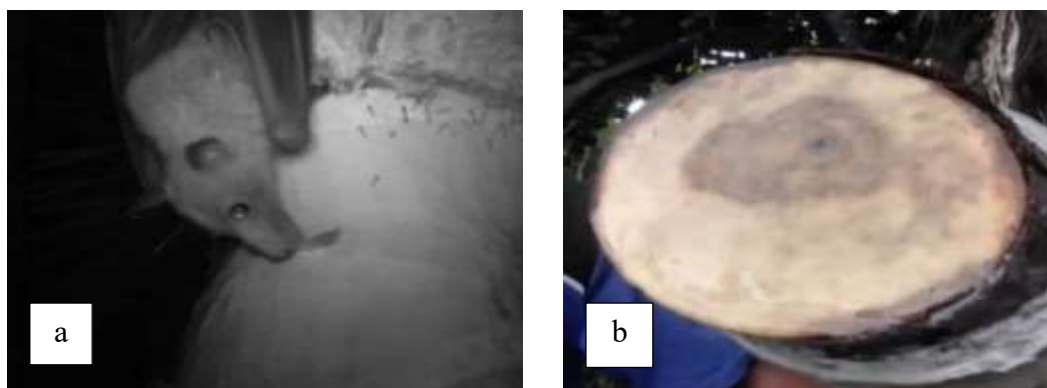


Figure 3. Sugar palm plant pests. a) Bats, b) Symptoms of bat attacks.

The highest civet pest attack in Nagari Baruah Gunuon (33.33%) is because sugar palm plants that grow a lot of fruit are different from 2 other nagari whose fruit production period has expired, for the lowest civet pest attack in Nagari Koto Tinggi (6.67%) in that nagari sugar palm plants have been

harvested a lot and sugar palm plants there are more focused on harvesting sap.

Weasels are mammals that are active in foraging at night, the tendency to be active at night is used as a time to forage. Weasel is a pest on sugar palm plants. Ferret pests have a staple food for their survival by eating fruits on sugar palm plants so that they can cause a decrease in fruit yields. The fruit eaten by the civet will spread into sugar palm plants.

Weasel pests on sample plants are observed directly by looking at the presence of ferrets and symptoms of their attacks. Symptoms of ferret attacks include eating fruit on mature sugar palm plants and causing damage to the fruit (Figure 4).



Figure 4. Sugar palm plant pests. a) Weasley, b) Symptoms of weasel attacks.

C. Percentage of plant parts infested with pests

The horn beetle is the pest that attacks the leaves the most on sugar palm plants with an attack percentage of 62.22%. The highest percentage of damaged leaves in sugar palm plants caused by horn beetle attacks was found in Nagari Koto Tinggi (93.33%) and the lowest in Nagari Talang Maua (40.00%). Damage to leaves caused by horn beetle pests is characterized by the presence of holes in the leaves both at the edges and in the middle of the leaf which results in perforated leaves and discoloration. The percentage of slimy stems in sugar palm plants caused by sago beetle attacks was found in Nagari Koto Tinggi (13.33%) and lowest in Nagari Baruah Gunuon (0%). The attack of sago beetle pests has a low percentage (6.66%). The presence of ferret pests that attack fruit on sugar palm plants, the highest percentage of damaged fruit in sugar palm plants caused by ferret attacks is found in Nagari Baruah Gunuon (33.33%) and the lowest in Nagari Koto Tinggi (6.66%). Weasels eat ripe sugar palm fruits and cause sugar palm fruit production to decrease.

The highest percentage of sap bunches that are sucked on sugar palm plants caused by bats is found in Nagari Koto Tinggi (46.66%) and the lowest in Nagari Baruah Gunuon (20.00%). Bats suck some of the sugar palm sap that is being harvested, as a result of which sugar palm sap production decreases. Sugar palm fruit bunches are partially dead due to attacks from horn beetle pests, horn beetle pests attack sugar palm fronds and cause the growth of sap bunches in sugar palm trees to be inhibited and can cause the death of bunches. The highest sap bunch death attack was in Baruah Gunuon (33.33%) and the lowest in Talang Maua District (0%). Damaged sugar palm plant fronds even cause the death of fronds caused by horn beetle attacks. The highest damaged leaf fronds were in Koto Tinggi District (66.66%) and the lowest in Talang Maua District (0%). The dead fronds of sugar palm plants were caused by the highest horn beetle attack in Talang Maua District (60.00%) and the lowest in Koto Tinggi District (0%).

Pests greatly affect the growth of existing sugar palm trees because they can damage important parts of the sugar palm plant. The percentage of the affected plant part is calculated based on the symptoms of pest attack found on the part of the sugar palm plant. In pest control, farmers must

know the percentage of the affected part of the plant. The part of the sugar palm plant is most attacked by pests, namely the leaves. Parts of plants that are damaged, especially the leaves, can experience growth delays that can result in death. The lack of information known to farmers about pest attacks on sugar palm trees must be considered, especially on the leaves of sugar palm plants.

Table 4. The percentage of plant parts attacked by pests in Limapuluh Kota Regency.

Brothers	Plant parts	Symptoms of an attack	Percentage			Average (%)
			Koto Tinggi (%)	Baruah Gunuong (%)	A Collection of Poems (%)	
Sago beetle	Trunk	Berlendir	13,33	0	6,66	6,66
Musang	Fruit	Rusak	6,66	33,33	20,00	19,99
Horn beetle	Daun	Rusak	93,33	53,33	40,00	62,22
Bat	Tandan nira	Dihisap	46,66	20,00	33,33	33,33
Horn beetle		Die	6,66	33,33	0	13,33
Horn beetle	Fronds	Die	0	6,66	60,00	22,22
Horn beetle		Rusak	66,66	33,33	0	33,33

B. Pest attack intensity

The intensity of the attack is calculated to see the extent of damage to a symptom found on the observation ground. The percentage of attacks on sugar palm plants has a rate of damage with different categories caused by pests (Table 5).

Table 5. The intensity of pest attacks in Limapuluh Kota Regency.

Brothers	Percentage			Installment-installment (%)	Category
	High Koto (%)	Baruah Gunuong (%)	A Collection of Poems (%)		
Horn Beetle	93,33	40,00	45,00	59,44	Heavy
Sago beetle	3,33	0	1,66	1,66	Light
Bat	23,33	5,00	16,66	14,99	Light
Civet cat	1,66	16,66	5,00	7,77	Light

The intensity of the horn beetle pest attack is the highest attack intensity with a figure of 59.44% and is included in the severe category. Nagari Koto Tinggi is a Nagari with a fairly high number of horn beetle attacks compared to the other two Nagari. Bat pest attacks rank 2nd with an attack intensity of 14.99% and are included in the mild category. The highest bat attack intensity is found in Nagari Koto Tinggi and the lowest in Nagari Baruah Gunuong. The weasel pest attack ranks 3rd with an

attack intensity of 7.77% and belongs to the mild category. The intensity of the highest ferret attack was found in Nagari Baruah Gunuon and the lowest in Nagari Koto Tinggi. The lowest intensity is the sago beetle attack with a value of 1.66% and belongs to the mild category. The highest sago beetle attack intensity is found in Nagari Koto Tinggi and the lowest in Nagari Baruah Gunuon.

From the explanation in the attacks found on sugar palm plants, the most common is the horn beetle attack. Horn beetle pests are the main pests in sugar palm plants. The horn beetle attack is the most common attack found in Limapuluh Kota Regency. This can be due to poor control, and low natural enemies. In some land areas in Limapuluh Kota Regency, farmers do not control well, and plants are left to grow. This condition makes the environmental conditions suitable for the development of horn beetles.

The results showed that there was a difference in the percentage of plants attacked, the percentage of plant parts attacked, and the intensity of attacks in 3 sub-districts in Limapuluh Kota Regency. In Nagari Baruah Gunuon (Bukik Barisan District) and Nagari Talang Maua (Mungka District) there are no sugar palm plantations because sugar palm plants grow spread in the community plantation area, while in Nagari Koto Tinggi (Gunuang Omeh District) sugar palm plants grow in large numbers in the form of plantations, but sugar palm plants grow irregularly. From each sub-district, the data obtained during the research on sugar palm plants is different. The difference in data is influenced by the farmer's environment who lack understanding of pest control on sugar palm plants.

In Nagari Koto Tinggi, the pest attack is higher than Nagari Baruah Gunuon and also Talang Maua because the condition of sugar palm plants has not been maintained, although in Nagari Koto Tinggi sugar palm plants are in the form of plantations, farmers have little difficulty in caring for sugar palm plants because there are quite a lot of them. In Nagari Baruah Gunuon and also Talang Maua, sugar palm plants there are in the form of an expanse and not in the form of plantations, for example in community housing or plantations there oil sugar palm plants grow and spread in small numbers and make it easier for farmers to care for sugar palm plants in the Nagari.

Conclusion

Pests that attack sugar palm plants in Limapuluh Kota Regency are horn beetles (*Oryctes rhinoceros* L.), sago beetles (*Rhynchophorus* sp.), bats (*Chiroptera*) and ferrets (*Paradoxurus hermaphroditus*). The percentage of plants attacked in Limapuluh Kota Regency was the highest for horn beetle pest attacks with an average of 68.88% and the lowest for sago beetle attacks with an average of 6.66%. The highest percentage of plant parts in Limapuluh Kota Regency was damaged by horn beetles with an average of 62.22% and the lowest in slimy stems due to sago beetles with an average of 6.66%. The intensity of attacks in Limapuluh Kota Regency was the highest for horn beetle pests with an average of 59.44% and the lowest for sago beetle pests with an average of 1.66%.

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