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ATTACKING OF Ficus spp STRANGLER ON OIL PALM PLANTATION; SRIWIJAYA UNIVERSITY CAMPUS AREA CASE

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Abstract:

Palm oil (*Elaeis guineensis* Jacq.) is an important commodity in Indonesia, but the presence of hemiepiphytes of the genus *Ficus* can inhibit its growth and productivity through a strangulation mechanism. This study aims to identify *Ficus* species that attack oil palm, evaluate the attack rate, and analyze the influence of stem diameter on plant health. The research was conducted in the roadside area of Sriwijaya University, Indralaya, using a descriptive survey method. The results showed that three species of *Ficus* attacked oil palm: *Ficus benjamina* (415 individuals), *Ficus retusa* (2 individuals), and *Ficus sundaica* (1 individual). The attack rate reached 24%, belonging to the category of light attack, with 2% of the plants experiencing death. Most *Ficus* have a small diameter (64.11%) in the range of 1 - <10 cm, with an estimated lifespan of ±5 years, while some individuals >35 cm are estimated to be ±35 years old. The *Ficus* attack has the potential to reduce palm oil productivity by up to 6% of total production. The results of the study show that *Ficus* hemiepiphyte has a significant impact on oil palm crops and its population can continue to increase if not controlled.

Keywords:

Oil palm, *Ficus*, Hemiepiphyte, Plant health, Productivity.

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1. INTRODUCTION

Oil palm (Elaeis guineensis Jacq.) is one of the main plantation commodities in Indonesia that plays a significant role in the national economy. This plant was first introduced to Indonesia in 1848 and currently Indonesia is the largest palm oil producer in the world (Ismiasih and Afroda, 2023).

Oil palm productivity is influenced by various factors, including seed quality, cultivation techniques, and external threats such as pests and diseases. One significant problem is the presence of hemiepiphytic plants from the genus Ficus, especially the strangler banyan, which can reduce yields and damage the stem structure of the host plant (Edyson et al., 2022).

Ficus is the largest genus in the Moraceae family with around 500 to 700 species spread throughout the world. This species is known to have high adaptation, grows as an epiphyte, and gradually develops roots that penetrate the soil until they grow independently. Competition between Ficus hemiepiphytes and cultivated plants, including oil palm, occurs due to the struggle for resources such as water, nutrients, and light (Moenandir, 2010). In addition, enlarged Ficus roots can put mechanical pressure on oil palm trunks, disrupt nutrient flow, and shorten the life of the host plant (Edyson et al., 2022).

Adeleye et al.'s (2017) research identified two species of epiphytic Ficus on oil palm, namely Ficusleprieuri and Ficusconraui, which act as stranglers and have the potential to damage plant structures.This finding is reinforced by the research of Hengki et al.(2018) which states that the presence of Ficus on oil palm if not controlled can cause competition for nutrients in the soil, damage plant metabolism, and reduce productivity. In the Sriwijaya University area, Indralaya, a 50-hectare oil palm plantation has experienced Ficus infestation.This attack is characterized by aerial roots wrapped around the stem, changes in leaf color to yellowish, and Ficus crowns covering the oil palm canopy.The spread of Ficus is also supported by fruit-eating birds that act as seed dispersal agents, accelerating the germination and spread of this species (Hendrayana et al., 2023). This study aims to identify Ficus species that attack oil palms in the Sriwijaya University area, evaluate the level of attack, and analyze the effect of Ficus stem diameter on the health of host plants.The results of this study are expected to provide a scientific basis for the management and mitigation of Ficushemiepiphyte attacks on oil palm plantations to support the sustainability of oil palm production in Indonesia.

2. METHODOLOGY

2.1. Time and Place

This research was conducted on oil palm plants growing in the roadside area within the Sriwijaya University area, Indralaya. Field data collection was carried out on October 5, 2024 – November 2, 2024.

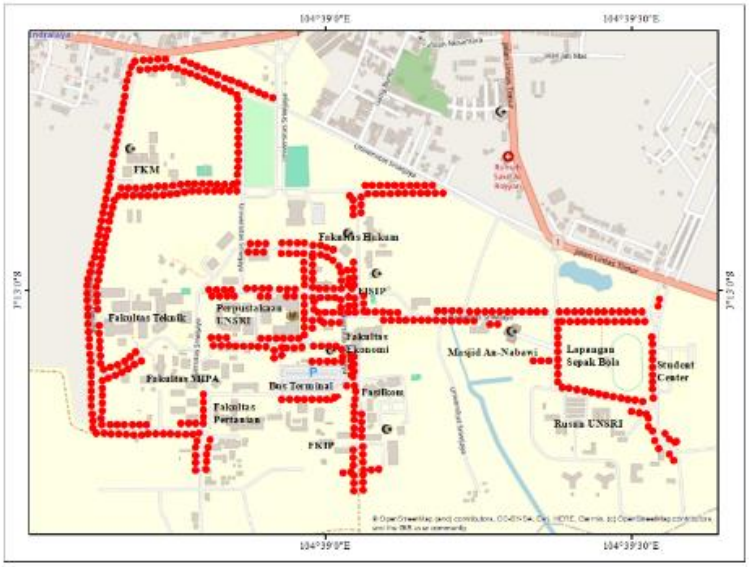

Figure 1. Map of Research Location, Sriwijaya University campus area. Red dots represents the oil palm trees that planted along road side.

2.2. Tools and Materials

Tools The tools used in this study were ladders, cloth meters, tape, cellphone cameras, stationery, and GPS Map Camera. While the materials used in this study were oil palm plants, both those infected by Ficus and those not, and Beringin (Ficus).

2.3. Research Approach and Type

This study uses a descriptive survey approach with quantitative methods. quantitative research methods that involve collecting, interpreting and displaying data using numbers, tables, graphs, images or other displays that can strengthen the facts and characteristics of the population being analyzed.

2.4. Population and Sample

The population in this study were oil palm trees growing in the roadside area of Sriwijaya University, Indralaya. Sampling was carried out using the census sampling technique, where all oil palm plants were sampled to obtain accurate and comprehensive data

2.5. Research Procedure

2.5.1. Initial Survey

The initial survey was conducted in September 2024 in the area of oil palm plantations growing on the side of the road in the Sriwijaya University area. This initial stage includes preparing the equipment needed for the study.

2.5.2. Sampling

Samples were taken directly from the research object. Each oil palm plant identified as Ficus found at the research point will be photographed and its species identified directly in the field.

2.5.3. Identification of Ficus Species

Identification of Ficus species in oil palm plants is carried out by observing the morphological characteristics of plants such as fruit, leaves and stems. Each sample is documented with photos, and the species classification process uses the Berg and Corner (2005) identification book, the Figsof Borneo Website, GBIF, and ITIS, Tree Flora of Malaya Book (Ng, 1981).

2.5.4. Percentage of Ficus Attacks

Measurement of the percentage of Ficus attacks on oil palms is carried out by recording the number of oil palm plants attacked and not attacked by Ficus. Then, the percentage of Ficus attacks is calculated using the formula (Tulung, 2022).

$P (\%) = n/N \times 100\%$

Description:

P = Percentage of attacked plants (%)

N = Number of plants observed

N = Number of plants attacked

Calculating the level of attack using the formula (Directorate of Plant Protection, 2000)

$I = \sum(ni \times vi)/((N \times V)) \times 100\%$

Description:

I = Attack intensity

ni = Number of attacked plants

vi = Attack score value

N = Total number of plants

V = Highest score for attack category

Plant attack score level used:

Score 0 = No attack

Score 1 = Light attack (1% - <25%)

Score 2 = Moderate attack (25% - <50%)

Score 3 = Heavy attack (50% – 85%)

Score 4 = Very heavy attack (>85% – 100%)

Ficus Stem Diameter

Measurement of stem diameter Ficus was carried out at a height of 25 cm above its root system (Purba et al., 2015) using a cloth meter, focusing on the larger stem of each branch. The size of the stem diameter is closely related to the age, growth, and health of the tree (Cintron and Noveli, 1984). The diameter was calculated using the formula proposed by Squad and Suryadarma (2017).

$D = K / \pi$

Description:

D = Stem diameter

K = Stem circumference

$\pi = 3.14$

Ficus Stem Diameter Distribution Analysis

The analysis of the Ficus stem class distribution was carried out by grouping Ficus diameter data, adapted from the vegetation levels of Soerianegara and Indrawan (1988). This grouping aims to facilitate the analysis of the population structure and size distribution of Ficus. The stem diameter classes used are as follows:

Class < 1 cm = Very Small (Seedling)

Class 1 cm - <10 cm = Small (Stake)

Class 10 cm - 35 cm = Medium (Pole)

Class > 35 cm = Large (Tree)

Calculating the percentage distribution of Ficus stem diameter classes using the formula:

Percentage of Diameter Class (Number of individuals in class) / (Total number of individuals) x 100%

2.6. Data Analysis

The data obtained were analyzed descriptively to identify the total number of oil palm plants and those attacked by Ficus. The percentage of plants attacked was calculated and interpreted to determine the category of attack level: low, medium, high, or very high. The results of the study are presented in the form of photos, tables, or diagrams.

3. RESULTS AND DISCUSSION

3.1. Identification of Ficus Species Attacking Oil Palm Plantations

Based on research conducted from October to November in the roadside area within the Sriwijaya University area, there are three Ficus species that attack oil palm plants within the Sriwijaya University area, Indralaya,

No	Species Name	Local Name	Number of Individuals	Percentage (%)
1	*Ficus benjamina*	Beringin	415	99.28%
2	*Ficus retusa*	Arajejawi	2	0.48%
3	*Ficus sundaica*	Buluemprit	1	0.24%
	Total		**418**	**100%**

There are three Ficus species from the Moraceae family identified as attacking oil palm plants in the Sriwijaya University area, Indralaya. Of the total 418 individuals, Ficus benjamina dominates with 415 individuals (99.28%), while Ficus retusa and Ficus sundaica were only found in 2 (0.48%) and 1 (0.24%) individuals, respectively.

The dominance of F. benjamina shows better adaptability compared to the other two species. Sutisna (1981) explained that the dominance of a species is characterized by large numbers, even distribution, high competitiveness, tolerance to the environment, and habitat suitability.

The limited presence of F. retusa and F. sundaica indicates more specific habitat needs or lower competitive ability. Sumihadi et al. (2019) stated that the distribution of Ficus is influenced by internal factors (reproductive patterns) and external factors (habitat conditions). Limited seed distribution can also be a limiting factor in the growth of the two species.

a. Ficus benjamina

Ficus benjamina L. or banyan, is the largest genus in the Moraceae family. According to Heyne (1987), banyan is often planted as an ornamental plant in public places such as squares, fields, and as shade along the road.

a b c d

Figure 2. Morphology of Ficus benjamina; (a) Leaf arrangement; (b) Leaf venation; (c) Single fruit; and (d) seedling on oil palm tree

Ficus benjamina has a tree height reaching 20-30 meters, the main trunk of this tree grows upright, providing support for the tree structure. Although the main trunk is upright, *Ficus benjamina* has many branches growing from the main trunk, which gives a lush and wide shape to the crown, gray in color. The leaves are arranged in a spiral with an alternate growth type, oval in shape with a pointed tip, measuring 5-10 cm long and 2-5 cm wide, with a shiny leaf surface, flat leaf edges and pinnate leaf veins. According to Sumihadi et al., (2019), *Ficus benjamina* fruit is classified as a berry with pale yellow skin while the ripe fruit skin is dark yellow to blackish brown. The characteristic of *Ficus benjamina* is the presence of hanging roots that extend from top to bottom in large numbers, showing the nature of hemiepiphytes that can grow from tree branches to the ground, until they look like vertical lines that support the tree (Hemmer et al., 2004). In addition, this tree produces milky white sap, which functions as a defense against herbivores. According to (Veneklass et al., (2002), Ficus benjamina is known for its ability to adapt well to various environments, including dry land.

b. *Ficus retusa*

Ficus retusa, known as Arajejawi, is a unique climbing plant species originating from the Malay Archipelago and the Malesia region (Berg and Corner, 2005). This species has extraordinary adaptability, especially in germinating and growing on hard surfaces such as rock crevices.

a b c d

Figure 3. Morphology of *Ficus retusa* L.(a) Leaf arrangement; (b) Leaf venation; (c) sap. and (d) fruit

Ficus retusa can reach a height of 10 meters with a rough textured branching stem in brown to black. The leaves are single, arranged in a spiral, subbovate to abovate shape with a length of 12 cm and a width of 5 cm. The base of the leaf is blunt, with rounded edges. The upper surface of the leaf has small, conspicuous dark brown fine hairs, while the underside is smooth (Berg and Corner, 2003). The leaf veins consist of 4-6 pairs, with a leaf stalk 0.5-1 cm long and 2 mm thick.

Ficus retusa flowers are light brown with three main parts: peduncle (stalk connecting to the branch), receptacle (concave flower base containing florets), and ostiole (small hole for pollinating insects to enter) (Maryam et al., 2024). The fruit is a small round syconium (0.6-1 cm), reddish orange when ripe, and appears in pairs in the leaf axils, creating a symmetrical appearance.

c. *Ficus sundaica* Blume.

Ficus sundaica Blume, known as "buluemprit", is an epiphytic species that grows in the tropical rainforests of Southeast Asia, including Indonesia and Malaysia. This species shows high ecological flexibility, allowing growth in a variety of habitats from lowlands to rocky areas (Susilowati et al., 2022).

a b c

Figure 4. Morphology of *Ficus sundaica*Blume

(a) Leaf arrangement; (b) Leaf venation; (c) Sap.

Ficus sundaica has a large tree that can grow to a height of 5-10 meters and begins its life as an epiphyte before developing into an independent tree. The trunk is woody, cylindrical, with a smooth bark texture, and is brownish gray in color. The leaves are arranged in a spiral or spread along the branches, with an elliptical to oblong shape, 11 cm long and 5 cm wide. The leaf veins are pinnate and have 7-10 pairs of clear secondary veins (Ng, 1981). Ficus sundaica fruit grows singly or in pairs, is oval in shape with a diameter of 1-1.5 cm, is yellow and turns red when ripe, is included in the berry category and has milky white sap.

3.2. Measurement of Percentage of Ficus Attacks

A total of 1,744 oil palm plants were observed, of which 418 plants experienced Ficus attacks. Of that number, there were 32 plants or those that died due to Ficus attacks. The data obtained were then analyzed to calculate the percentage of attacks and death rates.

Ficus attacks reached 24%, indicating that almost a third of the observed plants were infected. Although classified as mild, the death of 2% of plants due to this attack is still significant because it can reduce farmers' income and affect the local economy. According to Putz and Holbrook (1986), the death of the host plant is caused by the absence of a xylem and phloem vascular system in Ficus, which inhibits the transport of nutrients and water in the oil palm trunk.

Based on the attack rate of 24% and 2% death, this attack is categorized as mild, but still has an impact with the potential for economic losses of around 6% of the total harvest. Ficus causes morphological changes, such as abnormal root growth and a reduction in the number of healthy leaves. According to Hengki et al. (2018), Ficus attached to oil palm trunks can inhibit photosynthesis, damage the structure of the trunk and leaves, and increase susceptibility to pests and diseases

Most individuals (64.11%) have small diameters (1-<10 cm), indicating a high level of regeneration. As many as 32.06% of individuals are in the medium diameter class (10-35 cm), indicating a medium growth phase as an epiphyte. According to Ilahi and Putri (2023), this phase is a critical stage with a high mortality rate.

Individuals with very small diameters (<1 cm) numbered 3.35%, indicating an early phase as a hemiepiphyte, where competition with host trees can increase mortality. Meanwhile, only 0.48% of individuals had large diameters (>35 cm), indicating environmental factors that limit the growth of Ficus in oil palm plantations. According to Siappa et al. (2016), nutrient availability and environmental conditions affect the growth of Ficus.

3.3 Distribution analysis of Diameter Classes of Ficus Trees

Diameter classes of Ficus trees had been done by separating diameter size into four classes as shown in below table. Seedling with < 1 cm diameter consider as very small tree, 1- < 10 cm as small tree, 10-35 cm as medium tree, more than 35 cm diameter as large tree.

No	Diameter Class	Number of Individuals	Percentage (%)
1	Very small trees (< 1 cm)	14	3.35%
2	Small trees (1 – <10 cm)	268	64.11%
3	Medium trees (10 – 35 cm)	134	32.06%
4	Large trees (> 35 cm)	2	0.48%
	Total	**418**	**100%**

Table 2. The percentage data of diameter distribution represented each tree diameter class in the entire Ficus population observed.

Mo et al., (2022) explained that hemiepiphytic figs, kill their host trees via acquiring phosphorus as driving factor. They compared leaf phosphorus content data of figs and palms worldwide. It is found that P content of hemiephypitic figs and their host palms

significantly decreased when they were competing for soil resource, but that hemiephypitic figs recovered after host death.

4.5. Weather Conditions in Indralaya District, OganIlir Regency

The study was conducted at the Sriwijaya University Campus, Indralaya, OganIlir Regency, South Sumatra, at coordinates 3°14'30" S and 104°39'30" E with an altitude of 10-11 meters above sea level (BPS, 2023). This area is included in OganIlir Regency which is located at coordinates 3°02'–3°48' S and 104°20'–104°48' E.

The study used secondary data from Indralaya District as a proxy for geographic proximity and environmental similarity. Parameters observed included temperature, humidity, and wind speed during October–November 2024.

No	Month	Temperature (°C)	Humidity (%)	Wind Speed (m/s)
1	October	23°C – 32°C	62% – 100%	14
2	November	23°C – 33°C	53% – 100%	11

Source: Meteorology, Climatology, and Geography Agency, (2024).

Changes in weather conditions during the study, with a temperature range of 23°C–33°C supported the growth of oil palm and Ficus, although a temperature of 33°C in November increased transpiration and decreased growth efficiency (Nasution et al., 2024). A decrease in humidity from 62% to 53% can inhibit early growth as an epiphyte, because aerial roots have difficulty absorbing water in dry conditions (Zotz et al., 2021).

Wind speed also decreased, from 14 m/s in October to 11 m/s in November 2024. High wind speeds can accelerate the spread of Ficus seeds through natural vectors such as animals and wind (Sumihadi et al., 2019). Conversely, lower wind speeds in November are more supportive of pollinating insect activity, allowing the pollination process to take place more optimally and increasing the reproductive success of Ficus.

4. CONCLUSION

Based on the research, the following conclusions were obtained:

1. In the roadside area of Sriwijaya University, three species of Ficus were found with a total of 418 individuals, consisting of Ficus benjamina (415 individuals), Ficus retusa (2 individuals), and Ficus sundaica (1 individual). Ficus benjamina dominates (99.28%) with high adaptation as a hemiepiphyte that can cause strangulation in oil palms.

2. Of the 1,744 oil palm trees, 418 plants (24%) were attacked by Ficus with a mortality rate of 2%. Although relatively mild, this attack has a significant impact on crop yields, potentially reducing production by up to 6%.

3. Analysis of Ficus stem diameter shows the dominance of small individuals (1-<10 cm) as many as 268 individuals (64.11%) aged ±5 years, medium category (10-35 cm) as many as 134 individuals (32.06%) aged ±20 years, and only 2 individuals (0.48%)

with a diameter >35 cm aged ±37 years. The dominance of small individuals reflects high regeneration, while the lack of large individuals indicates the presence of growth limiting factors.

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