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Analysis of Weed Vegetation in Oil Palm Plants (*Elaeis guineensis* Jacq.) in Bekiun Plantation at PT. Langkat Nusantara Kepong

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Abstract

Managing and controlling weeds in oil palm plantations is a crucial undertaking. This research aimed to identify the attributes and categorizations of the prevalent weeds in oil palm crops within the PT plantation. Kepong Bekiun plantation is located in the Kuala district of the Langkat Regency, situated in the North Sumatra Province of Indonesia. The research was carried out from April to July 2024. This research employed the observation method to collect data, which were then analyzed utilizing the understory vegetation analysis method and a purposive sampling technique. The parameters for observation include Relative Density, Relative Frequency, Relative Dominance, and Important Value Index (INP). The study findings revealed the composition of weed vegetation at the Bekiun Plantation in the 2020 and 2004 planting year blocks. Specifically, the results showed that there were 24 types of weeds present, which included 14 types of broadleaf weeds, 2 types of sedges, 4 types of grasses, and 4 types of ferns. The predominant weed species within the Poaceae family is the grass group, specifically Axonopus compressus. The attributes of grass weeds consist of annual weeds that propagate through vegetative means with stolons and generative means through seeds. The growth of Axonopus compressus weeds is optimal in dry to slightly moist, but not waterlogged, conditions.

Keywords: Characteristics, Composition, Importance Value Index, Oil Palm Weeds

1. Introduction

Oil palm cultivation is inherently linked with weed management, as the presence of undesirable weeds, whose growth exceeds the population of oil palms, can hinder growth and development. In 2023, the area of national oil palm plantations in Indonesia reached 16.8 million ha, according to the Ministry of Agriculture's Research and Development Agency (Ditjenbun, 2024). The existence of weeds among oil palms has been identified as a potential cause of decreased productivity. The presence of weeds in oil palm plantations has been shown to reduce productivity due to the competition for resources such as groundwater, sunlight, nutrients, air, and space, resulting in a decline in the yield of cultivated plants.

Weeds are botanical species that exert a detrimental influence on other plants. The adverse effects of this phenomenon encompass the interference with the oil palm plants' growth process due to nutrient competition and the presence of plant pests (OPT) in weed seeds. According to Lau and colleagues (2021), weed seeds provide a conducive environment and refuge for small animals, such as insects and pests, enabling them to thrive and reproduce. Furthermore, weeds have the potential to diminish crop yields by utilizing allelopathy. Allelopathy refers to the phenomenon in which one plant inhibits the growth of other plants, mainly weeds, by releasing toxic chemical compounds produced through its metabolism.

The population dynamics of weeds in oil palm plantations are shaped by various factors, including environmental conditions, agricultural practices, and plant characteristics (Tantra & Santosa, 2016). Weeds pose significant challenges to production, as they can obstruct the movement of workers—particularly thorny species—compete for essential nutrients and water and serve as hosts for various pathogens and pests (Sastrosayono, 2003). In immature oil palm plantations, the most prevalent weed

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species include Desmodium triflorum, Paspalum conjugatum, and Elephantopus mollis (Wisdawati et al., 2022).

This research involved an analysis of weed vegetation within the oil palm plantations of PT. Langkat Nusantara Kepong Bekiun. The assessment of weed dominance through this analysis will yield data on the specific weed species that are most prevalent. Such information regarding dominant weed types will be instrumental in developing effective weed management strategies in oil palm cultivation areas.

2. Material and Methods

This study was carried out at the Bekiun Plantation of PT. Langkat Nusantara Kepong, located in the Kuala District of Langkat Regency, North Sumatra, Indonesia, at coordinates 03° 31' 42" N and 98° 21' 02" E, with an elevation of 105 meters above sea level. The research period spanned from April to July 2024. The methodology employed involved direct observation to collect data, which was subsequently analyzed through the understory vegetation analysis technique utilizing a purposive sampling approach. The research focused on oil palm productive plants (TM) established in the years 2020 and 2004. The materials and tools utilized included the TM oil palm plantation area, along with various equipment such as knives, measuring instruments, plastic bags, markers, scissors, cameras, raffia ropes, label paper, wooden stakes, weed identification manuals, and the Picture This-Plant Identifier application. Samples were collected from oil palm plantations already in a productive State" (TM). The subsequent chart presents the sequence of research implementation (Figure 1).

The 42 plots designated for observation were selected to identify the weeds of interest. Seven plots represented each plant age category, measuring 2 × 2 meters. Each sample area within a single block was replicated thrice.

The data that will be used as a parameter to find dominant weeds in the plot are relative density, relative frequency, relative dominance of weeds, and the critical value index. To obtain this data, a quadrant method formula is needed. The quadrant method formula to estimate the density of weed types is as follows.

$$KR = \frac{Density\ of\ a\ type}{Density\ of\ all\ types} \times 100\%$$

$$FR = \frac{Frequency\ of\ a\ type}{Frequency\ of\ all\ types} \times 100\%$$

$$KR = \frac{Dominance\ of\ a\ type}{Total\ number\ of\ types} \times 100\%$$

Important Value Index (INP) = KR + FR + DR

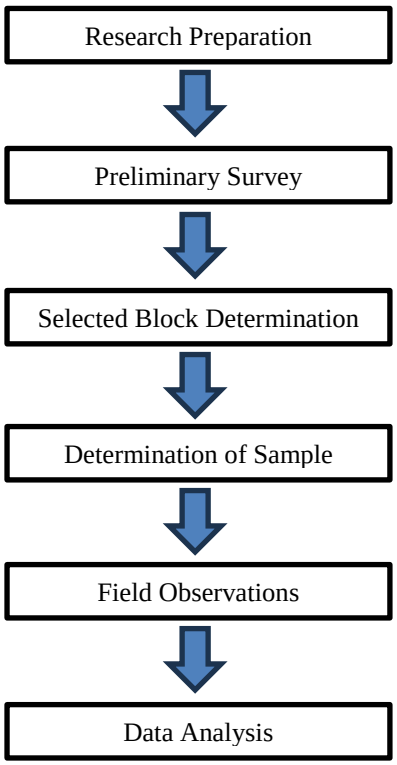

Figure 1. Research flow diagram

The age of oil palm plants to be studied is 4 and 19. Observations were made by taking weed samples and then identifying the type of weed and the number of each weed.

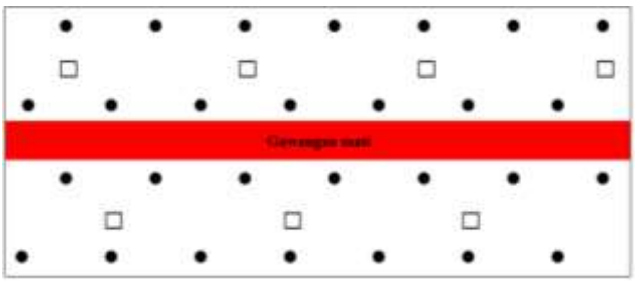

Figure 2. Scheme for Plot Area

3. Results and Discussion

3.1. Soil Analysis Results in Data in Bekiun Plantation in 2023

Soil samples were collected from Block 1PM2019A, classified as Andic Dystrudepts soil type. The results indicated a medium soil pH (6.5-7.5), with an organic carbon content that was found to be medium (2-3%), and a high level of soil nitrogen (0.51-0.75%). The total and available phosphorus levels were medium (16-25 ppm). The Cation Exchange Capacity (CEC) levels at both depths were high (25-40m.e%). The analysis indicates that the soil in this block exhibits a satisfactory level of fertility.

Table 1. Relative density of weed species in the 2020 planting year.

Blok		1PM2019A	
Depth (cm)		0-15	15-45
pH in H_20		M	ML
Organic C (%)		M	M
N (%)		H	H
P (ppm)	Total	M	M
	Available	M	M
KTK		H	H

Source: PT. Langkat Nusantara Kepong Kebun Bekiun
Information: ML=medium low, M=medium, H=high.

3.2. Relative Density

The relative density of each weed growth in the 2020 and 2004 planting year blocks showed differences. In the 2020 planting year block, the highest density value of the broadleaf group was the Torenia crustacea weed, with a relative density value of 1.75%, while in the 2004 planting year block, the highest broadleaf group was the Dymaria cordata weed, with a relative density value of 2.26%. The highest density value of the sedge group in the 2020 planting year block was the Cyperus rotundus weed with a relative density of 45.06%, while in the 2004 planting year block, the highest density value of the sedge group was the Cyperus rotundus weed with a relative density of 3.46%.

Figure 3. *Cyperus rotundus*

The highest density value of the fern group in the 2020 planting year block was the Didymochlaena truneatula weed with a relative density of 0.68%, while in the 2004 planting year block, the highest density value of the fern group was the Diplazium esculentum weed with a relative density of 3.00%. The highest density value of the grass group in the 2020 planting year block was the Ottochloa nodosa weed, with a relative density of 23.46%, while in the 2004 planting year block, the highest density value of the grass group was the Axonopus compressus weed with a relative density of 67.55%.

The density results obtained in Kebun Bekiun, precisely in the 2020 and 2004 planting year blocks, namely the highest density value is the grass group, the Axonopus compressus weed with a relative density of 67.55%, it can be interpreted that this weed has the largest number of individuals compared to other types of plants. There are 4 density categories: the low category with a value of 12-50%, the medium category with a value of 51-100%, and the good category with a value> 201% (Hidayat et al., 2017). Based on the results obtained, the density value in Kebun Bekiun is included in the medium category because it is 51-100%.

Table 2. Relative density of weed species in the 2020 planting year

Planting Year	Species Name	Group	Kr (%)
2020	*Acmella paniculata*	Wide leaves	2,48%
	Ageratum conyzoides	Wide leaves	1,13%
	Asystasia gangetica	Wide leaves	1,41%
	Borreria latifolia	Wide leaves	0,68%
	Clidemia hirta	Wide leaves	0,28%
	Cyperus rotundus	Puzzle	45,06%
	Cyrtococcum patens	Puzzle	2,14%
	Didymochlaena truneatula	Ferns	0,68%
	Diplazium esculentum	Ferns	1,41%
	Drymaria cordata	Wide leaves	1,24%
	Geophila repens	Wide leaves	3,61%
	Hyptis capitata	Wide leaves	1,52%
	Lygodium flexuosum	Ferns	0,23%
	Microlepia speluncae	Ferns	1,92%
	Mimosa pudica	Wide leaves	0,11%
	Ottochloa nodosa	Grass	23,46%
	Paspalum conjugatum	Grass	8,52%
	Phyllanthus urinaria	Wide leaves	1,80%
	Solanum torvum	Wide leaves	0,56%
	Torenia crustacea	Wide leaves	21,75%

Table 3. Relative density of weed species in the 2004 planting year

Planting Year	Species Name	Group	Kr (%)
2004	*Axonopus compressus*	Grass	67,55%
	Callisia repens	Wide leaves	3,58%
	Cyperus rotundus	Puzzle	3,46%
	Didymochlaena truneatula	Ferns	0,28%
	Diplazium esculentum	Ferns	3%
	Drymaria cordata	Wide leaves	2,26%
	Echinochloa colonum	Grass	3,24&
	Geophila repens	Wide leaves	2,14%
	Melastoma molabathricum	Woody Weeds	3,92%
	Microlepia speluncae	Ferns	0,52%
	Mimosa pudica	Wide leaves	0,24%
	Paspalum conjugatum	Grass	2,20%
	Phyllanthus urinaria	Wide leaves	0,92%
	Torenia crustacea	Wide leaves	6,70%

Each planting year block shows different frequency values. In the 2020 planting year block, the highest frequency value of the broadleaf group is the weeds Acmella paniculata , Geophila repens , and Phyllanthus urinaria with a relative frequency value of 6.78%, while in the 2004 planting year block, the highest broadleaf group is the weed Callisia repens with a relative frequency value of 10.42%.

3.3. Relative Frequency

The highest frequency value of the sedge group in the 2020 planting year block was the Cyperus rotundus weed with a relative frequency of 17.79%, while in the 2004 planting year block the highest frequency value of the sedge group was the Cyperus rotundus weed with a relative frequency of 6.20%.

The highest frequency value of the fern group in the 2020 planting year block was the weed Microlepia speluncae, with a relative frequency of 5.93%, while in the 2004 planting year block, the highest frequency value of the fern group was the weed Diplazium esculentum with a relative frequency of 8.41%.

Table 4. Relative frequency of weed species in the 2020 planting year

Planting Year	Species Name	Group	Fr (%)
2020	*Acmella paniculata*	Wide leaves	6,78%
	Ageratum conyzoides	Wide leaves	3,39%
	Asystasia gangetica	Wide leaves	3,39%
	Borreria latifolia	Wide leaves	2,54%
	Clidemia hirta	Wide leaves	2,54%
	Cyperus rotundus	Puzzle	17,79%
	Cyrtococcum patens	Puzzle	3,39%
	Didymochlaena truneatula	Ferns	1,69%
	Diplazium esculentum	Ferns	4,24%
	Drymaria cordata	Wide leaves	3,39%
	Geophila repens	Wide leaves	6,78%
	Hyptis capitata	Wide leaves	4,24%
	Lygodium flexuosum	Ferns	0,85%
	Microlepia speluncae	Ferns	5,93%
	Mimosa pudica	Wide leaves	1,69%
	Ottochloa nodosa	Grass	12.71%
	Paspalum conjugatum	Grass	6,78%
	Phyllanthus urinaria	Wide leaves	6,78%
	Solanum torvum	Wide leaves	2,54%
	Torenia crustacea	Wide leaves	2,54%

The highest frequency value of the grass group in the 2020 planting year block was the Ottochloa nodosa weed, with a relative frequency of 12.71%, while in the 2004 planting year block, the frequency value was Axonopus compressus weed with a relative frequency of 22.22%. The frequency is classified into 5 classes, namely class A with a value of 1-20% in the very low category, class B with a value of 21-40% in the low category, class C 41-60% in the medium category, class D 61-80% in the high category, and class E 81-100% in the very high category. Based on the results obtained, the frequency value in Kebun Bekiun in the 2020 and 2004 planting year blocks is included in class

B, which has a low category because the highest frequency value ranges from 21-40%. The high relative frequency value of a species indicates that the species has a wide distribution. Frequency can also describe the level of distribution and distribution patterns. Wide-distributed species mean they have a considerable frequency value (Maridi et al., 2015).

Table 5. Relative frequency of weed species in the 2004 planting year

Planting Year	Species Name	Group	Fr (%)
2004	*Axonopus compressus*	Wide leaves	6,78%
	Callisia repens	Wide leaves	3,39%
	Cyperus rotundus	Wide leaves	3,39%
	Didymochlaena truneatula	Wide leaves	2,54%
	Diplazium esculentum	Wide leaves	2,54%
	Drymaria cordata	Puzzle	17,79%
	Echinochloa colonum	Puzzle	3,39%
	Geophila repens	Ferns	1,69%
	Melastoma molabathricum	Ferns	4,24%
	Microlepia speluncae	Wide leaves	3,39%
	Mimosa pudica	Wide leaves	6,78%
	Paspalum conjugatum	Wide leaves	4,24%
	Phyllanthus urinaria	Ferns	0,85%
	Torenia crustacea	Ferns	5,93%

Figure 4. *Axonopus compressus*

3.4. Relative Dominance

In the 2020 planting year block, the highest dominance value of the broadleaf group was the Geophila repens weed, with a relative dominance value of 3.61%. In the 2004 planting year block, the highest broadleaf group was the Torenia crustacea weed, with a relative dominance value of 6.70%. In the 2020 planting year block, the sedge group exhibited a relative dominance value of 45.06% for the Cyperus rotundus weed, while in the 2004 planting year block, the sedge group demonstrated a relative dominance value of 3.46% for the same species.

Table 6. Relative dominance of weed species in the 2020 planting year

Planting Year	Species Name	Group	Dr (%)
2020	*Acmella paniculata*	Wide leaves	2,48%
	Ageratum conyzoides	Wide leaves	1,13%
	Asystasia gangetica	Wide leaves	1,41%
	Borreria latifolia	Wide leaves	0,68%
	Clidemia hirta	Wide leaves	0,28%
	Cyperus rotundus	Puzzle	45,06%
	Cyrtococcum patens	Puzzle	2,14%
	Didymochlaena truneatula	Ferns	0,68%
	Diplazium esculentum	Ferns	1,41%
	Drymaria cordata	Wide leaves	1,24%
	Geophila repens	Wide leaves	3,61%
	Hyptis capitata	Wide leaves	1,52%
	Lygodium flexuosum	Ferns	0,23%
	Microlepia speluncae	Ferns	1,92%
	Mimosa pudica	Wide leaves	0,11%
	Ottochloa nodosa	Grass	23,46%
	Paspalum conjugatum	Grass	8,52%
	Phyllanthus urinaria	Wide leaves	1,80%
	Solanum torvum	Wide leaves	0,56%
	Torenia crustacea	Wide leaves	1,75%

The highest dominance value of the fern group in the 2020 planting year block was the Microlepia speluncae weed with a relative dominance of 1.92%, while in the 2004 planting year block the highest dominance value of the fern group was the Diplazium esculentum weed with a relative dominance of 3.00%. The highest dominance value

of the grass group in the 2020 planting year block was the Ottochloa nodosa weed, with a relative dominance of 23.46%, while in the 2004 planting year block, the highest dominance value of the grass group was the Axonopus compressus weed with a relative dominance of 67.55%.

This result shows that the Axonopus compressus weed has the highest dominance value of all weed types, which means that this weed can dominate the Bekiun Garden area. Plant types with higher dominance values are dominant types. If a plant type grows in a suitable location to support its growth, it can become a dominant type (Kuswantoro et al., 2018).

Table 7. Relative dominance of weed species in the 2020 planting year

Planting Year	Species Name	Group	Dr (%)
2004	*Axonopus compressus*	Grass	67,55%
	Callisia repens	Wide leaves	3,58%
	Cyperus rotundus	Puzzle	3,46%
	Didymochlaena truneatula	Ferns	0,29%
	Diplazium esculentum	Ferns	3,00%
	Drymaria cordata	Wide leaves	2,25%
	Echinochloa colonum	Grass	3,23%
	Geophila repens	Wide leaves	2,14%
	Melastoma molabathricum	Woody weeds	3,93%
	Microlepia speluncae	Ferns	0,52%
	Mimosa pudica	Wide leaves	0,23%
	Paspalum conjugatum	Grass	2,19%
	Phyllanthus urinaria	Wide leaves	0,92%
	Torenia crustacea	Wide leaves	6,70%

3.5. Importance Value Index

The results of the observation analysis on the 2020 and 2004 planting year blocks indicate that the Axonopus compressus weed is the most prevalent in each vegetation type at all growth levels. The Axonopus compressus weed demonstrates superior growing site suitability compared to other weeds within the grass group. The high INP value suggests that Axonopus compressus weeds exhibit higher adaptability to their environment than others.

3.6. Characteristics of Dominant Weeds

Axonopus compressus from the Poaceae family. Creeping and climbing grass, up to 50 cm, rooted nodes, rarely annual. Lanceolate leaves, finely hairy edges, upper surface sparsely hairy, lower surface glabrous, short leaf tongue, short-hairy.

Table 8. Importance value index of weed species in the 2020 planting year

Species Name	Group	Planting Year	
		2020	2004
Acmella paniculata	Wide leaves	11,74%	
Ageratum conyzoides	Wide leaves	5,65%	
Asystasia gangetica	Wide leaves	6,21%	
Axonopus compressus	Rerumputan		157,32%
Borreria latifolia	Wide leaves	3,90%	
Callisia hirta	Wide leaves		17,57%
Clidemia hirta	Wide leaves	3,10%	
Cyperus rotundus	Puzzle	107,92%	13,12%
Cyrtococcum patens	Puzzle	7,67%	
Didymochlaena truneatula	Ferns	3,05%	1,45%
Diplazium esculentum	Ferns	7,06%	14,41%
Drymaria cordata	Wide leaves	5,87%	6,50%
Echinochloa colonum	Grass		16,89%
Geophila repens	Wide leaves	14,00%	
Hyptis capitata	Wide leaves	7,28%	
Lygodium flexuosum	Ferns	1,30%	
Melastoma molabathricum	Woody weeds		21,37%
Microlepia speluncae	Ferns	9,77%	4,14%
Mimosa pudica	Wide leaves	1,92%	1,34%
Ottochloa nodosa	Grass	59,63%	
Paspalum conjugatum	Grass	23,82%	8,61%
Phyllanthus urinaria	Wide leaves	10,38%	6,06%
Solanum torvum	Wide leaves	3,67%	
Torenia crustacea	Wide leaves	6,04%	22,72%

The inflorescence exhibits a panicle-like structure, branching into two to multiple oblong-shaped segments, and has the capability of reproducing through both seeds and stem cuttings. It thrives in open or moderately sheltered environments and can grow at elevations up to 1400 meters above sea level. The growth of this plant occurs through the use of both seeds and stem cuttings. The subject will experience rapid growth, development, and eventual dominance within the specified area if provided with appropriate growing media. This result aligns with the findings of Mangoensoekarjo and Soejono Toekidjan (2015), who assert that Axonopus compressus can develop from seeds and germinate and thrive in unfavorable conditions of nutrients and water. The seeds do not perish and instead enter a state of dormancy when the environment is not conducive to growth.

4. Conclusion

The weed vegetation within the Bekiun Garden was analyzed across planting year blocks in 2020 and 2004. The findings revealed 24 weed types, including 14 broadleaf weed types, 2 sedge types, 4 grass types, and 4 fern types. The predominant weed species within the Poaceae family is Axonopus compressus, commonly known as the grass group. The traits of grassweds encompass annual growth patterns, reproduction through vegetative means such as stolons, and generative methods such as seed production. Axonopus compressus weeds thrive in arid, somewhat moist, but not waterlogged environments.

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