

# Analysis of biotic disease incidence and abiotic disorders in oil palm (*Elaeis guineensis* Jacq.) main nursery at Adolina Estate

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## ABSTRACT

This study aimed to identify biotic diseases and abiotic disorders and determine their percentage and intensity in oil palm main nursery seedlings. The research was conducted at the Adolina Oil Palm Seed Center, PT Perkebunan Nusantara IV Regional II, using a quantitative descriptive method through direct observation of 400 oil palm seedlings. Data were collected through visual assessment and analyzed using disease incidence and severity formulas. The results showed that leaf spot disease was the most prevalent biotic disease, affecting 91 seedlings (22.75%) with a disease intensity of 7.88%, followed by anthracnose affecting 81 seedlings (20.25%) with an intensity of 6.50%. Several abiotic disorders and genetic abnormalities, including chimera, dwarfism, rolled leaves, crinkled leaves, grass leaf, juvenile characteristics, and short internodes, were also identified at relatively low and stable frequencies. Overall, disease severity levels were classified as mild (1.1–25.0%). Environmental conditions, particularly high humidity and nursery sanitation practices, were found to significantly influence disease development. These findings highlight the importance of proper sanitation, environmental management, and the use of healthy seedlings to minimize disease incidence and improve nursery quality.

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## 1. INTRODUCTION

Oil palm plantations play a major role in Indonesia's economy by contributing significantly to export revenue and employment opportunities. The success of oil palm cultivation is strongly influenced by the quality of seedlings produced during the nursery stage, particularly in the main nursery phase where seedlings are highly vulnerable to pathogen infection and environmental stress (Ayuningtyas *et al.*, 2022). Poor seedling quality at this stage may reduce field establishment, decrease future productivity, and increase replanting costs (Kelompok, Ngundi and li, 2023).

Biotic diseases such as leaf spot caused by *Curvularia* sp. and anthracnose caused by *Colletotrichum* sp. are among the most common diseases found in oil palm nurseries (Firdaus *et*

*al.*, 2018). These pathogens infect leaf tissues, causing necrotic lesions, chlorosis, and reduced photosynthetic capacity, ultimately inhibiting seedling growth and vigor. Under severe conditions, disease outbreaks may lead to significant economic losses due to increased disease management costs and reduced planting material quality (Hyde *et al.*, 2014).

Environmental conditions play an important role in disease epidemics in nurseries. High humidity, excessive rainfall, poor drainage, and dense seedling spacing create favorable microclimatic conditions for fungal sporulation, pathogen dissemination, and infection development. Inadequate nursery sanitation and poor management practices further accelerate disease spread through infected debris and water splashes. In addition to biotic diseases, abiotic disorders and genetic abnormalities such as chimera, dwarfism, rolled leaves, and crinkled leaves may also reduce seedling quality and uniformity (Afriliya, Fajar and Oil, 2019).

Previous studies have mainly focused on disease identification without providing a comprehensive quantitative evaluation of disease incidence and severity simultaneously, especially in the oil palm main nursery stage. Furthermore, limited information is available regarding the combined influence of biotic diseases, abiotic disorders, and environmental conditions on seedling health. Therefore, this study aims to analyze the percentage and intensity of biotic diseases and abiotic disorders in oil palm main nursery seedlings to provide a more comprehensive assessment of nursery health conditions (Kirkman *et al.*, 2022).

## 2. METHOD

This research was conducted at Adolina Oil Palm Seed Center, PT Perkebunan Nusantara IV Regional II, from March to April 2026. The study employed a quantitative descriptive approach to evaluate the occurrence of biotic diseases and abiotic disorders in oil palm seedlings at the main nursery stage.

### 2.1 Research Design and Sampling

This research was conducted at Adolina Oil Palm Seed Center, PT Perkebunan Nusantara IV Regional II, from March to April 2026 using a quantitative descriptive approach. The study aimed to evaluate the occurrence of biotic diseases and abiotic disorders in oil palm seedlings at the main nursery stage. The observed seedlings consisted of the DxP Simalungun variety aged 4–12 months. During the observation period in March 2026, rainfall in the research area reached 30 mm with 2 rainy days and a maximum dry period of 15 days. These environmental conditions were considered to influence disease development in the nursery environment. The population consisted of approximately 36,000 oil palm seedlings. A total of 400 seedlings were selected as samples using purposive sampling based on visual uniformity and accessibility. The observation area was divided into five plots, each consisting of 80 seedlings to represent field variability.

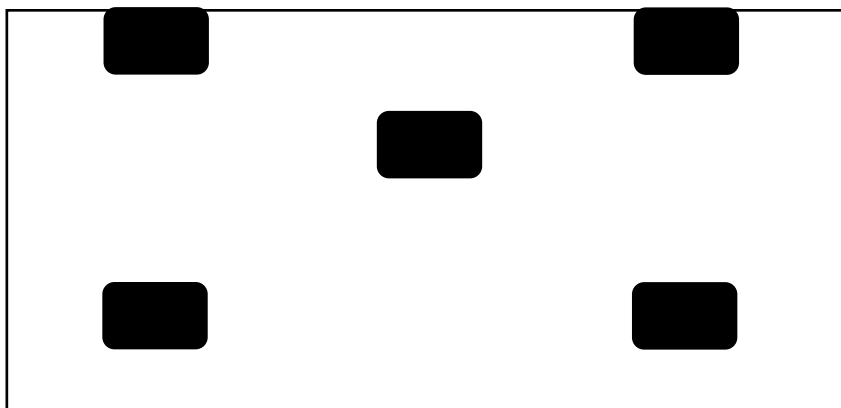


Figure 1. Observation plot plan

Description :  
 MN Nursery Land ; □ Observation Plot : ■

### 2.2 Data Collection

Data were collected through direct field observations conducted weekly for four consecutive weeks. Each seedling was carefully examined to identify symptoms of biotic diseases, including leaf spot caused by *Curvularia* sp. and anthracnose caused by *Colletotrichum* sp., as well as abiotic disorders and genetic abnormalities such as chimera, dwarfism, rolled leaves, crinkled leaves, grass leaf, juvenile characteristics, and short internodes. Disease observations were

recorded using a standardized scoring sheet. Identification was based on visible symptom characteristics, including lesion color, lesion shape, distribution patterns, and symptom severity on leaf surfaces. Disease identification in this study was based on visual symptom observations and literature references; therefore, pathogen identification should be considered preliminary because laboratory isolation and microscopic examination were not conducted.

### 2.3 Parameters Observed The main parameters observed in this study were:

The main parameters observed in this study were: Disease Incidence (FS) Disease incidence describes the proportion of infected seedlings relative to the total number of observed seedlings. Disease Severity (IS) Disease severity describes the level of damage caused by disease symptoms on each observed seedling.

### 2.4 Data Analysis Attack frequency was calculated using the following formula:

$$FS = (n/N) \times 100\% \quad (1)$$

Where: n = number of infected seedlings N = total number of observed seedlings

Attack intensity was calculated using a scoring method based on the level of damage. Each seedling was assigned a score according to symptom severity, then converted into percentage values.

The results were then categorized into damage levels, namely: light (1.1–25.0%), moderate (25.1–50.0%), and severe (>50%). Data were presented in tabular and descriptive forms to facilitate interpretation, Every week, observations were made on each oil palm seedling and calculated as a percentage (Mara, Ulu and Batanghari, 2021).

$$IS = (\sum(X_i \times V_i) / (N \times V_{max})) \times 100\% \quad (2)$$

IS = Disease attack intensity (%)

$X_i$  = Number of plants in each severity category

$V_i$  = Score value assigned to each severity category

N = Total number of observed plants

$V_{max}$  = Maximum score value in the scoring system

**Table 1.** How to Determine the Value (Score) of Disease Attack Symptoms in Each Plant

Severity Level	Unit load
0	Healthy
1	Mild
2	Moderate
3	Severe
4	Very Severe

**Table 2.** Characteristics of Plant Conditions that Occur Due to Disease Attacks According to the Intensity of the Attack

Attack intensity (%)	Unit load
0,0 – 1,0	Healthy
1,1 – 25,0	Slightly
25,1 – 50,0	Moderately Damaged
50,1 – 75,0	Severely Damaged Very Severely Damaged

## 3. RESULTS AND DISCUSSION

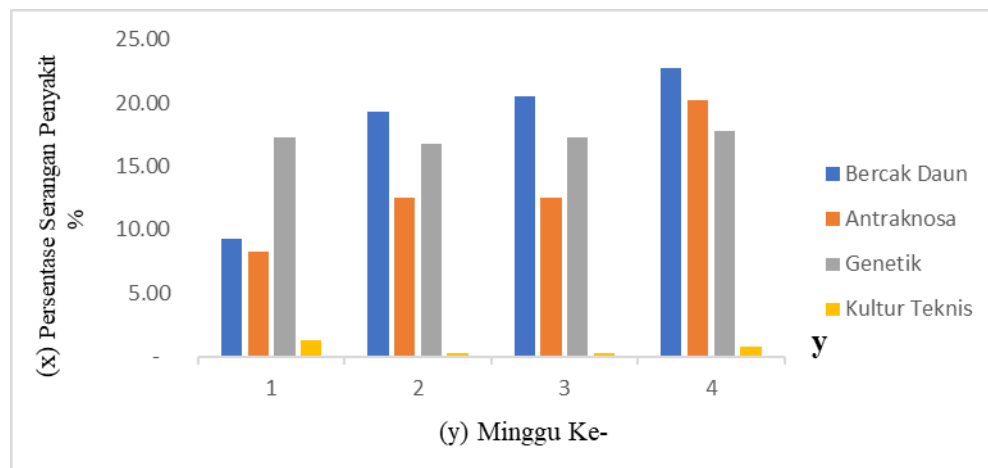
### 3.1 Attack Frequency

The results showed a consistent increase in disease incidence during the four weeks of observation. Leaf spot disease increased from 9.25% in the first week to 22.75% in the fourth week. Similarly, anthracnose increased from 8.25% to 20.25%. This indicates that disease development progressed along with plant age and environmental exposure. The increasing trend of disease incidence is strongly influenced by environmental conditions.

High humidity and frequent rainfall during the observation period created favorable conditions for fungal pathogens to grow and spread rapidly. In addition, dense plant spacing and limited air circulation contributed to the higher infection rate. Genetic abnormalities showed relatively stable values ranging from 16.75% to 17.75% throughout the observation period. This stability indicates that genetic disorders are not influenced by short-term environmental changes but are more related to seed quality and genetic factors.

**Table 3.** Attack Frequency

Week to-	Disease Attack Frequency %			
	Leaf spot	Antracnose	Genetics	Culture Technical
1	9.25	8.25	17.25	1.25
2	19.25	12.50	16.75	0.25
3	20.50	12.50	17.25	0.25
4	22.75	20.25	17.75	0.75

**Figure 2.** Percentage of Disease Attacks

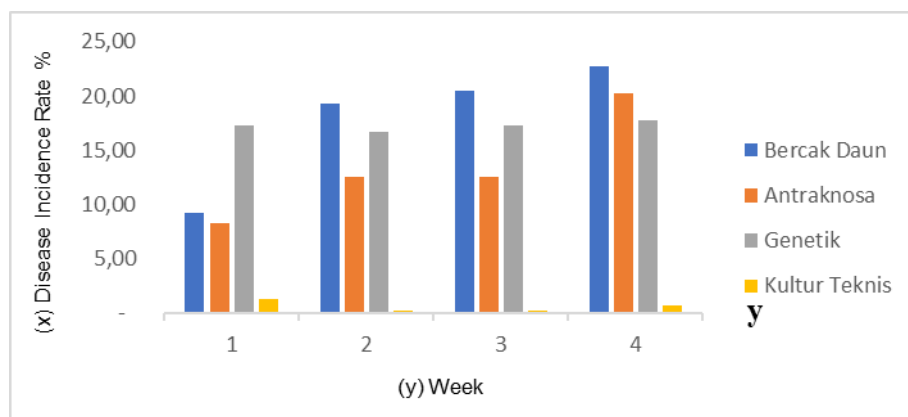
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**Table 4.** Attack Intensity

week to -	Attack Intensity (%)			Description
	Leaf spot	Antracnose		
1	3.44	2.50		Minor damage
2	6.63	3.94		Minor damage
3	7.19	4.38		Minor damage
4	7.88	6.50		Minor damage

**Figure 3.** Attack Intensity

### 3.3 Discussion

The increase in disease incidence observed during the study was closely associated with environmental conditions, particularly humidity and rainfall. High humidity increases leaf wetness duration, which promotes fungal sporulation, conidial germination, and pathogen penetration into leaf tissues. Fungal pathogens such as *Curvularia* sp. and *Colletotrichum* sp. produce spores that are easily disseminated through rain splashes and wind, allowing repeated infection cycles under favorable nursery conditions. The infection process generally begins when fungal spores attach to moist leaf surfaces and germinate, followed by penetration into epidermal tissues. This infection causes necrotic lesions, chlorosis, and tissue damage that reduce chlorophyll content and photosynthetic activity, ultimately decreasing seedling vigor and growth performance. Dense plant spacing and limited air circulation further prolong leaf surface moisture, thereby accelerating disease epidemics in the nursery environment. These findings are consistent with previous studies reporting that high moisture conditions significantly enhance the development of *Curvularia* leaf spot and anthracnose diseases in oil palm seedlings (Ul *et al.*, 2021) ; (Zhang *et al.*, 2019). However, the disease severity observed in this study remained within the mild category, which may be associated with relatively good nursery sanitation and management practices.

### 4. CONCLUSION

This study successfully identified biotic diseases and abiotic disorders and determined their incidence and severity in the oil palm main nursery. Leaf spot and anthracnose were the dominant diseases observed, showing increasing incidence throughout the observation period, although overall disease severity remained within the mild category. The findings indicate that environmental conditions and nursery management practices play important roles in disease development in oil palm seedlings. Proper nursery sanitation, adequate spacing, and good drainage management are essential to minimize disease spread and maintain seedling quality. Integrated disease management strategies are therefore recommended for sustainable nursery management. Further studies are needed to investigate biological control approaches and evaluate the long-term effects of environmental factors on disease development in oil palm nurseries.

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