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Health Analysis of Acacia (*Acacia crassicarpa*) Seedling in the Nursery of PT. Sekato Pratama Makmur in Bukit Batu District, Bengkalis Regency, Riau Province

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Abstract

Background: *Acacia is a top priority plant in developing industrial forest plantations, especially in Sumatra, because it meets the requirements as raw material for the pulp and paper industry. PT. Sekato Pratama Makmur (SPM) is a company that cultivates this plant. Constraints often encountered in developing pulpwood plantations include pests, diseases, and seedlings that fail to adapt to the field. It is essential to analyze the health of acacia seedlings in the PT. SPM nursery, as a basis for pest and disease control and plant protection measures. This study aims to determine the intensity of pest and disease attacks and the health condition of acacia plants.* **Methodology:** *The scoring method used in this study was used to determine the attack score on acacia seedlings. Data from this study were analyzed descriptively and quantitatively using the formulas of survival rate, intensity of pest and disease attack, and percentage of health.* **Findings:** *The results showed that the percentage of pest and disease attack intensity was 1.90 % in sowing 1, 6.16 % in sowing 2, and 5.88 % in sowing 3, with mild damage. The percentage of acacia plant health was 95.10 % in sowing 1, 89.38 % in sowing 2, and 89.20 % in sowing 3. Damage to leaves included leaf curling, leaf holes, leaf yellowing, leaf spots, and blight. This indicates that the acacia seedlings in the nursery are in good condition. The low intensity and minor severity of pest and disease attacks demonstrate that the control measures implemented by PT. SPM are effective.* **Contribution:** *This research contributes to the development of effective pest control strategies by providing initial information on the health condition of acacia seedlings and supports the long-term success of field planting.*

Keywords: *Acacia crassicarpa; Infestation Intensity; Nursery; Pests and Diseases; Plant Health*

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INTRODUCTION

Industrial plantation forests are built to increase the potential and quality of production forests by applying silviculture systems to meet the raw material needs of the forest products industry (Yudistira et al., 2019). PT. Sekato Pratama Makmur (SPM) is planting and logging acacia (*Acacia crassicarpa*). This plant species is a top priority to be developed in industrial forest plantation development, especially in Sumatra, because it meets the requirements as raw material for industry and paper such as fast-growing wood, high wood production, can survive on marginal land, and silviculture techniques have been mastered (Martins et al., 2020).

PT. SPM develops industrial plantation forests by applying the artificial propagation clearcut silviculture system. This system involves clear-cutting all trees in a forest stand, except for certain species protected by applicable laws. The regeneration is done by replanting the logged-out area to establish new forest stands of high species, age, and value that align with the company's goals (Faqih et al., 2018).

Successful planting is inseparable from procuring good-quality seedlings at the nursery. Seedlings must grow normally and be free from pests and diseases. Protecting young plants in the nursery is essential to avoid various risks of pest and disease attacks while still in the nursery and after planting in the field. Pest and disease control is a big concern because plants will produce quality wood if they are not attacked by disease (Naemah & Susilawati, 2015).

One obstacle in developing industrial forest plantations for pulp is the presence of pests and diseases that can reduce wood quality. In addition, seedlings that fail to grow and adapt in the field are a problem that is also often faced (Susilawati & Naemah, 2018). Based on the description above, it is essential to analyze the health of acacia seedlings in the nursery of PT. SPM as a basis for taking pest and disease control measures and plant protection so that prevention and improvement of plants can be carried out and support the success of planting in the field. This study aims to determine the intensity of pest and disease attacks and the health condition of acacia (*Acacia crassicarpa*) seedlings in the PT. Sekato Pratama Makmur nursery.

METHOD

The research was carried out in the nursery of PT. Sekato Pratama Makmur, Bukit Batu, Bengkalis Regency, Riau Province. The research location map can be seen in Figure 1. The materials used in this study were a map of the research location and 45-day-old acacia seedlings. The tools used in this research are a tally sheet, magnifying glass, camera phone, stationery, and calculator. The research procedures carried out were:

Method of Collecting Data

Sampling was done using a purposive sampling technique on 45-day-old acacia seedlings in the nursery. Acacia seedlings at the age of 45 days adapt to a new environment without shade, namely open areas. At this age, many seedlings die due to the inability to adjust to pest and disease attacks and environmental conditions.

Samples were collected using a diagonal system. The seedlings sampled were acacia seedlings from 18 tables in the nursery. Five trays were taken from each table, with one tray containing 32 acacia seedlings. The total number of samples observed was 90 trays. Data were collected by observing the health condition of the acacia seedlings sampled. The seedlings in the trays were observed, and the intensity of the infestation was counted to determine the health condition of the seedlings.

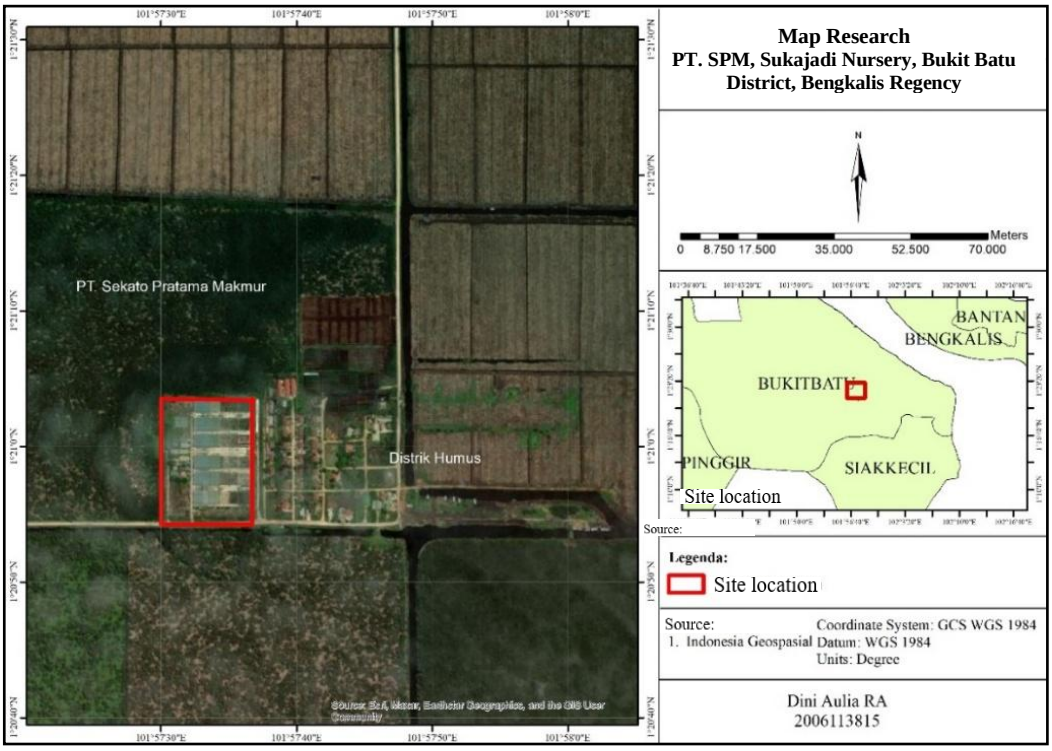

Figure 1. Research location map

Data Analysis Method

Data from this study were analyzed descriptively and quantitatively using the formulas of survival rate, intensity of pest and disease attack, and percentage of health.

Survival Rate (SR)

The survival rate is calculated based on the formula according to Suryawan et al., (2016), as follows:

$$SR = \frac{number\ of\ live\ plants}{number\ of\ initial\ plants} \text{ x } 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

The percentage of plant life is classified into several criteria according to the percentage value obtained from the calculation. Table 1 shows the criteria for the percentage of survival rate according to (Sunardi et al., 2021).

Table 1. Criteria of Survival Rate

No	Survival Rate (%)	Criteria
1	> 75	Good
2	51-75	Not good

3	26-50	Rather good
4	0-25	Bad

Source: (Sunardi et al., 2021)

Intensity of Pest and Disease Attack

Table 2 shows that acacia plants that are attacked by pests and diseases are determined by the value or score of the attack, based on the opinion of Mardji (2000).

Table 2. Damage scores on plants based on pest and disease attack symptoms

No	Symptoms on the Plant	Score
1	Healthy	0
2	Mildly damaged	1
3	Medium damaged	2
4	Heavily damaged	3
5	Dead	4

Source: Mardji (2000)

The plant damage score obtained is used to calculate attack intensity. The calculation of attack intensity uses the formula according to Triwibowo et al., (2014), as follows:

$$I = \frac{X1Y1+X2Y2+X3Y3+X4Y4}{XY} \times 100\ \% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Information:

I = intensity of peast and disease attack
X = the number of seedlings observed
Y = highest score criteria (4)
$X_{(1,2,3,4)}$ = number of infested seedlings according to the criteria
$X_{(1,2,3,4)}$ = score of infested seedlings according to the criteria

The overall condition of the seedlings due to plant pest organism attacks was classified into several conditions according to the percentage. According to Mardji (2003), the overall condition of seedlings based on the intensity of the attack can be seen in Table 3.

Table 3. Condition of Seedlings Based on Intensity of Pest and Disease Attack

No	Intensity of Pest and Disease Attack (%)	Damage Level
1	0-1	Healthy
2	>1-25	Lightly damage
3	>25-50	Medium damage
4	>50-75	Heavily damage
5	>75-100	Very heavily damaged

Source: Mardji (2003)

Health Condition of Seedlings

Acacia seedlings were observed, and the percentage of healthy seedlings was calculated. The percentage of seedling health condition is calculated according to Abadi (2003), as follows:

$$\text{Plant Healthy (\%)} = \frac{number\ of\ healthy\ seedlings}{total\ number\ of\ seedlings} \times 100 \ldots\ldots\ldots\ldots\ldots \quad (3)$$

Seedling health is classified into several criteria according to the percentage. Based on Sunardi et al., (2021), seedling health criteria based on percentage are presented in Table 4.

Table 4. Seedling health percentage criteria

No	Percentage of Healthy (%)	Criteria
1	> 75	Healthy
2	51-75	Less healthy plants
3	26-50	Low healthy plant
4	0-25	Healthy plants are relatively low

Source: (Sunardi et al., 2021)

RESULT AND DISCUSSION

Survival Rate

The percentage of survival rate is a factor that determines the resilience or adaptability of plants to conditions in the field (Ginting et al., 2021). The survival rate of live acacia seedlings was calculated for each new seedling in the shaded area. The survival rate of acacia seedlings in the PT. SPM nursery can be seen in Figure 2.

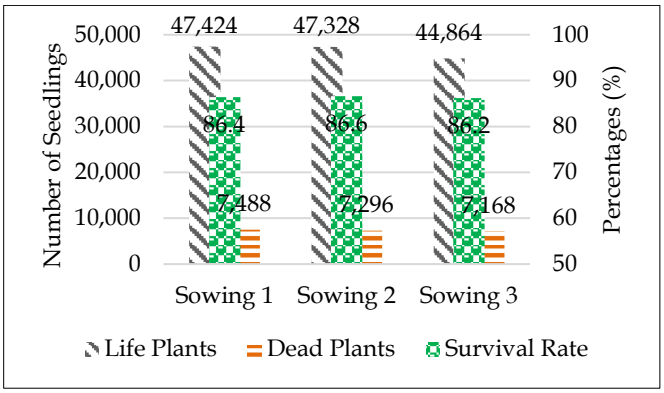

Figure 2. Survival rate of acacia seedling

The results in Figure 1 show that the survival rate of acacia seedlings at three planting times has a value of 86.4%, 86.6%, and 86.2%; based on Sunardi et al., (2021), this value is classified in the good category, which is >75%. This indicates that the seedlings can adapt well to the nursery environment. The results of research by Palimbong et al., (2023), related to the survival rate of acacia seedlings in the nursery have an average value of 97.5%, proving that the nursery environment affects seedling survival.

The survival rate of acacia seedlings at PT. SPM is relatively high because they use quality seedlings in the nursery with sufficient water availability and appropriate plant media. Planting media is an essential factor in the nursery. Using a combination of peat and cocopeat planting media has proven successful and suitable for acacia seedling nurseries, as indicated by the results of observations of survival rates in the excellent category. The research by Prasetyo et al., (2020), stated that combining peat and cocopeat in the proper ratio can support dense and compact root growth. This combination produces a loose media structure with smoother oxygen exchange and vital water binding capacity. Cocopeat can hold a lot of water, has a crumbly texture, and has good aeration, so it can accelerate and increase germination (Kuntardina et al., 2022).

The survival rate is calculated when the seedlings are in the shading area, where nutrients, water, and light are regulated and maintained to improve seedling quality. This is in line with the opinion of Racmawati et al., (2017), in the shade house the air humidity conditions are better maintained and can protect plants from exposure to rainwater and extreme temperature drops at night. Appropriate temperature, humidity, and light intensity can support seedling growth (Friadi & Junadhi, 2022).

Intensity of Pest and Disease Attack

The intensity of pest and disease attacks is the degree of plant damage measured to determine whether a plant needs special care or attention to improve its quality (Sasmita et al., 2018). The calculation results show the overall condition of acacia seedlings with a mild level of damage, which can be seen in Figure 3.

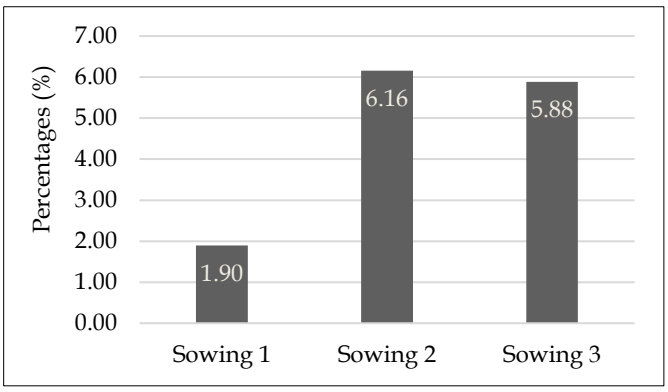

Figure 3. Intensity of pest and disease attack on acacia seedlings

The intensity of attack on acacia seedlings in sowing 1 was 1.90% with light damage, in sowing 2 the intensity of attack on acacia seedlings increased relatively high at 6.16% with light damage. The intensity of attack on the sowing 3 decreased to 5.88% with light damage. The number of pests and diseases found is the factor that causes the high and low intensity of attacks in the nursery. This follows research conducted by Zeni et al., (2021), that the number of pest and disease attacks that occur can affect the calculation of the percentage of attack intensity.

The increase in pest attack intensity at sowing 2 occurred because it is one of the weaknesses in monoculture crop cultivation, which is more susceptible to pests in the

nursery and the field. This happens because there is always a food source for pests and a large enough host for diseases (Putri et al., 2019). In addition to food availability for pests, cultivating plants of the same type provides a suitable habitat for pests to breed and spread quickly. This is in line with the research of Kaparang et al., (2021), which states that crops cultivated throughout the year without rotation with other crops will allow certain pests to develop quickly due to habitat suitability.

Pest and disease attacks can move from one seedling to another or are dynamic. This follows the opinion of Manek et al., (2023), that plant pests are dynamic, referring to a condition constantly changing, moving actively, and experiencing development. Environmental factors such as weather conditions and nursery cleanliness can also affect the percentage of attack intensity. The results of research by Pratiwi et al., (2022), related to the intensity of attacks on shallot plants, stated that the increase in the intensity of onion caterpillar pest attacks (*Spodoptera exigua*) was caused by weather conditions, causing the spread of onion caterpillar pests to be relatively fast.

Health Condition of Seedlings

Seedling health is an important aspect of supporting seedling quality. Based on the identification results, Figure 4 shows the percentage of acacia seedling health.

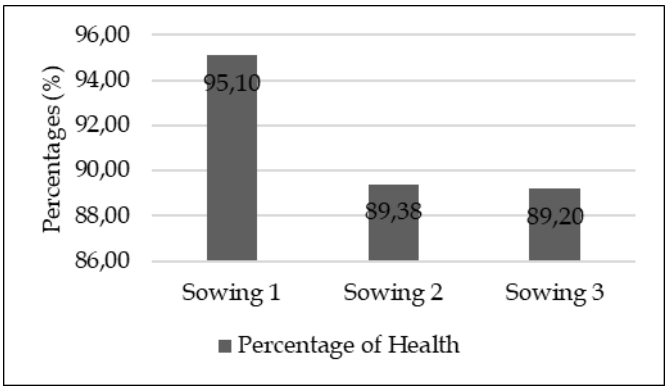

Figure 4. Percentage of acacia seedling health

The results in Figure 3 show the health percentage of acacia seedlings. The health percentage of sowing 1 had the highest percentage value of 95.10% while sowing 3 had the lowest percentage of 89.20%. The decrease in the percentage value of health is in line with the increase in the number of acacia seedlings attacked by pests and diseases. The more damaged plants due to pest and disease attacks, the lower the percentage value of plant health. In addition, plant health conditions are influenced by environmental factors such as unstable weather (Indriyanto et al., 2019).

Pest Infestation of Acacia Seedlings

The results of observations in the nursery found symptoms of damage due to pest attacks. The most significant damage occurred on the leaves of acacia seedlings, in accordance with the opinion of Aksar et al., (2022), which states that insects favor the leaves of all seedlings as food because they are still soft and young. Attack symptoms found on acacia seedlings included curled leaves and perforated leaves caused by pests.

Leaf curling

Observations in the nursery revealed symptoms of leaf curling. Figure 5 shows Acacia seedlings that curled up due to pest attacks.

Figure 5. The curling leaves of *Acacia crassicarpa*

Spider infestations can cause leaf rolling due to the tension created by webs attached to the leaf surface. According to Azwin et al., (2022), the initial symptom of infestation is leaf rolling, where the spider uses silk to bind parts of the leaf together for nesting and egg-laying purposes. Based on the identification by Soedijo & Pramudi (2015), the spider species with characteristics as shown in Figure 6 is *Oxyopes javanus*.

Figure 6. *Oxyopes javanus* found on leaves

The curled leaves found in this study were also caused by caterpillar infestation. These caterpillar pests connect two sides of the leaf, making it curl up like a long tube. Caterpillar pests use the tube as a place to live while eating the lower leaf tissue. Research conducted by Septian et al., (2021), stated that young leaves that roll up are a favorite place where caterpillars are protected and developed. The curled leaves of acacia seedlings and caterpillars in the larval, pupa, and imago phases can be seen in Figure 7. Armyworms cause losses in the larval phase due to the activity of making cocoons by smearing substances such as web threads, causing the leaves to curl. Armyworms in the pupa phase do not eat leaves but can cause leaves to curl.

Figure 7. Armyworms in the larval phase

Hollow Leaves

The results of observations in the field show that besides causing leaf curling, armyworms can also cause symptoms of hollow leaf attack. Damage to the leaves caused by this caterpillar can be of different types and levels. The armyworm imago phase can be categorized as a pest if, as a result of the larvae attack, it causes economic losses to acacia seedlings (Sutrisno, 2020). Most of the larvae of the imago are herbivores that feed on various parts of the plant. Perforated leaves are caused by contact with pests. Caterpillars are pests that are often found feeding on leaves. Feeding activities carried out by these larvae cause holes in the leaves, as seen in Figure 8.

Figure 8. Hollow *Acacia crassicarpa* leaves

In addition to armyworms, leaf-eating pests found in this study are grasshoppers. According to Mawardi et al., (2016), the grasshoppers identified in this research belong to the order *Caelifera*. Grasshoppers are insects that become pests because they cause holes in the leaves due to eating activities. This follows the opinion of Saputri et al., (2023), that young and adult leaf locusts are very voracious and usually eat the leaves of plants. Plants attacked by these pests have symptoms of tearing or holes in the leaves, and in severe attacks, almost the entire leaf is exhausted, including the leaf bone. Grasshoppers found on acacia seedlings can be seen in Figure 9. Pests that attack acacia leaves not only cause holes in the leaves but can also cause yellowing. Susilawati & Naemah (2018) state that perforated leaves reduce the results of photosynthesis and respiration processes due to the physical part of the leaf being lost.

Figure 9. Grasshoppers on *Acacia crassicarpa* leaves

Disease Attack on Acacia Seedlings

The nursery's observations revealed two symptoms of disease attack on acacia seedlings: yellowing leaves, spotting and leaf blight. The two symptoms were clearly visible on the leaves of the acacia seedlings.

Yellowing Leaves

The results of observations in the field found symptoms of yellowing leaves. Symptoms of this disease attack occur on the surface of the leaves. The yellowed acacia seedlings can be seen in Figure 10. Yellowing of leaves is a change in leaf color that shows irregularities, where leaves that should be green become yellow. This can occur due to further consequences of pest attacks, diseases, or lack of plant nutrients (Putri et al., 2021). If left unchecked, yellowing leaves will inhibit the growth rate of the seedlings, and the leaves will die or fall off.

Figure 10. Yellowing leaves

Leaf Spot and Blight

Diseases that can cause yellowing of acacia leaves are spotting and leaf blight due to the attack of leaf blight bacteria (*Xanthomonas campestris*), with symptoms of striped, elongated, and widened spots, then drying. Acacia seedling leaves that experience symptoms of bacterial leaf blight can be seen in Figure 11. This pathogen can develop rapidly during the rainy season or on plants without shade in open areas. It is usually found in areas with high humidity. The spread of this pathogen is caused by bacterial propagules that spread through watering water, equipment, contact with diseased plants, or carried by seeds (Oktavia et al., 2016).

Figure 11. *Acacia crassicarpa* seedlings infested with bacterial leaf blight

CONCLUSION

The intensity of pest and disease attacks on acacia (*Acacia crassicarpa*) seedlings in the nursery of PT. Sekato Pratama Makmur showed that the percentage of pest and disease attack intensity was 1.90% in sowing 1, 6.16% in sowing 2, and 5.88% in sowing 3, with a mild level of damage. The percentage of acacia plant health was 95.10% in sowing 1, 89.38% in sowing 2, and 89.20% in sowing 3. Damage to leaves included leaf curling, leaf holes, leaf yellowing, leaf spots, and blight. This indicates that the acacia seedlings in the nursery are in good condition. The low intensity and minor severity of pest and disease attacks demonstrate that the control measures implemented by PT. SPM are effective. This research contributes to the development of effective pest control strategies by providing initial information on the health condition of Acacia seedlings and supports the long-term success of field planting.

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