



## Coconut Plants (*Cocos Nucifera* L.) And Some Pests And Diseases That Attack Them

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### ABSTRACT

This study aims to identify several pests and diseases that attack coconut plants. The benefits of the plant lie not only in the flesh of the fruit, which can be processed into coconut milk, copra, and coconut oil, but all parts of the coconut plant have significant benefits. The method used for sampling was a purposive sampling method in the main nursery. In this study, sampling was conducted in one village with three nursery locations ( $f_1$ ,  $f_2$ , and  $f_3$ ). The population at each nursery location was 130 seedlings. Therefore, the sample used was 15% of the 130 plants, namely 20 plants. The results of this study: coconut beetle pests can be controlled effectively with insecticides: Sevin 85 SP with a dose of 10 grams/tree where half is watered and the rest is sprinkled onto the shoots of the plant towards the growing point, with an interval of every two months - Lebaycid 50 EC, with a dose of 5 cc/liter of water/tree and an interval of two months - For preventive measures, Basudin 10 G can be used with a dose of 20 grams/tree directly sprinkled onto the shoots of the plant and repeated every 3 months.

### INTRODUCTION

Coconut (*Cocos nucifera* L.) is a strategic commodity that has a social, cultural and economic role in the lives of Indonesian people. The benefits of the plant do not only lie in the flesh of the fruit which can be processed into coconut milk, copra and coconut oil, but all parts of the coconut plant have great benefits. The benefits of the coconut plant are so great that some call it the "tree of life" or "a heaven tree". In addition to being nicknamed the "tree of life", coconut is also called the "tree of heaven". Coconut is a tropical plant that has long been known to the Indonesian people (Matitaputty, Amanupunyo, & Rumahlewang, 2014).

Coconut plants (*Cocos nucifera*) are classified in the kingdom: plantae (plants), Subkingdom: Tracheobionta (vascular plants), Super Division: Magnoliophyta (flowering plants), Class: Liliopsida (monocotyledons), Sub Class: Areci, Order, Arecales, Family: Arecaceae (areca palm family), Genus: *Cocos*, Species, *Cocos nucifera* L (Yudirachman, 2016). Coconut is the only member of the *Cocos* genus from the areca palm family or Arecaceae. This plant is used by almost all of its parts by humans so that it is considered a multipurpose plant, especially for coastal communities. Coconut is also the name for the fruit produced by this plant. This plant is thought to originate from the coast of the Indian Ocean on the Asian side, but has now spread throughout the tropical coasts of the world. A tree with a single tree or no branches. Fibrous roots, thick and woody, clustered in the form of tubers, adaptive to coastal sandy land. The stem is segmented but when old it is not very visible, typical of the monocotyledon type with spreading vessels (not concentric), woody. The wood is not good for use in buildings (Kelayakan et al., 2023).

The leaves are single leaves with pinnate veins, the leaves are very deeply notched so that they look like compound leaves. The flowers are arranged in compound clusters protected by bracts; there are male and female flowers, monoecious, the female flowers are located at the base of the cluster, while the male flowers are in the part far from the base. Large fruit, 10 cm to 20 cm in diameter or even more, yellow, green, or brown in color; the fruit is arranged in a mesocarp in the form of lignified fibers, called coir, protecting the hard endocarp (called batok) and waterproof; the endocarp protects the seeds which are only protected by a membrane attached to the inside of the endocarp. The endosperm is a liquid containing many enzymes, and its solid phase settles on the endocarp wall as the fruit gets older; small embryo and only enlarges when the fruit is ready to germinate (called kentos) (Yudirachman, 2016) and (Mayasari et al., 2024).

Coconut (*Cocos nucifera*) belongs to the palmae family and is divided into three: 1) coconut in the *Viridia* variety (green coconut), *Rubescens* (red coconut), *Macrocorpu* (gray coconut), *Saccharina* (sweet coconut). 2) dwarf coconut with the *Eburnea* variety (flesh coconut), *Regina* (king coconut), *Pumila* (quail coconut), *Pretiosa* (widening king coconut), and 3) hybrid coconut (Amin and Prabandono, 2014). According to Yudirachman (2016). Its characteristics are tall and large trunks, can grow up to 30 meters or more, the base of the trunk is usually enlarged. Coconut in the fruit is rather slow, namely between 6-8 years after planting and its age can reach 100 years or more. The advantages of this variety are: Production of around 90 fruits/tree/year, Thick and hard fruit flesh with high oil content, More resistant to pests and diseases, Genjah Variety. According to Yudirachman (2016), the characteristics are that genjah is a coconut plant with a slender stem shape from base to tip, a stem height of 5 meters or more. Dwarf coconuts bear fruit at the age





of 3-4 years but bear fruit rarely and are small in size. The advantages of the genjah variety are; Fruit production of 80-90 fruits/tree/year, Seed production of 9-10 fruits/bunch, Oil content of 63.9%, Hybrid Variety (Defitri, 2019) and (Hutabarat, Sari, Rukhmana, & Dwijayanti, 2023).

Hybrid coconut varieties are obtained from the results of crossing between genjah varieties and in-varieties. The results of the crossing are a combination of good traits from both types of original varieties. Dwarf coconuts have weaknesses including: sensitive to poor environmental conditions. Fruiting abundantly but easily affected by climate fluctuations. The superior properties of hybrid coconut are: Fruit production of around 140 grains/tree/year, Thick, hard flesh and high oil content, Fruit bunch production of around 12 bunches and containing around 10-20 coconuts, the flesh of the fruit has a thickness of around 1.5 (Yudirachman 2016) and (Dacholfany, Ikhwan, Budiman, & Hutabarat, 2024).

### LITERATURE REVIEW

Coconut cultivation involves a series of steps from planting to harvesting. Here are some general stages in how to cultivate coconuts. Location selection is very important for the growth of coconuts so that they can grow well and not be difficult during harvesting. The following are the requirements for coconut cultivation locations summarized from various sources: Coconuts grow optimally in areas with a tropical climate, which is characterized by high temperatures throughout the year and sufficient rainfall, keep in mind that coconuts are not resistant to low temperatures, Coconuts require a minimum temperature of around 27-30 degrees Celsius for optimal growth, because temperatures below this limit can inhibit plant growth, Coconuts also require high air humidity, ideally above 60%. Sufficient humidity helps in the formation of flowers and coconut fruit, The soil where the coconut is planted should have good drainage to prevent waterlogging. Coconuts do not like soil conditions that are too moist, Coconut plants prefer to grow in sandy or clay soil with a loose structure (Hutabarat & Ekawarna, 2023) and (Riady & Hutabarat, 2023).

This soil allows coconut roots to grow well and facilitates water flow, Sufficiently deep soil is very important to facilitate the growth of coconut roots that can reach the nutrients needed, Coconuts usually grow better in low to medium plains. Although some varieties of coconut can grow in highlands, most are more suitable in lowlands, Coconuts need protection from strong winds and storms because these plants have shallow roots and stems that are susceptible to damage, Although coconuts are drought-resistant in some conditions, it is important to note that providing sufficient water is very important for early growth and fruit formation, The cultivation location should be easily accessible and have adequate infrastructure to facilitate maintenance activities and distribution of harvest results (Zahar et al., 2024).

Soil preparation is a critical step in coconut cultivation because good soil conditions can provide optimal support for the growth and production of coconut plants. The following are the steps for preparing the soil in the coconut cultivation process: Land Clearing; Clear the land from wild plants, debris, and other organic materials. Also make sure there are no plant residues or materials that can inhibit the growth of coconuts, Soil Cultivation; Carry out the soil by plowing or hoeing to break up soil clumps and ensure uniform soil texture. This helps increase soil porosity, facilitate water and air movement, and facilitate the growth of coconut roots, Organic Fertilizer Application; Provide organic fertilizer such as compost or manure to increase soil fertility. In addition, organic fertilizer also helps increase the soil's capacity to retain water and nutrients, Soil Liming (Optional); Carry out liming if necessary to balance the soil pH (Phongsavath, Andriani, & Saputra Hutabarat, 2022), (Hutabarat, Wiryotinoyo, Masni, & Handayani, 2022) and (Pratiwi, Hutabarat, Anggraini, & Zulfa, 2024).

Coconuts usually grow well at a soil pH between 5.5 and 7.5, Inorganic Fertilizer Application; Soil analysis can be used to determine the nutritional needs of coconut plants. Provide inorganic fertilizers that suit the needs of the plants, especially fertilizers that contain the main elements such as nitrogen, phosphorus, and potassium, Formation of Beds or Planting Holes; Make beds or planting holes according to the planned planting pattern. Ensure sufficient spacing between plants to support optimal coconut plant growth, Initial Watering; Carry out initial watering after the soil has been prepared to ensure sufficient soil moisture and help speed up the adaptation of the coconut seedlings (Pratiwi & Hutabarat, 2024) and (Hutabarat, Masni, Zahar, Pratiwi, & Sembiring, 2024).

### METHOD

The method used for sampling is the purposive sampling method in the main nursery. In this study, sampling was carried out in 1 village with three nursery locations ( $f_1$ ,  $f_2$ , and  $f_3$ ). The population at each nursery location was 130 seedlings. So the sample used was 15% of the 130 plants, which was 20 plants. Determination of sample plants was done by taking numbers/lotteries of 20 numbers randomly. Before taking plant samples, all plants (130 seedlings) were numbered and then 20 numbers were removed from the 130 numbers provided. Then the number that was removed was used as the sample plant number. Furthermore, the sample plants were observed visually (observing the percentage and intensity of disease pathogen attacks). Observations were continued microscopically in the Class 1 Jambi Agricultural Quarantine Laboratory.





## RESULTS

### Coconut Plant Pests

Damage to coconut plants caused by pest attacks, recently covering around 4 million trees, resulted in a decrease in production of at least 20,000-30,000 tons of copra each year. Based on the part of the plant attacked, coconut plant pests can be grouped as follows: 1. Shoot Destroyer: a. Brontispa Beetle (*Brontispa* sp.), b. Coconut Palm Beetle (*Oryctes rhinoceros* L.), c. Sago Beetle (*Rhynchophorus ferrugineus*). 2. Leaf Destroyer: a. Grasshopper (*Locusta migratoria manilensis*), b. Woodhopper (*Valanga nigricornis* Burn.), c. Swordtail grasshopper (*Sexava* sp.), d. Coconut kapok bug (*Aleurodicus destructor* M.), e. Javan aspidiotus bug (*Aspidiotus* sp.), f. Areca nut bagworm (*Mahasena corbetti*), g. Parasa caterpillar (*Parasa lepida*), h. Palu snail caterpillar (*Darna catenatus*), i. Hidari caterpillar (*Hidari irava* Moore) j. Artona caterpillar (*Adona catoxantha* H.), k. Setora caterpillar (*Setora nitens*). 3. Flower Destroyer: a. Coconut flower moth (*Batrachedra arenosella* W.) b. Tirathaba caterpillar (*Tirathaba rufivena* Walk.). 4. Fruit Destroyer: a. Rats (*Ratus-ratus* Roquel), b. Squirrels (*Callosciurus notatus* and *Callosciurus nigrovitatus*).

The description below will briefly discuss several important pests, from year to year which are the main causes of damage to coconut plantations.

#### 1. Brontispa Beetle (*Brontispa* sp.)

Family: Chrysomelidae Order: Coleoptera Symptoms of attack: -Brontispa beetle damages coconut shoots, especially in young plants. Both larvae and beetles are in the folds of young leaves that have not yet opened and bore into the tissue of young leaves, leaving elongated burrow marks. Furthermore, the leaves wrinkle and eventually die. - The damage caused by this beetle, in addition to damaged coconut leaves and young fruits falling, can result in the attacked coconut trees not bearing fruit at all in the following years. Prevention and Eradication

##### a. Mechanical method

Namely by cutting the affected leaves. The weakness of this method is that the tree loses its assimilation tools and causes wounds that can easily cause the spread of *Oryctes rhinoceros* or *Rhynchophorus ferrugineus* pests.

##### b. Chemical method

The affected trees can be sprayed with 0.15% dieldrin or 0.16% Chlordan every 4-6 weeks. The use of systemic insecticides has 114 better expectations than contact poisons, because of the nature of *Brontispa* which always avoids light and hides.

##### c. Combination of mechanical-chemical methods

This method is carried out to overcome severe and chronic attacks in a relatively short time. The combination of cutting the affected leaves and spraying with insecticides can destroy this pest more quickly.

##### d. Biological method

Using two types of parasites: -egg parasites (*Haeckliana brontispae* and *Ooencyrtus* sp.). -larva and pupa parasites (*Tetrastichodes brontispae*). The implementation of the eradication is as follows: Several bamboo gutters filled with larvae or pupae of *Brontispa*

containing parasites are placed on coconut trees. It is hoped that the parasites will spread, then attack the *Brontispa* pests that are disturbing the coconuts.

#### 2. Coconut Beetle (*Oryctes rhinoceros* L.)

Family: Dynastidae Order: Coleoptera Symptoms of attack: -Adult beetles bore and drill the base of the leaf sheath until they reach the leaves that have not yet opened. As a result, when the leaf opens, the affected leaf scar appears to have a triangular tip. -If it attacks the growing point, the coconut tree will die because it is no longer able to produce new leaves. -Damage caused by coconut beetle attacks can be continued by sago beetles or coconut horn beetles. made of soil, yellow in color. Adult beetles (imago) are 3-5 cm in size, reddish brown in color. Adult beetles leave their cocoons at night and immediately fly up the coconut tree. Then they infiltrate the shoots, making holes through the base of the young leaf sheaths to the middle of the shoots and staying there for 5-10 days.

Prevention and Eradication

##### a. Sanitation method

That is, not giving the imago and its larvae a chance to live in piles of dirt, for example by: -dismantling piles of dirt/garbage while searching for and destroying the larvae and imago found. This work should be done regularly, every 2 months. -burning piles of dirt and garbage.

##### b. Chemical method

Based on the research results of Soenardi et al. (1978) coconut beetle pests can be controlled effectively with insecticides: -Sevin 85 SP with a dose of 10 grams/tree where half is watered and the rest is sprinkled onto the top of the plant towards the growing point, with an interval of administration every two months -Lebaycid 50 EC, with a dose of 5 cc/liter of water/tree and an interval of administration of two months -For preventive measures, Basudin 10 G can be used with a dose of 20 grams/tree directly sprinkled onto the top of the plant and repeated every 3 months.

##### c. A combination of mechanical, chemical and sanitation methods, the affected trees are cut down.

The tops are clibelah-belch and given aldrin 40% WP for "trapping". The stems and other parts are burned. The work is carried out in such a way, namely starting from the border of the area that is still free of pests and the area that has been cleaned, which is a barrier to the spread of further attacks. "Trapping" can also be done by piling up garbage





that has been given insecticides such as BHC or HCH. Beetles that lay eggs on it will be poisoned.

d. Biological method

Biological control of coconut beetle pests can be done by using: 1) Using the fungus *Metharrizium anisopliae*, This fungus attacks coconut beetle larvae so that they dry out and die. Often pupae and beetles are also attacked.

2) Using the Baculovirus oryctes virus In 1987

The Indonesian government imported this virus to control the *Oryctes* pest which was once rampant. Control is by infecting *Oryctes* beetles with this virus and infected beetles will die within 4-6 weeks. During this time, the infected beetles are released into the coconut plantation so that they can spread the virus carried to other coconut beetles. The minimum number of coconut beetles released is 10/ha/month.

e. Technical culture method

By planting ground cover plants in the coconut plantation area so that the reproduction of vegetable beetle pests can be suppressed.

3. Sago Beetle (*Rhynchophorus ferrugineus* Oliv.)

Symptoms of attack: -The cause of damage is the larval stage. -In young coconut plants, larvae are found in the roots, stems and leaf crowns. -In old coconut plants, it only attacks the leaf crown and as a result of the attack, the top of the plant breaks. If the attack hits the growing point, it can cause plant death. -Remains of fiber and dirt come out of the holes in the stem.

Prevention and Eradication

a. General Sanitation

The sago beetle attack is a continuation of the coconut beetle attack, therefore the coconut beetle attack must be avoided, the garden must be clean and avoid injury to the coconut tree trunk. When cutting the leaves, instead the leaf sheath is left along  $\pm$  30 cm or the leaf sheath is allowed to dry before being removed.

b. Chemical method

The type and dose of insecticide used to control this pest are the same as those used to control the coconut beetle. Systemic insecticides can also be used by root infusion or injection through the coconut plant trunk.

4. Sword Grasshopper (*Sexava* sp.) Family: Locustidae Order: Orthoptera

Symptoms of attack: - This grasshopper pest eats coconut leaves, especially leaves that have reached a perfect growth level (old) starting from the edge of the leaf and leaving irregular attack marks. The attack starts from the lowest leaf sheath. In a forced situation, the sword grasshopper can also attack young leaves, fruit skin and flowers. - *Sexava* usually runs rampant in the dry season. Both nymph and imago (adult) forms are very greedy. In severe attacks, the lower leaves only have ribs left. This is found in abundance in the Aru, Seram and Bacan islands. Adult grasshoppers measure up to 11 cm, are green in color. A female lays  $\pm$  50 eggs. The eggs are shaped like grain,  $\pm$  12 mm long. The egg period is 50 days. The newly hatched larvae are 12 mm long, green or reddish brown in color (Dacholfany et al., 2023).

Prevention and Eradication

There are 4 ways to eradicate them, namely

a. Mechanical method

This is done by looking for eggs and nymphs, then destroying them. Adult grasshoppers are relatively easy to catch, and this can be done, but only in very limited numbers. 120 In North Sulawesi (Sangihe-Talaud), the use of adhesive mixed with Agrocide, Linclane or HCH has also been tried, which is installed around the base of the stem. This adhesive is a barrier for female grasshoppers to lay eggs in the soil around the base of the stem, and at the same time holds back the nymphs that will rise upwards.

b. Technical culture method

Namely by planting ground cover plants, for example *Centrocema* sp., *Calopogonium* sp. and so on. Ground cover plants increase the humidity of the soil where *Sexava* lays eggs, thereby increasing the amount of egg damage, in addition to fertilizing the soil itself.

c. Chemical method

Namely spraying the affected plants with one or more insecticides, such as BHC or Endrin 19.2 e.c. with a dose of 2 cc / liter of water. This insecticide is sprayed on the base of the stem up to a height of 1 meter, and also the soil around the base of the stem with a diameter of 1.5 m. For 1 tree, 6 liters of solution are needed. Other insecticides that can be used are Sumithion 50E, Surecide 25E, Elsan 50E or Basudin 90 sc.

d. Biological method By using natural enemies such as *Leefmansia bicolor* and *Doirania leefmansia*, both of which attack the egg stage.

5. Parasa Caterpillar (*Parasa lepida*) Family: Limacodidae Order: Lepidoptera

Symptoms of attack: -Parasa caterpillars live in groups while eating coconut leaves so that only the fronds remain and the coconut plants look bare. -These caterpillars also attack coconut nurseries. Nature and lifestyle There are four stages experienced by parasa caterpillars during their life, namely the egg stage 5-6 days, caterpillar 33-37 days, pupa 19-23 days and moth. Eggs are laid in groups on the underside of young leaves and are yellowish in color. Young caterpillars have green stripes on a yellow base, old caterpillars are green or yellowish green and on their backs there is





a green band and black spots on the coconut.

Prevention and Eradication

- a. Mechanical method, namely by ripping leaves from trees that are attacked during the caterpillar stage, or by collecting cocoons.
- b. Chemical method, namely spraying with insecticides such as Dimecron 50 EC, Suprecide 10 EC or Ambush 2 EC.
- c. Biological method, namely using natural enemies such as *Apanteles parasae* caterpillars, while the cocoons can be destroyed by three types of wasps, namely *Cryptus axymorus*, *Goryphus* and *Chrysis* and the *Chaetoxorista javana* caterpillar

### Coconut Plant Diseases

Disease is an abnormal and detrimental physiological process of plants caused by primary (biotic) and its disturbance is continuous and the consequences are expressed by abnormal cell/tissue activity, the consequences that appear are called symptoms (Whetzel, 1929). The causes of biotic diseases are generally in plants, can be transmitted, and are called diseases. As for diseases that are not, are not contagious, and are usually called physiogenic diseases. The causes consist of several groups such as viruses, viroids, bacterial phytoplasmas, fungi, rickettsia, protozoa, nematodes and higher plants (Sinaga, 2003).

Diseases in cultivated plants are usually caused by fungi, bacteria, viruses and the environment (climate, soil, etc.). Fungi are a group of living organisms that resemble higher plants because they have cell walls, do not move, reproduce with spores, but do not have chlorophyll. Fungi do not have stems, leaves, roots, and vessels like in higher plants. Bacteria are one of the small creatures (organisms) that are large including saprophytes (living in the bodies of other creatures, not harming and benefiting other creatures). Viruses are obligate pathogens (only living and reproducing in living organisms). The size of the virus is very small (sub-microscopic) and consists of chemical compositions, namely protein and Nucleic Acid. Viruses are and can cause various diseases in all forms of living organisms (Pratiwi & Hutabarat, 2024). Diseases caused by the environment are usually caused by the incompatibility of environmental conditions where plants grow with environmental conditions that are the habitat of native plants, so that plants grow unhealthy. Symptoms of diseases caused by the environment are usually similar to symptoms of diseases caused by living things, the difference is that diseases caused by the environment are not contagious (Rukmana, 2005). Disease attacks on cultivated plants are more directed at the physiological process because they attack plant cells and tissues, the impact of losses caused by disruption of the plant photosynthesis process, this occurs because of damage to the cross-section of the leaf due to disease, so that the leaves cannot absorb sunlight optimally, absorption that absorbs leaves includes, leaf rust by the fungus *Phachyriza phakes pora*, bacterial spot disease by *Xanthomaras phaseoli*, mosaic virus that attacks young leaves and young shoots (Sitinjak, 2016). According to Agrios (2005), stated that leaf spot disease is a disease caused by a function that inhibits and reduces photosynthesis results and will then inhibit growth. Several Diseases that Attack Coconut Plants and Their Control According to Yudirachman (2016) diseases that often attack and harm coconut plants are as follows;

#### 1. Fruit Drop

This disease was first found in North Sulawesi. Fruit drop reaches 75%. This disease attacks coconut plants in various regions. Causes of premature nutfall and shoot rot rot) is the fungus *Phytophthora palmivora* (Butl). On Generally, this fungus attacks young shoots and fruit that are more than 2 months old. Symptoms of this disease attack first appear in leaves that are pale in color, slightly bent and eventually break and fall. Leaves that are heavily attacked will fall off. Rotting grass gives off an unpleasant odor. Coconut plants attacked by this disease cannot be cured because the shoots die before symptoms of the disease appear. This fungus also causes fruit to fall. Symptoms of attack on fruit are small brown spots that become easily wet with a diameter of approximately 1 cm in the middle between the tip and base of the fruit. The spots will become wet and brown, causing the fruit to fall. Diseased coir tissue appears pinkish brown or yellowish brown.

#### 2. Top Rot

Top rot disease is caused by the fungus *Phytophthora*. This disease attacks young coconut plants. Symptoms of this disease are the appearance of translucent spots on the surface of the leaves, then immediately become yellowish brown, often merging to form larger spots on the spots, there are spots consisting of fungal *Acervuli*. Affected leaves will die faster.

Control

The technology for controlling coconut shoot rot and coconut fruit fall can be done by implementing various control components as follows:

#### a. Eradication or destruction of infected plants

All plants infected with shoot rot, both those that have died and those that are just showing symptoms of attack, must be cut down and destroyed. All parts of the infected plant are burned to remove *Phytophthora* inoculum.

#### b. Chemical Control

Coconut fruit rot can be controlled by using systemic fungicides such as Fosetil-Al with a dose of 8 grams of active ingredient, applied every 6 months. Root injection can also be done using 8 grams of Aliete CA or 5.6 grams of





phosphoric acid per tree per year.

c. Control all trees in the garden to prevent Phytophthora infection.

Control is carried out on infected trees and surrounding trees up to the second layer of infected trees. Sanitation, the condition of the garden is kept clean by removing sources of disease, such as fallen coconuts, dirt, and the remains of fruit and flowers stuck in the leaf axils to prevent the development of Phytophthora.

d. Quarantine

This control technique plays a role in preventing the entry of coconut plants infected or contaminated with Phytophthora fungi into areas that have not been attacked by the fungus. Avoid planting coconuts in locations that have been infected with this disease, especially on land with poor drainage.

3. Shoot Rot

Shoot rot disease or buds (Pre-emergent shoot rot) is caused by the fungus *Marasmius palmivorus* Sharples. This disease attacks newly grown seeds. Symptoms of disease attack at the early infection stage, when the fiber is opened, spots and layers of white or reddish-white mycelium are visible on the buds and edges of the leaf buds. This disease can arise from seeds infected with the fungus, either in the field or during germination.

4. Natuna Wilt

The cause of Natuna wilt disease is not yet known for sure, but from the isolation of dead tissue, *Diplodia* bacteria and *Fusarium* fungus, sp. were obtained. Symptoms of Natuna wilt disease attack, initially the middle leaves suddenly wilt, turn yellow and finally die. In the flowers there is rot, the stems hang and finally fall along with the fruit bunches. The death process is very fast, 1-3 months since the initial symptoms appear. Natuna disease is prevented by making drainage channels, good soil cultivation, fertilization and proper planting patterns, plant quarantine so that there is no illegal traffic that causes the spread of disease from one area to another.

5. Yellow Wilt

Yellow wilt disease is caused by many factors, including: a. Poor environmental factors, such as waterlogging or drought, b. Technical culture factors, such as poor soil cultivation methods, improper use of pesticides, lack of fertilizer and irregular fertilization, c. Vegetation conditions, such as gardens with lots of weeds and dirty, d. Pest and disease factors that breed without control, e. Physiological factors, such as root disorders due to unsuitable soil conditions so that plant metabolism is disrupted.

The symptoms are that all or part of the leaves are yellow, especially when exposed to sunlight, the plant grows stunted, the closer to the top the size of the leaf stalks and leaves becomes smaller. Some of the upper leaf stalks are thin and bent at the tips. Some of the lower leaf stalks hang and dry. Flowers and fruit buds are very rare. Young fruit falls off and very few are able to survive until old age. The size of the fruit is small and irregularly shaped. The flowers that grow after the tree is sick are shorter and smaller, they crack and open imperfectly, and even the flowers that are still wrapped become rotten as if they have been attacked by a rot disease. Control (Masni, Tara, & Hutabarat, 2021). It is recommended to take measures to prevent the spread of the disease, such as quarantine and eradication by cutting down infected trees and then destroying them

6. Gray Leaf Spot

Gray leaf spot disease is caused by the fungus *Pestalotiopsis palmarum* (Cke) Stay which causes gray spots, *Helminthosporium incurvatum* Bernard and *Curvularia maculans* (Bancroft) Boedijn which causes brown spots. The spread of this disease is through spores, air, water or insects. Symptoms of gray spot disease attack, initially appear as translucent spots, which change to blackish brown, and finally gray. The gray part is surrounded by a dark brown edge. The spots can merge to become large spots. The characteristic symptom of gray spot is that it is not surrounded by a chlorotic path.

Disease control:

Technical culture control: is done by maintaining the nursery and young plants in good condition, providing sufficient irrigation, and providing balanced fertilizer. Providing potassium fertilizer is useful for increasing plant resistance to disease.

Chemical control: can use fungicides if 25% of the leaf surface has been covered in spots. Fungicides that can be used are those with the active ingredient mancozeb or chlorothalonil.

A. Harvest

Harvest is an important activity in coconut cultivation, because it is directly related to the results which are generally the final stage of the cultivation cycle of a plant. Proper harvesting, in the sense that it is in accordance with the purpose for which the harvest is carried out, can bring more profit. In carrying out coconut harvesting, there are several things that must be considered, namely: 1. Age of the plant, 2. When to harvest, 3. Harvest interval, 4. Harvest method, 5. Amount of results.

1. Age of Plant

In optimal growth conditions, the coconut plant can be harvested: a. Early maturing varieties after 3-4 years of age, b. Deep varieties after 6-7 years of age, c. Hybrids after  $\pm$  3 years of age

Fruit production will continue to increase until the plant reaches 60-65 years of age, even more if the plant growth conditions remain good. After reaching peak production, production will gradually decrease, until finally





reaching a "senile" state, with very low production to no production at all. The length of the productive period is influenced by several factors, namely: a. Genetic characteristics of the planted variety, b. Climate and soil conditions, c. Cultivation systems, such as: continuity of fertilization, irrigation, soil cultivation, pest and disease control, and so on.

#### 2. Harvest Time

The harvest time of coconuts depends on the use of the harvest and this is usually closely related to the age of the coconuts. If the need is for vegetable coconuts (fresh coconuts), copra and for seeds, then the coconuts to be harvested must meet the following requirements: a. The age of the fruit is around 11-13 months, where  $\frac{2}{3}$  of the skin of the fruit has dried, b. The skin of the fruit is brownish, c. When the fruit is shaken, it makes a sound.

At this stage of ripeness, the fruit has a high copra and oil content. The quality of the copra produced from the fruit is also the best. While harvesting coconuts with the aim of obtaining young coconuts (Javanese = degan), the fruit must meet the following requirements: a. The age of the fruit is around 7-9 months, b. Generally, the fruit is found in fruit bunches with a spiral of 9-10, c. The skin of the fruit is smooth, slippery and shiny.

#### 3. Harvest Interval

The harvest interval (picking turn) can be interpreted as the time period required from the first harvest to the next harvest. The harvest interval is related to the number of available workers and the area of the plantation and the costs involved. In certain areas where there are enough workers available, harvesting can be done every month or even faster, but in other areas with limited workers and very large coconut plantations, harvesting is usually carried out every two months by picking the two oldest bunches of fruit. Example of calculating the coconut harvest interval in a coconut plantation area that has 22,500 productive trees and is planned to be harvested every month. If there are 25 effective days in a month and 15 workers are available, then: a. Trees to be picked/working day =  $22,500/25 = 900$  trees, b. Trees picked/HK/worker =  $900/15 = 60$  trees, c. If each tree can be picked 5 fruits, then each worker per working day must pick fruit =  $60 \times 5 = 300$  coconuts.

With the calculation above, then by using 15 workers all productive trees can be harvested every month. In Java, coconut harvesting is carried out once a month. This is done to avoid fruit theft. Coconut plantation companies outside Java harvest at intervals of once every two months. This harvest interval coincides with the pruning turn on the green manure plants which are important for mulching. While in Sulawesi, the harvest interval is usually carried out once every three months.

#### 4. Harvesting Method

The method of harvesting coconuts varies depending on the purpose. For example, the method of harvesting coconuts for consumption, copra must be different from the method of harvesting fruit for seed purposes.

##### a. For consumption

There are several known ways of picking fruit. The common way of picking fruit is: 1) The tree is climbed by trained workers. To make it easier to climb, kowakan-kowakan (levels) are usually made on the trunk at a distance of every  $\frac{1}{2}$  meter. In young trees, these kowakan wounds often become nests for coconut beetle pests, 2) Using a pole with a sharp knife/sickle tied to the end. This method is usually done if the tree is still low. For tall trees, a longer pole is needed, 3) In several areas in Sumatra and Kalimantan (also in Malaysia and Thailand) trained monkeys (*Macacus nemestrinus*) are used to pick fruit. Where there is a lack of trained pickers, the fruit is usually left to fall on its own (for example in the Samoa Islands and British Guinea).

##### b. For seed purposes

The best way is to climb a coconut tree and the fruit is not dropped directly to the ground, but is put into a sack (basket) then lowered slowly with a rope. This is done to avoid damage to the seedling.

#### 5. Amount of Yield

The high and low yields are influenced by various factors, including: a. Coconut varieties, each of which has its own genotype, b. Soil and climate conditions, c. Groundwater conditions, d. Pest and disease attacks, e. Plant maintenance and surrounding conditions. In normal plantation conditions, each tree can produce an average of 1.5-2.0 tons of copra per hectare.

## DISCUSSION

### B. Storing Coconut Fruit

The fruit that has been picked, before being further processed into copra, is usually stored for several days. Unless the fiber will be used for by-products, then the fruit is immediately peeled after the harvest (download).

The advantages of storing fruit are as follows: 1. Peeling/removing the fiber is easier, 2. Removing the white seed from the shell is easier and cleaner, 3. The shell obtained is dry, hard, and when used as fuel, it burns well and produces very little smoke, 4. The water content of the white copra decreases and the thickness of the white copra layer increases. As a result, the yield of copra and oil is higher, 5. The quality of the copra produced is higher when compared to fruit that is not stored first.

There are two opinions about the origin of the coconut plant. The first opinion states that the coconut plant originates from Central America. The reason is that there are more coconut plant species found in that area than in other places. Meanwhile, another opinion states that the coconut originates from Southeast Asia. The coconut plant has many





benefits from the tree to the fruit. Coconut is a plant that is widely used by humans, especially its fruit, which is used as a spice and cooking ingredient. This plant is used by humans for almost all its parts so that it is considered a multi-purpose plant, especially for coastal communities. Coconut is also the name for the fruit produced by this plant. There are two types of coconut, namely dwarf coconut and deep coconut.

## B. Morphological Characteristics

### 1. Roots

Coconut trees have dense fibrous roots, reaching 4,000-7,000 strands on mature trees. The number of roots depends on the growth conditions of the plant and soil fertility. Some fibrous roots grow horizontally near the surface of the soil, sometimes reaching a length of 10-15 meters. Others grow into the soil up to 3-5 meters, but are unable to penetrate hard layers. Likewise, if the root tip reaches the surface of the groundwater, the tip stops extending. Fibrous roots are an average of 1 cm thick. There are no hair roots at the tip. The function of the hair roots is replaced by soft-walled root parts like bubbles that come out on the surface of the root located behind the root cap. This part is light in color, averages 5 cm in length, and functions to absorb nutrients needed by the plant. White parts also grow from the surface of the root that function to regulate root respiration (pneumatophora). Among the living roots, there are also dead roots. Because most of the coconut roots are roots that grow horizontally, if the tree grows in a place where the soil is too loose, the trunk will easily fall. But in general, the root system of the coconut tree ensures that the plant does not collapse. The base of the trunk easily produces adventitious roots, which when they enter the soil will function as ordinary roots. These adventitious roots sometimes grow out of the part of the trunk that is scarred.

### 2. Trunk

Coconut trees only have one growing point located at the tip of the trunk, so the trunk always grows upwards. Coconut trees do not have cambium, so they do not have secondary growth. Wounds that occur on the trunk cannot recover because the tree does not form callus. The trunk gradually lengthens. Large and wide leaves grow successively at the tip. At a certain level of growth, flower arrangements gradually emerge from the leaf axils. The actual trunk of a young tree is only clearly visible when the tree is 3-4 years old, when the lowest leaves have fallen. At that age, the base of the trunk has reached a fixed large and thick size. The diameter of the trunk is between 30-40 cm. In coconuts, the base of the trunk is up to twice as large. In pure dwarf coconuts, the size of the trunk at the base, middle and tip is almost the same. The height of the tree can reach 30 meters, depending on the variety. Its growth movement when it is still young is fast, but depends on the conditions of the growing environment, such as soil conditions, climate, pests and diseases, etc. The speed of tree growth can be seen from the location of the leaf sheath bases on the stem. On average, 12 leaves are formed in one year. The sheath marks at the base of the stem are generally sparse, but they become denser towards the tip. The age of the plant can be determined by counting the sheath marks on the stem. From the cross section of the stem, on the outside there are visible vascular bundles in very large numbers, gradually decreasing in number towards the inside. On the outside, these vascular bundles gather and connect with the vascular bundles from the leaf stalk.

### 3. Leaves

In newly grown seeds, 4-6 leaves are initially formed, arranged one around the other so that they form a sheath and are pointed at the tip. This arrangement is necessary to make it easier to penetrate the fiber layer next to the base of the fruit. After that, 4-6 leaves are formed in succession, which are larger than the leaves that were formed first, and are arranged separately from each other, but the leaf blades are not yet pinnate. Then other leaves follow in succession, their size increasing. The bases of the leaves wrap around the base of the stem, forming a false stem. The leaves gradually become more pinnate, starting from the base of the hel. Land clearing is done depending on the type of vegetation. There are two types of land clearing, namely forest land clearing and non-forest land clearing. Forest land clearing is initially done by cutting down bushes, then felling trees. Felling must be completed 2.5-3 months before planting. As for non-forest land clearing, it is necessary to clearly know the weeds growing on the land, whether they have rhizomes or not. This will affect the next steps in controlling weeds.

## C. Seed Sowing

Before being planted in the garden, coconut seeds are sown first to produce good coconut seedlings. There are three ways of sowing, including: 1. Hanging sowing is done if the number of coconut seedlings needed is relatively small.

2. Spread sowing is a traditional and very simple method, namely by simply spreading coconut seeds on the floor of the house, under the bed or in an open bathroom. Similar to hanging sowing, this method is only suitable for small-scale sowing. 3. Sowing in beds is a sowing technique that is widely used for large-scale coconut plantations. This method has the advantage of simplifying the selection of coconut seedlings, saving on the purchase of polybags and being able to provide seedlings in large quantities at a relatively low cost. Seeding in beds should be done during the rainy season to save on watering costs and should be done close to a water source or river and it would be even better if it is close to the garden to be planted. The steps for seeding in beds are as follows: 1. Cleaning the nursery land from stumps, tree stumps, and other plant remains, 2. Soil cultivation to a depth of 30-40 cm, 3. Adding manure to increase fertility (dose 10-20 tons/ha), 4. Making beds and drainage channels, 5. Sowing coconut seeds at a distance according to the length of





the nursery, 6. Sowing is done by immersing them in the soil with 2/3 of the seeds entering the soil and the other 1/3 being above the surface of the bed soil. Before sowing, the coir can be dipped in an insecticide solution to prevent termite attacks, 7. Providing shade if necessary, namely if the air is too hot, 8. Seedling maintenance in the form of watering/irrigation, weeding, and pest and disease control. Watering is done once a day or once every two days depending on the conditions using a watering can to prevent damage to the shoots.

Seedling maintenance is carried out for 32 weeks (8 months) until seedlings with 4 leaves are obtained and are ready to be transferred to the garden. The maximum age of seedlings for planting is 1 year after sowing. If the seedlings are too old, plant growth will be slow. Before being transferred to the garden, the seedlings are first selected to separate good seedlings from bad seedlings (rejected). Because of the existence of rejected seedlings, the number of seeds sown must take into account reserve seedlings and seedlings that will be rejected, which is around 20%. Seeding in polybags or plastic bags is usually done on coconut plantations that require large quantities of seedlings. The advantages of this seeding technique are that it can be done at any time without waiting for the rainy season, makes transportation easier, does not damage plant roots, makes maintenance and observation easier, and saves space. However, seeding with this technique requires additional costs, namely for the purchase of polybags.

#### D. Planting

Coconut seedlings that are ready to plant are then moved to the garden for planting. This planting should be done at the beginning of the rainy season so that the soil is really moist and good for the growth of coconut plants. Things that need to be considered before planting seedlings are the planting distance to be used, making planting holes, moving seedlings to the garden, and planting ground cover plants. Coconut plants require the right planting distance, namely a planting distance that allows the leaves of two adult coconut plants growing side by side not to touch and a fairly wide planting distance. Because the planting distance is quite wide, soil cultivation can be done after planting. The optimal planting distance for dwarf coconut plants is 7 m, while for tall coconuts it is 9 m. Farmers can use several forms of planting distance, including equilateral triangles, rectangles, and squares. The equilateral triangle model is the most widely used model, because it produces 15% more plants (more efficient use of land). After determining the planting distance used, the next step is to make a planting hole where previously stakes were installed based on the shape of the planting distance.

#### CONCLUSION

Through this study it can be concluded that: Harvesting techniques can use three methods, the first is the coconuts are allowed to fall, while the method that is widely used is by climbing. The first technique (the fruit is allowed to fall) has a disadvantage, namely that the fallen fruit is overripe, so it is not suitable for raw materials for copra or desiccated coconut. Harvesting coconuts by climbing is often done in the dry season. By climbing a coconut tree, coconuts that are ready to be harvested (harvest criteria) can be selected while cleaning the leaf crown. The disadvantage is that it damages the tree by making a platform to stand on. In addition to human power, picking can be done using the help of animals (monkeys/snake monkeys). The speed of picking by monkeys is 400 grains per day with a rest period of 1 hour. However, monkeys cannot clean the leaf crown and their selectivity is lacking. Another harvesting method is harvesting with a pole. This harvesting is done using bamboo that is connected and the end is fitted with a sharp knife in the form of a hook. With this technique, the average picking capacity is 100 trees/person/day.

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