

# ITTO PD 477/07 Rev. 4 (F)

Improving Forest Functions in Bengkulu Province Through  
Community Participation in Rehabilitation of Degraded Forest  
by Using Local Prospective Commodities

## PROPAGATION AND CULTIVATION TECHNIQUES OF BENTARA DURIAN (*Durio zibethinus Murr*)



JAKARTA, DECEMBER 2018



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By:

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Kamboya

**THE DIRECTORATE OF FOREST TREE SEED**



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Second Edition, December 2018

#### **Published by:**

The Directorate of Forest Tree Seed

ITTO Project of PD 477/07 Rev. 4 (F)

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## **PREFACE**

The involvement of the community and the types of species that are used, usually determine the success of forest and land rehabilitation activities. In Bengkulu Province, one of the popular local prospectives species is Bentara Durian. However, information in the community about how this species cultivated is still limited.

The book, entitled "Propagation and Cultivation Techniques of Bentara Durian" was produced in order to meet the demands of the community, especially in Bengkulu Province, which wanted to know more about the cultivation of Bentara Durian plants.

Publish of this book can be accomplished thanks to the project collaboration between ITTO, the Ministry of Environment and Forestry (Directorate of Forest Tree Seed) and the Environment and Forestry Service of Bengkulu Province through the activities of "Improving Forest Functions in Bengkulu Province Through Community Participation in Rehabilitation of Degraded Forest by Using Local Prospective Commodities".

I would also like to thank and appreciate to all of the people who have been involved in the process of this book compilation.

Hopefully this book will benefit readers.

Jakarta, December 2018

Mintarjo  
Director of Forest Tree Seed



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## I. INTRODUCTION

Durian (*Durio zibethinus* Murr) is a tropical fruit crop native to Indonesia. This habitat originally is from the island of Sumatra and Kalimantan, which spread all over Indonesia and Asia, especially Southeast Asia (Malaysia, Brunei, and the Philippines). There are more than 100 cultivars durian are known to the public, one of these is Bentara Durian. It has a local name *Durian Tembaga* (copper) *Batu Layang*. The local name reflects the origin of the durian that is derived from *Dusun Batu Layang*, *Batu Layang* Village, District *Hulu Palik*, North Bengkulu, Bengkulu Province. Bentara stands for Bengkulu Utara *Ben* = Bengkulu and *Tara* = *Utara/North*). The Minister of Agriculture issued a decree number 493/Kpts/SR.120/12/2005, it is stated that Bentara Durian released as a superior variety of durian. This variety has registered at the Center for Plant Variety Protection and Licensing of Agriculture, Ministry of Agriculture, in number 001/PVL/2006 on July 21, 2006. The single mother tree and the owner of Bentara Durian were presented in Figure 1 and 2 in sequence.



Figure 1.

The single mother tree of Bentara  
durian id Batu Layang Village



Figure 2.

Owner of the mother tree, Mr  
Sutarkam (inset: Bentara durian  
fruit, production in 2018)

The excellences of Bentara Durian compared with other durian species are: obovate fruit shape, fruit is easy to split, good smell, very thick fruit flesh, oval small seeds, flesh's color yellow copper, dry texture meat and fine fibrous, very sweet taste, average fruit weight of 2.5 to 4 kg/fruit, and adapt well in the lowlands. The great thing of Bentara Durian is the sugar content can obtain 25.8 Brix meaning that the taste is fairly sweet in its class. It has low-fat content which is 4%, and 76% water content, and the fruit production can reach 125-175 fruits/tree/season.

The geographic distribution of Bentara Durian includes District *Hulu Palik*, *Kerkap*, and *Padang Jaya*, North Bengkulu. However, it is possible to develop this durian in other areas, especially in Bengkulu. This is because the adaptability of durian is high enough to grow and thrive in tropical areas with maximum altitude of 800 m above sea level, rainfall 1500-2500 mm/year evenly throughout the year with two months dry, with the average of air temperature is 22 - 32°C, loose soil structure, well-drained and good aerated soil, the depth of water table is from 1.5 to 2 m, and soil pH between 6-7.

Mother tree of Bentara Durian is at *Dusun Batu Layang*, *Batu Layang Village*, District *Hulu Palik*, North Bengkulu, Bengkulu owned by a farmer named Mr. Sutarkam. This tree age, according to its owner, has more than 60 years. The tree planted by Sutarkam's parents. The mother tree has been a source of seed for seed multiplication of Bentara Durian. Three farmers in North Bengkulu who commonly reproduce seeds of Bentara durian are Mr. Sutarkam, Mr. Uri, and Mr. Sutardi.

Mr. Uri intensively develops the seed of Bentara Durian. He already has one mother tree of white labeled and eight trees of purple label as sources of seed multiplication (scions/bud woods).

The demand for seeds and fruit Bentara Durian is very high, but the limitations of seeds, number of trees, as well as skilled of human resources in the seedlings propagation causing market demand cannot be met. As a result, only certain people who get the access can enjoy the pleasure of Bentara Durian fruit.

Bentara Durian has high economic value. Moreover, it has conservation, rehabilitation, and restoration of land functions. Deep roots can hold soil from erosion and pretty shady canopy of trees able to suppress the impact of rainfall into the soil surface, so inhibit surface erosion. Water that falls on the soil surface will move vertically into the ground to become groundwater that is very useful for living things.

## **II. METHODS OF BENTARA DURIAN PROPAGATION**

Durian plants can be propagated by generative and vegetative methods. Nonetheless, the generative reproduction of superior durian rarely implemented even until barely applied. This is due to the generative propagation characteristic of the mother plant does not guarantee a 100% (percent) will inherit to the produced seeds or seedling. Therefore, vegetative propagation often applied so that the characteristics of the mother plant can be inherited 100% to the next generation. In addition, durian plants which obtained from generative propagation will produce fruit after 15 years planted, while the plant durian derived from vegetative propagation will produce fruit at the age of 4-5 years old.

One of the superior properties of durian generative propagation is that formation of taproots adequate penetrate into the earth, so that be able to suppress soil erosion. On a purely vegetative propagation (grafting, stem cuttings, or other), the taproots is not formed. To overcome this, plant propagation of Bentara Durian is using rootstock obtained from the seeds and bud woods which come from a producing and superior tree.

There are two methods of grafting vegetative propagation, i.e. grafting and budding. Based on the experiences of the three farmers on the multiplication of Bentara Durian, the best way of propagation Bentara Durian is using budding method. In addition, the use of the buds wood will not damage structure of the mother tree.

The requirements of seedlings vegetative propagation for the best results are as follows; a) the scion and rootstock are compatible, b) its sliced scraped must flat and smooth, c) the cambium of scions (buds) and cambium of rootstock contact evenly, d) especially for budding, the bark should easily peeled off (the bud should be easily removed from its wood), and e) qualified environmental conditions (the humidity and temperature).

Bud grafting (budding) is plant propagation by combining two different parts of the plant so that cambium tissue from each plant can be joined properly. The success of Bentara Durian propagation by budding is determined by the readiness of the rootstock and the quality of the bud from the mother plant.

## **2. 1. Rootstock**

Rootstock has function to collect food from the ground to the shoots. Seedlings that will be used as rootstocks should be selected which is able to adapt with the upper trunk (shoot). Therefore, the seedling capable to merges and supports the growth of its upper trunk. In addition, the plants should be in healthy conditions and in a good root system, and should come from the good quality and quantity of fruit on the plants grafted. There are several steps which must be taken to prepare rootstock, namely:

- a. Selection on the seed. Seeds should come from a plant which is capable to adapt to local soil conditions. Choose seeds which are really old, having perfect shape, uniform, not flat, not too small, and free from injury or pests. Seed selection can be done by put it into the water. Seeds that drowning are good seeds and can be used as seedlings.
- b. Durian varieties which are suitable to use as a rootstock are *Bokor* and *Siriwig*. Both of these varieties have large seed that can produce a deep and a good root system, and root rot resistant.
- c. Before planting, soaked the seeds with fungicides or Clorox 1% solution, and then washed it. Immersion aims to prevent fungal attack. Next, the seeds are ready for planting.
- d. Seeds planting can be carried out in a polybag with size 20 cm x 25 cm. Mix manure and soil to the polybag with a ratio of 1: 1. a polybag planted by one seed in a slanted position and not too deep (partially appeared on the ground). Give Furadan 3G as much as 3-5 grains to each polybag nearby the planting hole. Planted seedlings placed under shade of paronet or coconut leaves to protect the seeds from exposure of direct sunlight and rainfall.

- e. A good seed will germinate within 3-5 days after planting, leave seedlings grow up until its seed pieces loose. Seeds and seedlings durian as the rootstock is presented in Figure 3. When the seed cotyledon loose, do fertilization using NPK (15:15:15) with dosage 2 gram/litre of water by using a sprinkler. Fertilizer application applied once a month.
- f. During seed plantation, maintenance must be carried out regularly such as fertilizing, watering, and pest and disease controlling. After seedling heights achieve 40-50 cm, diameters 3-5 mm, and ages about 3-4 months old, then attaching bud to the seedling ready to be done (bud grafting). Rootstock is fertilized with urea in 1-2 weeks before bud grafting. Urea fertilizer applies dosage 2 g/l of water.



Figure 3. Seeds and seedlings durian as rootstock

- g. Besides use polybag, seeds planting to produce rootstocks can be implemented on the seedbed. Each seedbed consist of 3 (three) to 4 (four) lanes, such pattern allow seedlings to flourish and availability of space to perform the bud grafting process. Preparation of rootstock for bud grafting in the seedbed was presented in Figure 4.



Figure 4. Preparation of rootstock for bud grafting in form of seedbed

## 2. 2. Preparation of Bud Wood (Scions)

The criteria of the scions/ bud woods for grafting material must consider the following requirements:

- a. Sources of bud woods should come from Bentara Durian tree which certified as white label or purple label. Trees of Bentara Durian (Purple Label) and branches selection for bud woods at the nursery owned by Mr. Uri (white hat) were presented in Figure 5.



Figure 5. Trees of Bentara Durian (purple label) and the owner of Bentara Durian nursery, Mr. Uri (white hat)

- b. Select bud-woods from branch which is not too old and not too young (half-woody). The bark colors greenish light brown or light gray. Buds that were taken from too old branches will have slow growth and low percentage of success. Branches as the bud-woods source in pre-growth and growing up conditions were presented in Figure 6.
- c. Select bud branches that have no leaves (the leaves have fallen). If not, leaves should be dropped down and it has to be done 2 (two) weeks before bud woods retrieval.
- d. The branch that will be taken its bud woods must come from flourishing and healthy plants.

- e. Bud is taken by peeling the bark from the wood. if inside of the bark (cambium) moist, indicates that the cambium is active. Thus, when bud grafting immediately held, it will accelerate unification with the rootstock.



Figure 6. Scions/bud woods as buds sources on the bud grafting (pre-growth bud and growing up bud; left to right)

## 2. 3. Methods of Implementation

Tools and materials required in the implementation of the bud grafting are razor blade, cutter, or special grafting knives that really sharp and sterile or clean, and a rope or plastic wrap. Durian seedling grafting equipments (scissors twigs/scions, plastic wrap, and a knife grafting) were presented in Figure 7.

Before the bud grafting applied, notice the condition of the bud wood must come from a round branch. To prevent the development of fungi, need to do some treatment, namely: the bud wood originated taken from the mother plant, and in order to avoid excessive evaporation, the leaves on the scions should be cleaned up. Furthermore, wash scions with water, then soak it with chlorox 10% for 1 minute.



Figure 7. Durian seedling grafting equipments (scissors twigs/ scions, plastic wrap and a knife grafting)

There are several steps on the bud woods grafting are as follows:

- a. Select rootstock that suitable for grafting. The 3-12 months old rootstock, thick/fresh bark and has trunk diameter of  $\pm$  1 cm are the best for grafting. Clean the Rootstock from dirt/dust by rubbing it with thumb and forefinger of our hands on the cutout part for grafting.
- b. The determination of grafting spot by create a slice as high as 3x (three times) of the blade height from the border of roots and stems as a backup spot if the first grafting fails for the next trial after 3 weeks. And so on until the third trial of grafting.
- c. An incision (window) making by create 2 (two) vertical incision so long as 2-3 cm, the distance between incisions adjusted accordingly stem diameter ( $\pm$  1 cm), make horizontal incision at the upper end of vertical incision, then using a knife, pull the bark down from the horizontal incision to form a tongue or a V along 2-3 cm. Cut  $\frac{1}{2}$  of the tongue long enough for a hold place of incision or pattern of buds. This steps can be seen in Figure 8-11.



Figure 8.  
Horizontal incision



Figure 9.  
Vertical incision



Figure 10.  
Pulling down the bark



Figure 11.  
Cutting the bark

- d. Cut bud from the bud wood about the size or smaller than rootstock's incision so as cover the stem incision. The bud (include its cambium) slashed slowly from top to bottom to form a shield with a diameter at least of 2-4 mm, and then using a knife / blade tip, remove its wood from the bud. The bud cuttings were presented in Figure 12 and 13.



Figure 12.  
Taking the bud away



Figure 13.  
The bud ready to be inserted

- e. Insert a prepared-bud into the incision of rootstock. In this insertion, the inner eye patch/bud should not be touched by hands or dirty, it can lead to the graft failure. In addition, the insertion must be placed together gently to avoid scratched

or damaged in the bud. Insertion of eye patch/bud to the rootstock was presented in Figure 14.

- f. After insertion completed, tie the rootstock with plastic rope. The binding must be done from the bottom to up to avoid the entry of rainfall. In the process of binding, do not tie too tight on the eye patch/bud to prevent the eye patch from damage. Figure of tied eye patch was presented in Figure 15.



Figure 14. Eye patch/bud insertion



Figure 15. Tied eye patch

- g. Inspection time the success of bud grafting conducted at the age of 3-4 weeks after grafting implementation. If the color of the bud is still green indicates that grafting is successful, but if the bud color is brown and dries means grafting is failed.
- h. For the successful grafting, unwrapped plastic rope by slash on the plastic strap as shown in Figure 16.



Figure 16. Sample of succesful bud grafting

For fails grafting, in the bottom of the stem can be grafted again (in other side of first grafting) or under the windows of the first grafting.

- i. After grafted bud has 2-3 mature leaves and could photosynthesize, cut approximately 2-3 cm above the bud grafting stem. There are 3 (three) basic ways of stems cutting, namely:
  - 1) Primary stem cut directly 1 cm above the bud grafting, with a sloping cut shape so that rainwater or water spray can fall down and not restrained on the grafted bud.
  - 2) Primary stem cut directly 10 cm above the bud grafting; so that when grafted bud growing, it can be tied in order to grow upright. When the bud grafted has grown up to 30 cm, then the primary stem will be cut to a height of 1 cm above the grafted bud.
  - 3) Process of the third cut not be done by cutting stem all at once. Cutting depth is half of the diameter of primary stem, and then lay down the primary stem. Rootstock recline aims to accelerate the growth of the grafted bud and it was presented in Figure 17.



Figure 17. Reclining rootstock to accelerate the growth of the grafted bud

- j. Sprout that grows from the rootstock should be discarded to avoid disturbing the growth of the buds on the stem.

- k. Leave the grafted bud grow straight up and avoid branching until  $\pm$  60 cm height.
- l. Seedlings that have been successfully grafted need to be treated. Treatments which are carried out are as follows:
  - 1) Watering at least once every 2 (two) days depend on the weather (raining or not). It should be remembered that the grafted plant experiences injured/stress and require food, water, and good care.
  - 2) Fertilization can be done using foliar fertilizers such as Atonik, Metallic, or Gandasil D with a concentration of 2 cc/l of water or use NPK fertilizer (15:15:15) at a concentration of 1-2 g/l of water. Fertilizer application is done once a week. Besides foliar fertilizer application, fertilization can also be given to the soil with dosage of 1-2 grams/plant/month.
  - 3) Spraying insecticides was carried out when the pests attacked plants. Common type of pests in nursery are fleas shield, mealy bugs and caterpillars. Insecticides that are used, for example; Supracide 25 WP, Decis 2.5 EC, Reagent 50 SC, or Decis 2.5 EC, Matador, Kanon with concentration of 2 cc/l of water. It should be added adhesive such as Suntick when spraying is done during rainy season.
  - 4) Spraying fungicides was carried out when the disease attacked plants, such as Iodoh/blight, symptoms of dark patches on the surface of leaf, leaves folded and attached to each other, and then leaves turn brown, dry up and die. Diseases that attack plants in nursery mainly caused by *Rhizoctonia* sp, *Phytophthora* sp, *Fusarium* sap, and *Phytiun* sp. Diseased seedlings immediately separated from the healthy plants to prevent more transmission, then the remain seedlings sprayed with Antracol 70 WP, Dithane M-45 80 WP, Benlate with a concentration of 2 cc/l or 2 g/l of water. Spraying was repeated once a week.
- m. The grafted buds which are formed are ready to plant after 6-9 month old or when stem of grafted bud achieve  $\pm$  50 cm height and plant height reaches 60-90 cm.

The things that must be considered for the success of grafting, namely: a) the knife must sharp and sterile, b) the eye patch/bud should not suppress rootstock's bark, and c) environmental grafting should mild, not too hot and not too wet. The best time of grafting execution is in the morning between the hour's 07:00-11:00 pm. This is moment of plant actively photosynthesized so that the cambiums are also in an active condition and optimum. After 12.00 pm (at noon) the leaves begin to wilt and bud grafting can be conducted in the shade to keep off from direct sunlight.

### **III. CULTIVATION OF BENTARA DURIAN**

#### **3. 1. Planting Hole**

Growth and development of plants depend on the condition of the planting medium. Planting hole is one of a significant contributing factors to the annual growth and development of plants. The good planting hole should meet the following requirements:

- a. Make planting hole with a size of 80 x 80 x 70 cm or 70 x 70 x 60 cm or adapted to soil types and soil conditions and topsoil (20 cm depth) separated from the subsoil. The distance between holes at least 8 x 8 m, so the plant will not compete nutrition in the soil, will not cover other plants from sunlight, as well as to prevent the spread of pests and diseases to the nearest plants.
- b. Leave the planting hole for 2-3 weeks so as the ground poison gas expands by the sun and gone by wind.
- c. Cover up again the planting hole with the part of dugouts top in advance after mixed with organic fertilizer or compost as many as 10-15 kg/hole.
- d. Early of rainy season is the best time for planting precisely in the afternoon, so that planted seedlings will not get exposure of sunlight directly.
- e. Put durian seedling into the planting hole with upright position, then cover it with soil about 5 cm above the base of durian seedling stem. Seedling tied to sticks/bamboo so that plant can grow upright.
- f. Then flush durian seedlings after planted to fulfill its water needs.
- g. Planted seedlings need to be made shade to avoid exposure to direct sunlight and heavy rainfall. Shade can be released after 3-5 months.
- h. Soil around the plants should be closed by grass/hay as mulch, so that soil moisture stay stable.

### **3. 2. Maintenance**

There are some important aspects during maintenance of durian planting are as follows:

- a. Weeding, it aims to remove weeds/unwanted plants growing around in the planted seedlings (1 m from the tree stem) that will interfere plants growth.
- b. Watering steps that must be taken into consideration are as at the following:
  - 1) At the beginning of growth, watering is done every morning and evening sufficiently so that it won't be flooded.
  - 2) The need of water during vegetative term is about 4-5 L/day and during productive term is about 10-12 L/day.
  - 3) After one month old, a plant watering is done three times a week. However, the watering should be taken more attention when the plants are bearing fruits to prevent a loss.
  - 4) Durian plant will require a lot of water after harvested for plant recovery to the normal condition.

### **3. 3. Fertilization**

The purposes of fertilization are to sufficient nutrient needs that cannot be provided by soil, to substitute the lost nutrients after harvested, and to improve/maintain the fertility status of biological, physical, and soil chemical. Therefore, the dosage and method of fertilization rely heavily on its soil fertility level, local weather condition, and plant conditions (age, vigor, variety, and its maintenance). The guideline presents general information/knowledge.

Fertilization in plants that have not been fruitful is given with doses as the following at below:

- a. Fertilization of NPK (15:15:15) applied twice a year, with doses are as follows:
  - 1) For the plant age of 1 year; give NPK fertilizer with dosage of 40-80 g/tree/year.
  - 2) For the 2 years old plant, give NPK fertilizer with dosage of 150-300 gr/tree/year.

- 3) For the 3-4 years old plant, give NPK fertilizer with dosage of 400-600 gr/tree/year.
- b. Organic fertilizer/compost/manure is given once a year by the end of the rainy season with minimal dosage about 15-20 kg/tree.

Fertilization in the plants that have been fruitful is as follows:

- a. After pruning, applied organic fertilizers 40-60 kg, 670 g urea, 890 g SP-36, 530 g KCl per tree.
- b. When the buds begin to ripen, applied 335 g urea, 445 g SP-36, 265 g KCl per tree
- c. Two months after second fertilization, applied 180 g urea, 650 g SP-36, 150 g KCl per tree.
- d. When the flowers appear, applied 45 g urea, 225 g SP-36, 100 g KCl per tree.
- e. One month before harvesting, applied 180 g urea, 650 g SP-36, 150 g KCl per tree.

### **3. 4. Pruning Shape**

Pruning has objective to obtain optimal growth and production. Moreover, trimming also has aim to simplify the maintenance of plants. Pruning concept especially are to remove branches/twigs that are not useful, stimulating the emergence of vegetative buds on the branches that are bearing fruit earlier, and controlling excessive plant growth and support the continuity of production. Parts of plants that should be pruned are as follows:

- a. Branches and buds below the main branch.
- b. Irregular shape of branches.
- c. Water buds in the middle of canopy.
- d. Dry branches after harvesting.
- e. Branches that are affected by pest.

These are several trimming implementation procedures:

- a. Pruning should be done to the branches and water buds of the productive plant.

- b. Cut small angled branches, branches and twigs that are attacked by pests and diseases, and then burn at designated place.
- c. Cut the dense, intersecting, or ulterior/covert of branches and twigs.
- d. Cut the header/canopy back down one section at the terminal twigs of former fruits cut, in order to maintain optimal height of plants (3 m).
- e. Cut the branches and twigs that grow inward or downward the header.

There are some ways of shape pruning as the following at below:

- a. Forming of the canopy is began since one year old plant. The main stem can be maintained approximately up to 70-100 cm height. Choose only one main stem. If the stem was formed two main stems, cut one of them. Once the main stem height achieves 1 meter, trim the bud and let grow new buds and prospective primary branch. Select 6-10 prospectives primary branches which have symmetrical position to make balance between its canopy shape and its branching.
- b. During the growth process, remove buds wild around the branches. The canopy crown will form convex shape, like an open umbrella or a pyramid.
- c. A 2-3 m tall tree section is the crown canopy, while part of main stem throughout 0.7-1 m has function as a buffer.
- d. Forming of the canopy is done by maintain the main stem and 10 selected prospectives primary branch and the plant growth should be strived for the balance between its canopy shape and its branching.
- e. Pruning should be done by using scissors to trim branches and saws for the big trunk.
- f. Apply Vaseline, oils, and grease paint on the stem/large branches after pruning.

### **3. 5. Control of Plant Pest Organisms**

At the beginning of planting, it is necessary to make efforts to protect the plants to produce optimal durian production. The

efforts are done by pest control (plant destructive organisms, such as pests, pathogens and weeds). The effectiveness of pest control can be done by combination approachment of one or more control techniques which is developed in unity. This approachment is commonly known as IPM (integrated pest management).

a. Pest Control

Pest is a destructives animals to the plant and its yield until causing economic loss. Pests that affect the growth, production, and quality of durian are stem borer, fruit borer, mealy bug, caterpillar, and durian fleas.

1) Borer

Stem borer (*Batocera* sp., *Xyleutes* sp.) is the type of pest that often attacks the durian. This pest attacks by putting their eggs in the fruit skin/rind. Then, the eggs are protected by networks like spider's house. Hatched eggs become larvae slowly get in to fruit flesh by broaching and perforate the walls of the fruit. The larva lives in the fruit until adult.

a) Symptoms

Stem borer attacks by making a hole in the trunk, branches or twigs. The attacks were causing crops/durian become wither, dry and fall leaves, then eventually die. While the fruit that is attacked by stem borers sometimes fall before getting mature.

b) Control

Prevention efforts from stem borer attack can be done through decent garden sanitation. If there were trunk, branches, and twigs that have been attacked, should be immediately cut off and destroyed. Holes effect borer in the stem as soon as possible covered with cotton which has been smeared with paraffin (*carbolonium plantarum*) in a concentration about 2 cc/litre. Other applications can also spray/infused with insecticide active component of Ethofenprox, Deltamethrin, BPMC, or Betasiflutrin with concentration as recommended at the label. Another controlling way can be done by scraping the brown

spots on stems which are attacked until to be healthy tissue. Moreover, applied active ingredient fungicide of Mankozeb on those stem, such as Ridomil. Dosage used is 2-3 g/liter to prevent fungal infection impacts.

2) Fruit Borer

Fruit Borer (*Tirathaha* sp., *Dacus dorsalis*) caused by the attack of *Hypoperigea leprosticta*. The attack transmission of this pest is by flying from one tree to the other tree of durian. This fruit borer insect lays its eggs on durian fruit. The spawn activities conducted periodically every near of dry season.

a) Symptoms

Infected fruit becomes rotten wormy and eventually falling. Eggs placed on the fruit skin/rind and protected by networks like spider's house. Hatched eggs become larvae slowly get in to fruit flesh by broaching and perforate the walls of the fruit. The larva lives in the fruit until adult. The fruit that is attacked by fruit borers sometimes fall before getting mature.

b) Control

Control of fruit borers can be done by put its natural enemies, namely flies *Tachinidae*, *Venturia* sp., and *Apanteles tirathabae*. To avoid transmission, infected fruit immediately collected and burned. As for treatment, could use pesticides deltamethrin, such as Decis 2.5 EC or Betasiflutrin (Buldok 25 EC).

3) Mealy Bug

Mealy bug (*Pseudococcus* sp.) is one of the pests that often attack durian plant. This insect pest secrete a white waxy and like-white cotton substances that cover the whole soft-pink body. Therefore, the pest has appearance like-white dust. Mealy bug is commonly found in plant parts that become a meeting point between leaves and stem (node) as well as above and below of the young leaves.

a) Symptoms

The insect attacks plant by sucking nutrients from plant. As a result, the plant sometimes become withers. Furthermore, affected leaves turn into curls and weaken so that flowers and fruits may fall off. The rind that has attacked becomes white color. Additionally, mealy bug also secrete a like-honey sweet liquid to invite ants and causes the appearance of dew soot fungus. This fungus can inhibit the process of photosynthesis and plant growth.

b) Control

Control of mealy bug attacks can be done by maintaining garden sanitation of weeds and other host plants, such as citrus, soursop (graviola), coffee, and cocoa. In addition, mealy bug prevention can also be done by fruit trimming in a bunch. Insecticide can be used with active component of Deltamethrin or Lambdacyhalothrin with dosage as recommended on the label.

4) Durian Fleas

Durian fleas has brown color and the body covered with a white wax yarns results of its body secretion. The body, wings, and legs shapes have similarity to the fleas that attack Leucaena (Lamtoro) plant.

a) Symptoms

Durian fleas in groups attack the young buds. Fleas suck fluid of the leaf bone so that the leaves become dwarf and stunted growth. After sucked fluid, these fleas secrete a concentrated clear fluid and sweet. Generally, the liquid will spread evenly across the surface of the leaf to attract ants mass.

b) Control

In order to prevent the fleas infect other plants, leaves and twigs, they should be trimmed and then destroyed. Meanwhile, chemical control can be done by spraying insecticides of Supracide 40 EC at dose of 100-150 g/5 litres of water. Active insecticide of

deltamethrin (such as Decis 2.5 EC) and Profenofos (like Curacron 500 EC) can also be used. The dose used should adjust to the recommended dose on the label.

b. Diseases Control

Disease is an unusual activity and harm physiological process in plants caused by biotic factors. Generally diseases disorders occur on an ongoing basis. Disease indicated abnormal tissue activities, causing decrease in the production and quality of the durian yields. As a result, durian plantation business will suffer economic loss. The biotic factors caused by pathogens, such as viruses, bacteria and fungi.

1) Stem Cancer

Stem cancer caused by the fungus *Phytophthora palmivora*. Generally, this disease often occurs when transition of the dry season to the rainy season.

a) Symptoms

Symptom appearance due to stem cancer attack is the presence of red mucus wound in the stem bark near the ground. The red mucus can only be seen in the morning before 06.00 am and the mucus will not be seen in the afternoon because evaporates. Furthermore, after stem rot, the tops of the plants dry, the leaves wither and fall off, and then eventually die.

b) Control

Controls to prevent stem cancer attacks are by garden sanitation, widening planting spacing, suppress weeds, using a robust rootstock, using disease-free seed, and branches trimming. Meanwhile, if the plants have affected, on the wounds stem smeared porridge bordo, or fungicide Metalaxyl (Ridomyl), Fosetyl aluminum, (Alliete), or else based-copper (Cu) fungicide. The control of affected stems is by scraped up until the brown color not visible, then sprayed with fungicide active component of Propamokarb Hydrochloride (like Previcur N), Metalaxyl Aluminum, bordo slurry with a

concentration of 2 g/l or fungicide contain active of Phosphonate, because active component of Ridomyl mz is Metalaxyl. Diseased plants should be immediately destroyed.

2) Root Rot Disease

Root rots disease caused by *Phytiun complectens* Braun, which is a pathogenic fungus.

a) Symptoms

The initial attack of root rot characterized by appearance of necrotic spots on the lateral roots starts from tip section root. The diseased root looks normal from outside, but the bark tissue becomes brown and the woody parts become pink. At the high attack rate, above the ground level will appear died branches of tree, followed by the development of buds from the underneath branches, leaves wilt and then fall.

b) Control

Root rot disease prevention can be done by improving drainage and choose disease-resistant rootstock. Plants that have been attacked should be dismantled and destroyed. While the control can use a fungicide active component of Metalaxyl, Phosphonate, or Fosetyl aluminum, and can use Mankozeb fungicide active ingredient, such as Dithane M-45 at the recommended dosage in the packaging/label.

3) Leaf Spot Disease

Leaf spot disease caused by the fungus *Rhizoctonia solani*. This fungus can survive underground. This disease can attack durian, ranging from nursery to the planting area. Transmission of the disease will be more rapid under high rainfall condition.

a) Symptoms

The attacked leaves will appear dry large spots. In severe conditions, these spots will cause leaf perforated. The leaves that are attacked will dry and

fall. At the advanced level, the trees will be bald and fruit production declines.

b) Control

Leaf spot disease prevention can be done by thinning within the plant. While the plants that are attacked, immediately trim the twigs, then spray with a copper fungicide active ingredient in accordance with the recommended dose in the packaging.

4) Pink Disease

Pink disease is caused by fungus *Cotidium salmonicolor*.

a) Symptoms

The symptoms appears when the stem occurs yellow liquid in the trunk and enveloped by shiny mushroom yarns shaped like a spider. In the severe level, this disease can cause death of the stem.

b) Control

The prevention of pink disease attacks can be done by using the ideal spacing of 10 m x 10 m. Other preventive measures are by conduct weeding regularly, trimming and spraying fungicide. Fungicides that will be used should contain active ingredient mankozeb such as Dithane M-45 regularly with the recommended dosage on the packaging/label.

5) White Root Disease

White root disease caused by the fungus *Rigodoporus lignosus*.

a) Symptoms

The symptom appears when the color of the leaves turn yellow then brown. At further stage, the leaves will shrivel and eventually fall out.

b) Control

Precaution against white root disease can be done by using a healthy and disease-resistant seedlings, improve drainage, provide biological agents (such as natural enemies of pests), as well as keep the land not too wet and clean from weeds. As the transmission prevention measure of healthy plants,

the host plants should be removed from the garden area. In addition, for the chemically prevention could use a fungicide Triadimenol (Bayfidan) concentration of 0.1% or Cyproconazole (Alto) concentration of 10%.

6) Fruit Rot Disease

Fruit rot disease caused by fungus *Phytophthora palmivora*.

a) Symptoms

The symptom appears when skin fruit occurs damp spots with color blackish brown. This symptom will continue to decay on the infected plants form a white mycelium and sporangia.

b) Control

Fruit rot disease prevention is done by keeping the garden sanitation. Moreover, it can be done by spraying the prospective fruits with ingredient a fungicide active of Metalaxyl, Fosetyl aluminum, or Phosphonate with appropriate concentrations as recommended in the packaging /label.

7) Fruit Loss

Fruit Loss (fruit fall) diseases caused by lack of certain elements, such as phosphorus, potassium, and magnesium.

a) Symptoms

The symptoms of fruit loss is characterized by the death of the fruit before the fruit matures.

b) Control

Controls of this disease attacks can be done by giving complete fertilizer with proper dosage and fertilizing in appropriate time. For example; a package of fertilization for adult plants set up three times, namely: first application is done about 4 months before flowering season, second application is done one month before blooming, and final application is done one month after blooming. The first dosage of NPK application is balanced (1:1:1); the second dosage fertilization is elements of P and

K are increased, while the third dosage application is elements of K is improved.

8) Physiological Disease

- a) The fruit flesh as if burned, generally due to lack of boron. It can be treated by using boron fertilizer applications with dosage of 2 g/m of wide canopy.
- b) Wet at the sticking place of pongge due to excess water during fruit ripening. It can be overcome by good water drainage and applied agricultural lime or dolomite about 2 kg/tree at 90 days after blooming.
- c) The fruits are not ripe evenly, mostly because of lack of calcium. To overcome can be done by the application of calcium nitrate ( $\text{CaNO}_3$ ) about 2 kg/tree at the day after blooming.

### 3. 6. Other Maintenance

In addition to the above treatments, the durian is also necessary to be paid attention other ways are as follows:

- a. The plant growth regulator (PGR) application has aims to influence tissues in various organs of plants. This substance is not providing any additional element of nutrients in plants durian. In fact, PGR can make the plants become weak, so its use must notice the instructions on the label in the box. Therefore, the use of PGR only as mixed ingredients.
- b. Fruit trimming has aims to create sufficient photosynthesis so as to produce good fruits. Every 2 kg of fruits must be supported with 200 leaves. Fruit trimming is done in 40 days after the fruit is formed. Choose the perfect shape of fruits and dispose the defective fruits or too many fruits in one branch.
- c. Fruit handling/treatment. The young durian fruit must be treated for its optimal growth. Maintenance begins with the selection of fruit after reaches 5 cm diameter. Leave the two best fruits with ideal distance one to another around 30 cm. Plant that is fruiting for the first time, advisable remain only one or two fruits. To prevent the fruit loss, 10 days old of fruit applied NPK fertilizer (0.5-1 kg/tree). In addition, to avoid fruit falls, the durian fruits tied with plastic rope.

## **IV. CLOSING**

Bentara Durian is an annual plant which has deep taproot and able to adapt in tropical environment making it possible to be developed in Bengkulu Province. This plant capable of suppressing soil erosion, improves degraded land, and able to improve the economic welfare of the surrounding community by developed its cultivation.

Durian originally is one of the forest plants species, so that adequate to compete among the standing trees. It allows diversification or intercropping of durian with other forest trees. Therefore, need to be considered ideal planting spacing between intercropped trees. The tree which intercropped should have economic value and the ability to prevent/minimize erosion as well as able to rehabilitate degraded land.

Bentara Durian quality can achieved through vegetative propagation by bud grafting. Bud grafting seedlings should get good maintenance in order to grow and develop properly and to produce high quality fruits. Preparation of rootstock, bud woods/scions, the planting hole, fertilization, plant protection from plant pests, as well as other maintenance needs to be done carefully. The perseverance of farmers on Bentara Durian cultivation is the key success to create Bengkulu as a place of durian heaven.

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