

FARM PRIMER **JACKFRUIT PRODUCTION**



UPDATED
Package of
Applicable
Technologies
on
Jackfruit
Production

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Foreword

Jackfruit (*Artocarpus heterophyllus* [Lam.]), locally known as 'nangka', is a convergence commodity in Region 8. This has led to the selection by DA-RFO 8 of the Eastern Visayas Integrated Agricultural Research Center (EVIARC) Sweet variety and the launching a plant-now-pay-later (PNPL) program .

After the first fruiting, however, problems like lack of funds and market support had emerged. This prompted the RRDEN and ViCARP to find solutions, one of which is the revival of food product development.

Several food products were eventually developed like puree, juice, leather, tart, vacuum-fried jackfruit, and dehydrated jackfruit. Many of these products have picked up market support. Foremost of these are the vacuum-fried and the dehydrated jackfruit now sold under the brand Baybay Delights, now the official delicacy of the new City of Baybay.

As the market for jackfruit and its products grows however, RRDEN and ViCARP recognize the need for the steady supply of ripe fruit. Together, they are working to expand the plantation areas through establishment of scion groves and continue developing products from jackfruit.

DA-RFO 8 with the local government units and the Farmers Information and Technology Services (FITS) Centers, has organized jackfruit farmers especially those in the PNPL program to ensure a continuous supply of ripe fruit. They have also conducted trainings on scion grove establishment.

The increasing number of farmers who are interested to plant jackfruit need the package of technology to guide them in the cultural management of the crop. This primer is therefore, a must-read material for those who would like to venture into jackfruit production.

JOSE L. BACUSMO

President, Visayas State University
and ViCARP-Regional Research and Development
Coordinating Committee (RRDCC) Chair

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- DOST-PCAARRD for providing the much needed financial support for the printing of this primer on Jackfruit production.

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) locally known as 'nangka' is one of the popular fruit species in the Philippines. This is manifested by its wide distribution and cultivation. Its many uses and excellent adaptation to wide range of growing conditions may have contributed to its popularity.

Jackfruit is an evergreen tree, which grows up to 21.34 m under favorable conditions. It bears fruit as early as 3 years after planting and produces fruit that weighs as much as 50 kg.



Uses and Nutritional Value

Jackfruit has many uses. The ripe fruit can be eaten fresh or processed into dessert, preserved, candies, jelly and delightful flavoring for ice cream. The immature fruit can be eaten as vegetable. Boiled or roasted seeds are edible. The various parts of the tree are used to treat illness such as ulcer, asthma, abscesses, skin disease among others. The bark from the trunk is used in making cloth and ropes while the wood which is classified as medium hardwood is a good materials for making furniture and musical instruments such as 'ukulele' and guitars. The sap from its trunk is used for dyeing.

Jackfruit is a nutritious food. Its food composition per 100 g edible portion is as follow:



Jackfruit Production

Constituent	Fruit		
	Immature	Ripe (Pulp)	Seeds
Moisture	85.20	72.40	57.60
Food Energy, cal	51.00	97.00	43.00
Protein, g	2.00	1.40	5.60
Fat, g	0.60	0.40	0.60
Total Carbohydrates, g	11.50	24.00	34.90
Fiber, g	2.60	0.80	1.40
Ash, g	0.70	1.00	1.30
Calcium, mg	53.00	23.00	23.00
Iron, mg	0.40	1.10	0.80
Sodium, mg	3.00	2.00	3.00
Potassium, mg	323.00	107.00	763.00
Vit. A, I.U.	30.00	175.00	-
Thiamine, mg	0.12	0.90	0.60
Riboflavin, mg	0.05	0.05	0.06
Niacin, mg	0.50	0.90	0.60
Ascorbic Acid, mg	12.00	5.00	10.00

Source: Coronel, 1983

Production

Climatic and Soil Requirements



Jackfruit prefers an abundant, evenly distributed rainfall throughout the year and an elevation below 800 m. It is tolerant to cold and able to bear fruit normally at 1,500 m above sea level. Above this, it bears fruits well but quality is reduced. It grows best in deep, well-drained sand or clay loam soil with a pH range of 5.5-7.0. It cannot tolerate water stagnation and poor drainage.

Variety

The National Seed Industry Council (NSIC) has approved jackfruit varieties for planting in the country. Some of these varieties are planted in the Foundation Grove of Department of Agriculture-Regional Integrated Agricultural Research Center (DA-RIARC) in Abuyog, Leyte. Varieties planted there include Sinapelo, Cervantes, Burabod, and EVIARC Sweet and Baybay Sweet.

EVIARC Sweet is recommended by the Bureau of Plant Industry-National Seed Industry Council (BPI-NSIC) for processing but could also be used for fresh fruit because of its high sugar content or total soluble solids of 25.1°Brix.

DA-8 is promoting the variety for commercial scale production because it is well adapted to the region. It is also the preferred variety by processors due to its thick aril and high edible portion of 42.58% which would give bigger profit margins compared to other jackfruit varieties. Moreover, its golden yellow flesh has moderate latex.

Propagation of Planting Materials

Jackfruit is usually propagated through **cleft grafting**. Cleft grafting is a process of joining a rootstock and a scion until they are united permanently. This is the most common commercially used method of asexual propagation for jackfruit in DA-RIARC Abuyog.

Tools Used for Grafting



1. Ice candy wrapper
2. Jackfruit scion
3. Sharp budding knife
4. Grinding compound

Procedures in Cleft Grafting



1 Select a healthy and vigorous rootstock.



2 Cut-off the rootstock to desirable height where there is an active growth.

Fun Fact

Cleft Grafting is also known as Wedge grafting



3

Make a longitudinal cut at the center about 1.5 cm enough to accommodate the wedge cut of the scion.



4

4. Select a healthy scion almost the same size as the rootstock.

Tip:

1. The rootstock should be conditioned under the shade and watered one week before grafting.
2. Harvest healthy scion at least 10-12 days prior to actual grafting.
3. Use healthy scions and rootstocks and sharp budding knife for higher percentage of success.

Jackfruit Production



5. Hold firmly the scion and make a wedge cut about 1.0-1.5 cm long on the basal section.



6

Insert the wedge on the rootstock and secure firmly with a plastic tape.



7

Wrap the scion loosely with a plastic wrap.



8

17-18 days after grafting operation, unwrap the graft and cover with 1" x 10" plastic wrapper

24/04/2007



9

One week after, remove the plastic cover.

24/04/2007

To date, **7** out of **16** plant nurseries inventoried are accredited in the region.



10

After one week remove the plastic cover or one month after grafting operation, transfer the newly grafted seedling outside for conditioning in the screenhouse or nethouse.

Land Preparation and Layout

Clear and underbrush the area. To layout, set a straight base line along the boundary. Orient the rows either east to west or north to south for sunlight to penetrate between rows. Stake a distance of 8 m between hills and 8 m between rows.

Dig holes at one cubic foot to provide room for root development. While digging, separate the topsoil from the subsoils.

Land Preparation and Layout

1. Plant 3-5 month old grafted jackfruit. However, large planting materials are preferred to minimize mortality rate when planted in the field.
2. Cut the bottom of the polybags to minimize root injuries upon transplanting.
3. Set the plant in the previously prepared holes spaced 8m x 8m apart.
4. Cover the holes after planting and press down the soil around the base of the plant to remove larger air spaces.
5. In transplanting, be sure that the root collar is above 1-2 inches from the ground level to prevent rotting of the stem.
6. Plant anytime where rainfall is evenly distributed throughout the year. Otherwise, plant at the onset of the rainy season to avoid water stress.

Fertilizer Application

In the absence of soil analysis, use the fertilizer requirements below as your guide:

Year	Kind of Fertilizer Materials	Frequency of Application/Year	Quantity/Tree
At Planting (Basal)	<i>Urea (45-0-0)</i>	<i>1</i>	<i>25g</i>
	<i>Complete</i>	<i>1</i>	<i>25g</i>
	<i>Organic</i>	<i>1</i>	<i>25g</i>
1	<i>Urea (45-0-0)</i>	<i>4</i>	<i>25 g</i>
	<i>Complete</i>	<i>4</i>	<i>25 g</i>
2	<i>Urea (45-0-0)</i>	<i>4</i>	<i>50 g</i>
	<i>Complete</i>	<i>4</i>	<i>50 g</i>
	<i>Organic</i>	<i>1</i>	<i>4 kg</i>
3	<i>Solophos</i>	<i>2</i>	<i>100 g</i>
	<i>Complete</i>	<i>2</i>	<i>100 g</i>
	<i>Muriate of Potash</i>	<i>2</i>	<i>100 g</i>
	<i>Organic</i>	<i>1</i>	<i>8 kg</i>
4	<i>Solophos</i>	<i>2</i>	<i>200 g</i>
	<i>Complete</i>	<i>2</i>	<i>200 g</i>
	<i>Muriate of Potash</i>	<i>2</i>	<i>200 g</i>
	<i>Organic</i>	<i>1</i>	<i>16 kg</i>
5	<i>Complete</i>	<i>2</i>	<i>400 g</i>
	<i>Muriate of Potash</i>	<i>2</i>	<i>400 g</i>
	<i>Organic</i>	<i>1</i>	<i>30 kg</i>
6 & above	<i>Complete</i>	<i>2</i>	<i>400 g</i>
	<i>Muriate of Potash</i>	<i>2</i>	<i>400 g</i>
	<i>Organic</i>	<i>1</i>	<i>30 kg</i>

Jackfruit Production



1. Dig 4 holes equidistant from the base of the plant.

2. For newly planted, dig holes 0.3-0.5m from the base and 1m for non-bearing and 1.5m for bearing trees.

3. Distribute the amount of recommended fertilizer mixture on 4 holes.





Broadcast evenly and incorporate the lime into the soil by plowing
(RR=2-4 t/ha)

Weeding

1. Ringweed and underbrushed once a month until six months for newly planted and every 3 months thereafter until 2 years, and;

2. Every 6 months for 2 years old and above.



Pruning

Formative Pruning



1. Cut the top of the main stem leaving 1.5 to 2 meters from ground level.
2. All branches within 1m from the ground should be cut.





1 year after pruning

**3-4 spreading branches;
dense crown.**

Pruning consists of removing small, unproductive as well as diseased and insect-damaged branches.

Since fruits are usually produced on the trunk and large branches, pruning would give more light and air to the developing fruits.



Reproductive stage

Pruning

Maintenance Pruning

Consists of removing water sprouts, small, unproductive as well as diseased and insect-damaged branches.

Done after harvesting the fruits.

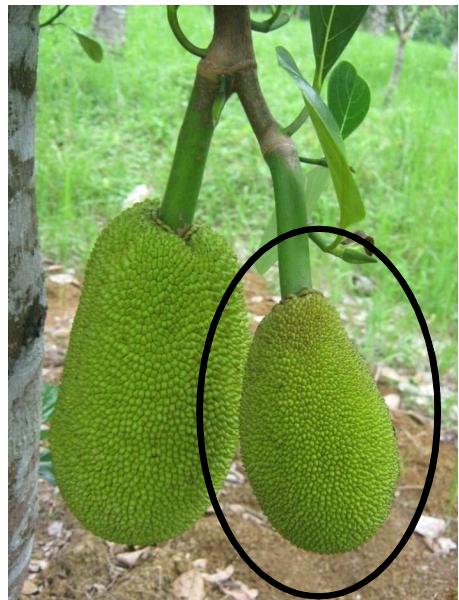


Overgrown Jackfruit tree before and after pruning

Fruit Thinning

To obtain good quality and well-developed fruits:

1. Allow only one fruit to develop per foot stalk by removing those arising from the sides of the main peduncle to obtain good quality and well developed fruits.
2. Maintain only a maximum of 3 fruits per tree during the first year of fruiting.
3. Optimum of 8 fruits on the 7th year and gradually increase to 20 fruits per tree on the 15th year.



However, allow the tree to produce more fruits as it grows older.

Harvesting

Harvesting fruits when they reach 148 days from spike emergence, fully mature but still firm and without aroma. Mature fruits have widely spaced spines and produce a hollow sound when lightly tapped. The rind becomes yellowish green.

Harvesting should be done at mid morning to late afternoon (9:00 A.M. to 3:00 P.M.) to reduce latex flow because at this time of the day latex cells are less turgid. This would minimize latex stains which give the fruit an unsightly appearance. Never let the fruit fall to the ground to avoid rotting of affected portions. After harvesting, remove the retained peduncle and unwanted water-sprouts from the trunk.

Jackfruit Production

Grading and Sorting

Grade and sort the fruits (excluding deformed, infested/infected, and damaged ones) using the classification below:

Class A= 15 kg or more (Large)

Class B = 10-14.9 kg (Medium)

Class C = less than 10 kg (Small)

Packaging

Below is the estimated cost and return per year of one hectare jackfruit plantation specifically for EVIARC Sweet variety.

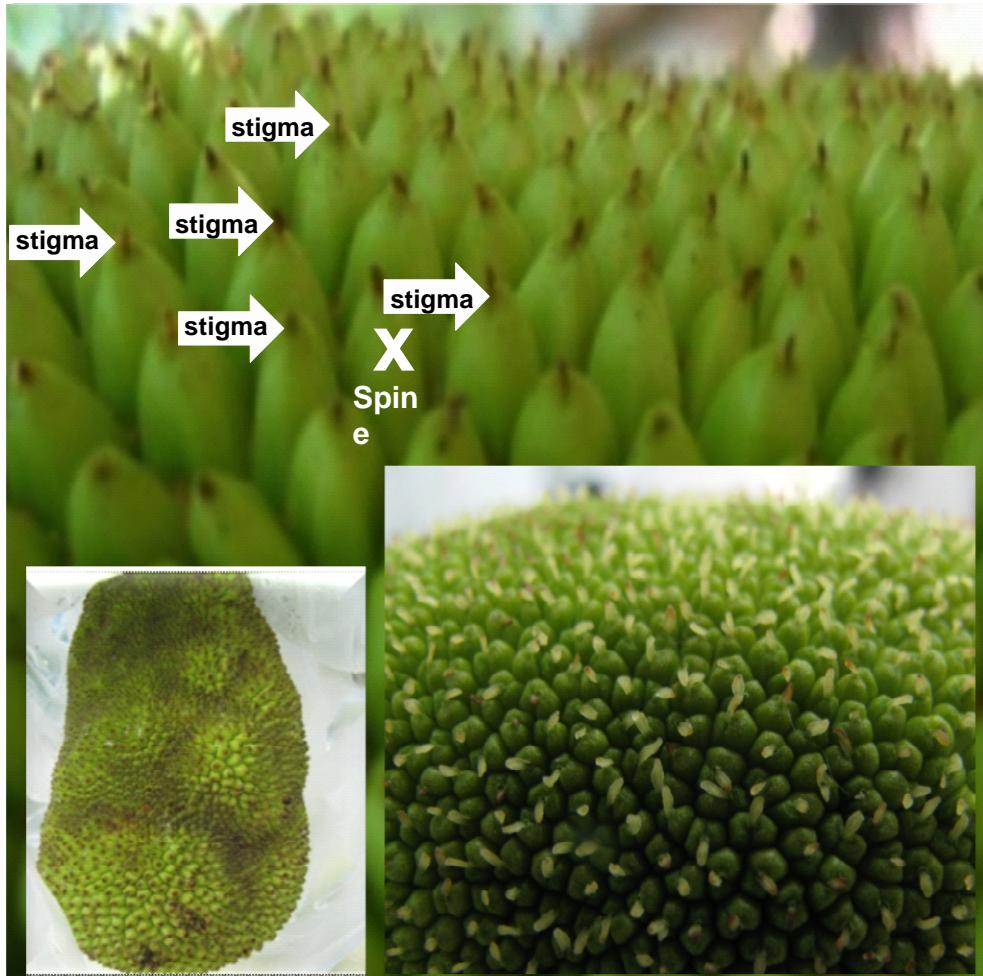
Year	Production per Hectare (kg/ha)	Gross Income	Total Cost			Net Income	
			Fixed Cost	Labor Cost	Material Cost	Total	
0	0	0	1,400	3,840	9,859.20	15,139.20	(15,139.20)
1	0	0	1,000	12,780	3,671.20	17,451.20	(17,451.20)
2	0	0	2,400	16,500	3,671.20	22,611.20	(22,611.20)
3	2520	25,200	2,400	15,720	6,586.40	24,746.40	453.60
4	6552	65,520	2,400	16,920	10,897.20	30,257.20	35,262.80
5	14976	149,760	2,400	16,920	19,747.60	39,107.60	110,652.40
6	22464	224,640	3,340	16,440	28,689.60	45,973.60	176,170.40
7	28080	280,800	3,340	16,440	37,850.80	52,190.80	223,169.20
8	33696	336,960	3,340	17,160	51,988.50	74,238.50	264,471.50
9	37440	374,400	3,340	18,360	54,302.80	78,342.80	298,397.20
10	37400	374,400	3,340	18,360	54,302.80	78,343.80	298,397.20

Assumptions:

Land	= contracted rental for 5 years @ P1000/yr for 5 succeeding years.
Depreciation cost	= 10-year life span of all tools & materials except for wheel barrow & tandem ladder
Fertilizer cost	= Urea (P20/kg); complete (16/kg); muriate of potash (P16/kg); organic fertilizer (P6.20/kg)
Cost per MD	= P120/day
Cost of sacks	= P8/pc
Productive Trees	= Year 3 (45% of 156 trees total population); Year 4 (70%), Year 5 & above (100%)

No. of fruits per tree was increased because fruits allowed to mature can be increased as the tree grows older.

Correct timing of fruit bagging



10-15 days after all stigmas blackened

Research conducted at RIARC Abuyog showed that bagging of fruits must be done on an uninfected fruitlet 10-15 days after fertilization. Clean empty sacks and sharkskin plastic are to be used.



Fruit Dimension Ideal for Bagging

**Width = 12.52 cm
Length = 20.66 cm**

**Moulding clay or
cement replica as
guide for correct
bagging size of
jackfruit EVIARC
Swet variety.**

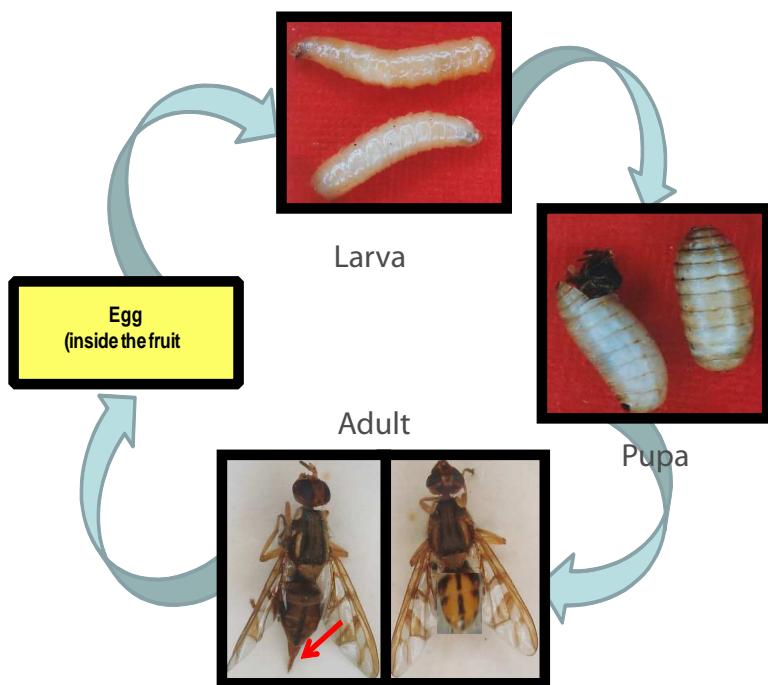
Pest Management

A number of insect pests and diseases attack jackfruit. These can cause considerable losses both in quantity and quality of fruit harvested. The common pests are as follows:

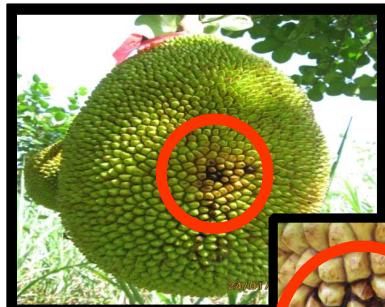
Fruit Fly (*Bactrocera umbrosa* Fabr.)

Fruit fly is the most common and damaging insect pest of jackfruit. The back of the thorax or middle section has four bristles or setae and is predominantly black with yellow stripes. Facial spots are present and the abdomen is black.

Its size is very variable, sometimes becoming very wide. Males have a row of setae on their abdomen called the pectin. This is used for pheromones dispersal.



Jackfruit Production



Fruit fly Damage



Control Measures/Options

1. **Bag** fruits with nylon sacks at 10-15 days after fruit fertilization. (fruit fly observed to lay eggs as early as 20 days after fertilizations)
2. **Dispose** the infested fruit by burning or burying them in 1-m deep compost pit. Chop the infested fruits to enhance decomposition.
3. **Use** methyl eugenol-based fruit fly attractant to kill the male adults.

Pest Management



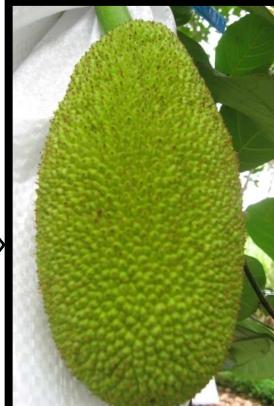
Fruit size: 12.52cm x 20.66cm



Wrapping of fruits with Shark skin (119.50cm) & nylon sack open at the bottom.



Tagged the fruits right after fruitlet emergence for timing of wrapping and easy monitoring.

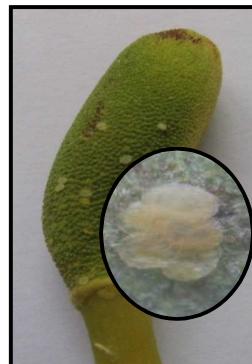


About 83% yield reduction could occur if the fruits are not properly bagged under filed condition.

Jackfruit Production

Crambid Fruit Borer (*Glyphodes caesalis* Walker)

The moth is pale brown with white markings on its wings, larva is light yellow with black dots or markings all over the body.



Life Cycle



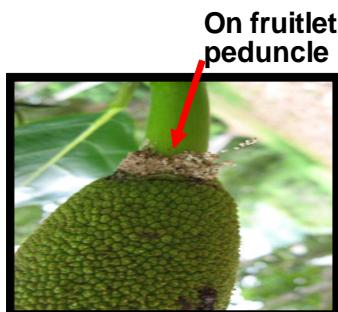
Borer Damage



On flower bud



On fertilized
fruitlet



On mature fruit



% damaged
tissues/fruit at
harvest:

FF = 63.96%

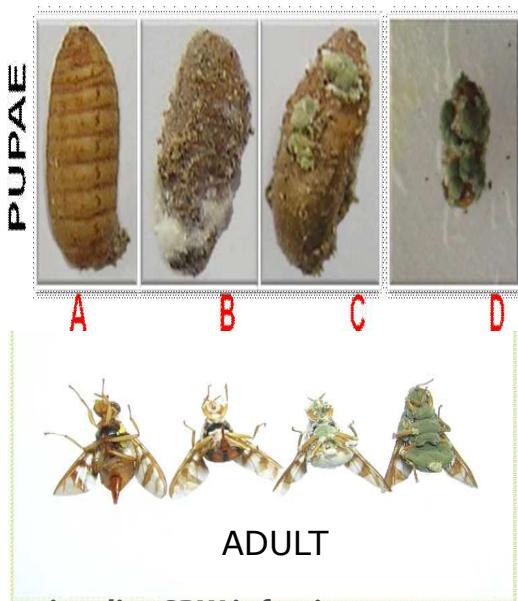
FB = 33.89%

76.50%

Pest Management

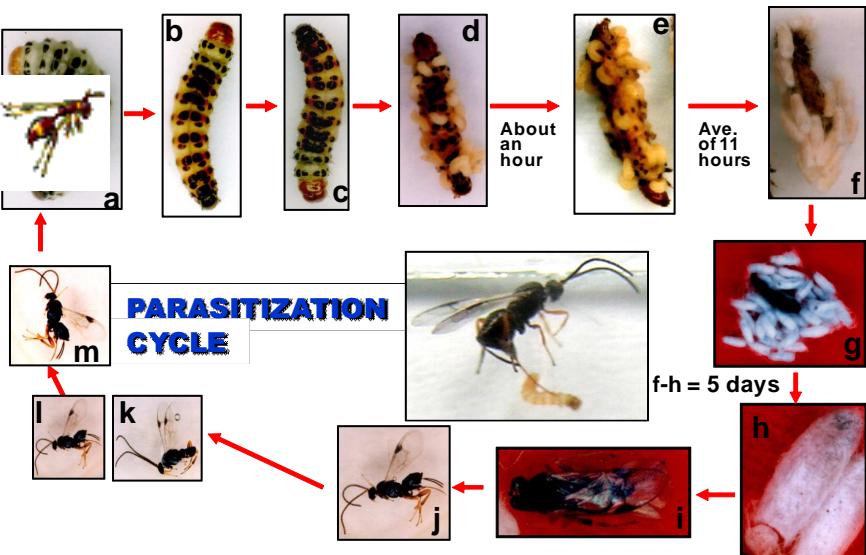
Control Measures/Options

- 1.** Trap the adult moths with light traps.
- 2.** Time the application of *Metarhizium anisopliae* SPW isolate on eggs, first and second stage larvae while they are still outside the fruit. Dissolve 1 bag *Metarhizium* per 16 liters knapsack sprayer and spray to fruits at fruitlet emergence until 1 week after fruit wrapping.
- 3.** Apply 1 Tricho card per 5 trees or 31 cards of *Apanteles* sp. per hectare.
- 4.** Provide a “refuge” area of small flowering plants in the jackfruit orchard as food source of free-living adults of *Apanteles* sp., a very promising parasitoid or biological control agent of the insect pest. Cultured *Apanteles* sp. cocoons can also be applied at the rate of 3,000 cocoons per hectare.
- 5.** Dispose the infested fruit by burning or burying them in 1-m deep compost pit. Chop the infested fruits to enhance decomposition.
- 6..** Spray the recommended rate of insecticides on flowers and fruitlets whenever necessary before wrapping at 10-15 days after fruitlet fertilization.



Manifestations of *Metarhizium anisopliae* SPW infection on pupae and adult borers

Jackfruit Production



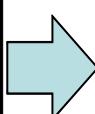
Parasitization Cycle of *Apanteles sp.*



Gumamela



Okra



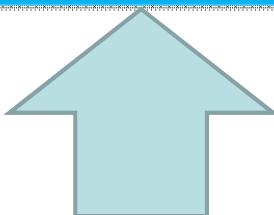
Host Plants of Leaf Folder as Alternate Host of *Apanteles sp*

Pest Management



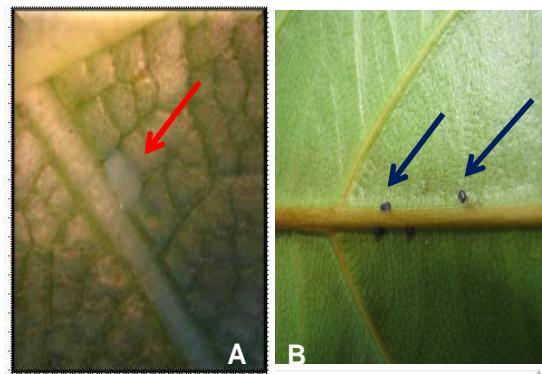
Modified technique for *Apanteles* sp. field release.

% Parasitism:
10.56



% Parasitism:
4.19

- Field releases of *Apanteles* sp. cocoons resulted to increased percent parasitization of field -collected borer larvae.



Healthy (A) and parasitized (B) borer egg on jackfruit leaf as oviposition substrate

Application of *Trichogramma evanescens* (jackfruit fruit borer egg parasitoid in jackfruit plantation.

Curculionid Fruit Borer

The adult weevil is black with powdery brown zigzag band across the forewings. Grubs are white with a dark head and feed inside older fruits. Fruit rotting damage can be mistaken as caused by fruit fly.



Control Measures/Options

1. Spray insecticides at recommended rate on flowers and fruitlets whenever necessary before wrapping.
2. Bag the infested fruitlet at 10-15 days after fertilization.
3. Dispose the infested fruit by burning or burying them in 1-m deep compost pit. Chop the infested fruits to enhance decomposition.

Disease Management

Sclerotium Fruit Rot (*Sclerotium rolfsii* Sacc.)

Causal Organism and Symptoms

The disease is caused by a fungus, *Sclerotium rolfsii* Sacc. The severely affected fruit shows white cottony mold growth that later produces abundant hard, black sclerotial bodies. The disease rapidly spreads during moist conditions or high relative humidity and causes rotting of the fruits.

Control Measures/Options

1. Observe proper sanitation in the farm.
2. Dispose infected and fallen fruits properly by burying or composting.
3. If wrapping material needs to be recycled (e.g. shark skin or sack) they must be washed, disinfected or sun-dried to kill the sclerotial bodies and other parts of the fungus that may be a new source of infection later.
4. Spray protective fungicides at recommended rate whenever necessary before wrapping.



Jackfruit Production

Jackfruit Decline (*Phytophthora palmivora*)

Causal Organism and Symptoms

The disease is caused by the fungal-like organism *Phytophthora palmivora* (Butler). The affected tree shows yellowing of leaves, pre-mature defoliation that usually starts from the top (die-back symptom) and in severe cases death of the whole plant. Trunk cankers and girdling of the tree base near the soil surface and gummosis are also observed.



Disease Management

Control Measures/Options

- 1. Observe proper sanitation as follows:**
 - a. Use disease-free planting materials;
 - b. Sterilize soil to be used for nursery medium.
 - c. Adopt aseptic practices in grafting, i.e. sterilize cutting implements, keep working surfaces clean of debris
 - d. Use clean water in watering the plants.
 - e. Check plants regularly for any signs of sickness. Remove infected fruit or tree part if found affected with the disease.
 - f. Underbrush or do ring weeding regularly.
 - g. Dispose fallen fruits by burying or composting later.
- 2. Increase use of organic matter in the soil (e.g. chicken dung, cow's manure).**
- 3. Decrease use of inorganic fertilizer.**
- 4. Scrape canker lesions and paint with Copper-based protectants (e.g. Nordox, fungoran, Kamantigue fruit extract can be used to treat cankers. , etc.)**
- 5. Provide good drainage in the farm.**
- 6 Mound trees to avoid ponding of water near the tree base.**
- 7. Prune trees to improve light penetration, air circulation around canopies and rapid drying of foliage and to remove primary and secondary inoculum from the canopy.**
- 8. Apply chemical when necessary.**
 - Spray trees with Systemics; e.g. Fosetyl al (alliette), metalaxyl)
 - Phosphate injection or spray
 - Spray using defense activators

Jackfruit Fruit Bronzing (*Pantoea stewartii*)



Causal Organism and Symptoms

The disease is caused by a plant pathogenic bacterium *Pantoea stewartii* (formerly *Erwinia stewartii*). Symptoms include yellowish to reddish discoloration of the rags and flesh of the jackfruit which appear healthy outside. The bacterium is suspected to be carried to the flower by insects especially orange beetle and find its way inside the developing fruit.



Disease Management

Control Measures/Options

Management of fruit bronzing needs further study but for the meantime the following may be done:

1. Remove and properly dispose infected fruits.
2. Control fruit borer and other insects that possibly carry the bacterium to the flower.

Other Minor and Uncommon Diseases



Early Fruit Drop

Causal Organism and Symptoms:
Colletotrichum sp.

Symptoms include rotting of the peduncle area which leads to early fruit drop. Characteristics of the pathogen and its management still needs further study.

Jackfruit Production



Male Fruit Rot

Causal Organism and Symptoms:

Rhizopus artocarpi and Choanephora cucurbitarum

Symptoms include rotting of the male fruit. This is normal since the male fruit is destined to die after it has shed-off its pollens. Dying male fruit is attacked by the opportunistic *Rhizopus artocarpi* and *Choanephora cucurbitarum*.

Higher Fungi



Daldinia



Bracket Fungi



Pink Disease

These fungi could infect jackfruit trees whose health had been compromised like wounds in the trunk.

Disease Management

Control Measures/Options

1. Minimize wounding trees.
2. Improve plant nutrition by applying organic matter (e.g. chicken dung or cow's manure)

Lichens



Lichens do not actually penetrate the leaf but may hinder photosynthesis in the leaf. Photosynthesis is the process wherein the plant converts sunlight into food for plant growth.

Control Measures/Options

Improve the overall health of the tree by applying organic matter (e.g. chicken dung and cow's manure).



Jackfruit Production

**Philippine Council For Agriculture,
Aquatic and Natural Resources
Research and Development (PCAARRD)**
Department of Science and Technology (DOST)



**Visayas Consortium for Agriculture and
Resources Program (ViCARP)**
Visayas State University (VSU)



**Regional Research and Development
Extension Network (RRDEN)**
Department of Agriculture-
Regional Field Unit 8 (DA-RFU 8)



**Department of Development
Communication (DDC)**
Visayas State University (VSU)

