Tree Crops

1. Avocado
2. Breadfruit
3. Citrus
4. Cocoa
5. Coconut
6. Mango
7. Plantain

TECHNOLOGY PACKS

COCOA

November 2015

Background

Production decisions concerning how much effort and resources to invest and which farming practices to follow, have consequences and create opportunities for the farm affecting production levels, input costs, time constraints, and the potentially size of the operation. They also may have implications for resource use and environmental quality.

Numerous information exist on the various aspects of production and handling/ marketing of crops and livestock, the majority of which are outdated, not easily understood and lacking the where with all for addressing present day challenges such as good agricultural practices (GAPs) and food safety and climate change that impact on the environment and rural livelihoods. These issues are also closely related to the importance of the role of primary producers in increasing the earnings of all actors along the value chain in supporting the development of a commercially viable and sustainable agricultural industry.

The production of high quality and easily understood information packages is critical as this forms a basis for farmers to obtain financing from lending institutions and to efficiently increase their production through the availability of modern technology. This will also result in a reduction of rural unemployment and will greatly help in alleviating poverty and other associated social ills.

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COCOA

November 2015

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Introduction

This Technological Package (Tech Pack) deals with the production and postharvest aspects of cocoa.

Also included in the Tech Pack are appendices:

- List of recommended pesticides and application rates
- Good Agricultural Practices data record sheet.

Notwithstanding the identification of any specific pesticide for the control of pests and diseases, this decision is for the discretion of the Ministry of Agriculture Area Extension Officer and the farmer.

However, the mention of any pesticides and other products used in the Tech Pack should strictly comply with local regulations and all instructions provided by the manufacturer. Also, the use of trade names in the Tech Pack is for the purpose of citing examples and is not meant to either endorse or discredit any particular product.

Description

Cocoa (*Theobroma cacao* L.) is a tropical tree crop originating from the Amazon basin where it grows in the shaded rainforest under storey. The tree produces pods on the trunk and branches that contain about 40 cocoa beans surrounded by a sweet tasting pulp. When fermented and processed, the beans produce one of the most loved and desired flavours in the world—chocolate. Chocolate has been referred to as the "food of the gods"; scientific research is revealing that chocolate is indeed a health food.

Plate 1 Bearing cocoa tree
Source: https://sjaaks.com/images/cocoa/tree.jpg?1352903501

Site Selection

Choose sites that:

- Have soils that are of moderate to high fertility, free draining, and good moisture holding capacity with a pH range of 4.5 - 7.0.
- Are less than 1000 feet (300 m) above sea level
- Have annual rainfall of 50 - 100 inches (1250 - 2500 mm), well distributed over the year. The dry period should be no longer than 3 months
- Very accessible to facilitate the easy movement of inputs and harvested beans
- Protected from high winds by hills, valleys, windbreaks.

- Have soil from potential sites tested by a soil laboratory to obtain pH status and fertilizer recommendations.

Varieties

Many older selections are available like the ICS accessions and IMC-67. The newer high yielding selections, Trinidad Select Hybrids (TSH) may be preferred.

Propagation

Propagate via seedlings, cuttings or grafted plants using the desired varieties. Seedlings and grafted plants are especially useful in drier locations as their tap root systems take moisture from lower parts of the soil profile. They are also more firmly rooted than cuttings. Plants can be obtained from the Ministry of Agriculture or private nurseries.

Land Preparation and Planting

Prepare land about a year in advance, establishing contour drains, permanent shade, temporary shade, windbreaks and hedges.

Permanent shade trees last for many years and grow above the canopy of the cocoa trees. Some popular ones include Immortelle, Cedar, Cassia, Breadfruit, Breadnut and Avocado. If new land is being cleared then suitable forest trees can be left to provide shade. These can be later replaced with fruit trees. Mature cocoa trees needs 25% shade to help with moisture management during the dry season . Six Immortelle trees per acre spaced 60 x 60 feet (18 x 18 m) with a crown diameter of 50 feet (15 m) will provide 25% shade.

Permanent shade and windbreaks are necessary to maintain a high level of soil moisture, minimize weed competition, minimize wind damage and regulate field temperature and humidity thus minimizing environmental stress on the plant.

Temporary shade are plants which lasts for a year or two. Bananas is the most economic and popular temporary shade for St. Lucian conditions. Other plants used are tannia and pigeon pea. Establish

bananas with a spacing of 8 x 8 feet (2.5 x 2.5 m). This gives 50% shade for young cocoa plants. Use the same spacing for the cocoa trees. Place cocoa rows in the middle of the banana rows.

Use a square planting pattern on flat land (Figure 1) and a triangular planting pattern on sloping land (Figure 2)

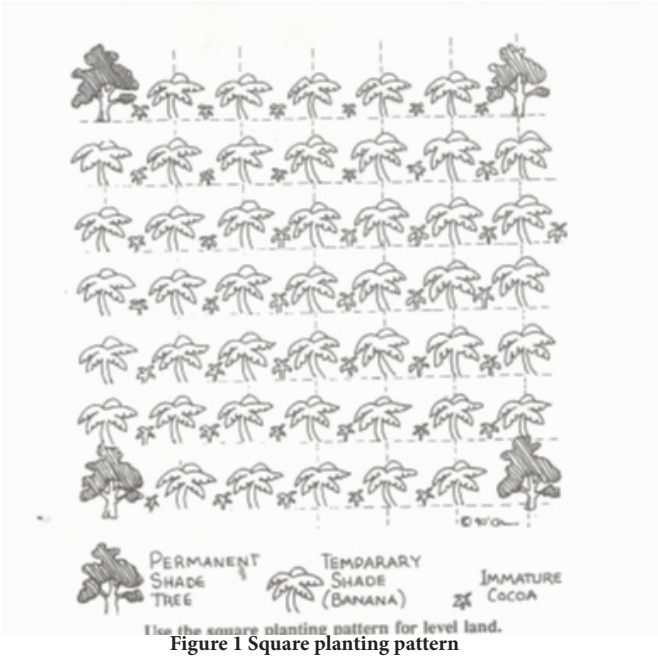


Figure 1 Square planting pattern
Source: Hess, Oleen. Farmers guide to Cocoa production

Figure 2 Triangular planting pattern
Source: Hess, Oleen. Farmers guide to Cocoa production

Having well drained soils to provide proper soil aeration is vital to avoid suffocating the roots. On flat land cambered beds can be used. On sloping land ensure that drains are dug on the contour. Drains must be cleaned yearly at the end of the dry season to ensure that they function properly. At the end of the rainy season block ends of drains to hold in water to provide extra moisture during the dry season.

Plant suitable vegetation, e.g. Vetiver grass on uphill side of the drains to prevent soil caving into them.

Use the following guidelines to plant the trees:

- Dig holes 18 inches x 18 inches and 12 inches deep (40 cm x 40 cm and 30 cm deep)
- Mix soil removed from hole with pen manure (two parts soil to one part manure) and fertilizer as recommended after a soil test. In the absence of a recommendation use 1 ounce (30 g) of 12.12.17+2 fertilizer.
- Water plants in bag
- Remove bag and place plant in hole
- Refill hole with soil mixture, firming soil in the process. Ensure that the base of the plant is at ground level
- Leave a slight mound of soil around the plant to avoid water ponding.

Fertilization

It is best to follow recommendations available after a soil test. In the absence of such recommendations, apply 12.12.17+2 or 16.8.24+2 at the drip line of the plant twice per year (at the beginning and end of the rainy season) at the rates given in Table 1. Fertilize after weed control and pruning (if necessary).

Table 1 Fertilizer rates for cocoa

Year	Fertilizer rate /plant		Fertilizer type	Application style
	ounces	g		
1	4	115	12.12.17+2	Banded and covered at drip circle
2	4	115	12.12.17+2	Banded and covered at drip circle
3	8	225	16.8.24+2	Banded and covered at drip circle
4	12	340	16.8.24+2	Broadcast
5	12	340	16.8.24+2	Broadcast
6-7	16	450	16.8.24+2	Broadcast
8 +	32	900	16.8.24+2	Broadcast

Weed Control

Manual: cutlassing, weed eaters.

Mechanical: brush cutting with tractor.

Chemical: selective herbicides, which kill grasses but do not harm the cocoa plants, may be best e.g. Fusilade. When using contact and systemic herbicides during young stages, apply with a shield attached to the knapsack sprayer.

Pruning

Prune to remove unwanted parts of the plant, for ease of movement and to improve production. Cut branches at a 450 angle for easy runoff of water.

Formation pruning:
Remove jorquettes below 5 feet (0.8 m). Select jorquette above 5 feet (0.8 m). Remove basal chupons and suckers that are below the chosen jorquette. Also remove weak branches from jorquette.

Sanitary pruning:
Remove dead and diseased branches, entangled branches, unwanted chupons, suckers, old pods, vines, termite nests, witches broom, etc.

Structural pruning:
Prune branches to form well balanced trees that are upright and have umbrella shaped crowns. Maintain a maximum crown height of about 16 feet (5 m). Allow branches from adjacent trees to meet but not overlap. Maintain lower branches at about 6 – 7 feet (2 m) above ground.

Shade Management

Reduce temporary shade (e.g. that provided by banana) as cocoa trees mature as shown in Table 2. Also maintain windbreaks and ground hedges ensuring that they are at an optimal growth.

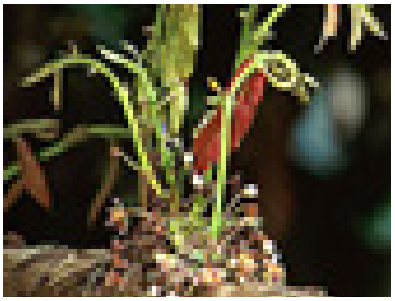
Table 2 Temporary shade management of cocoa trees

Tree Age (Years)	Amount of temporary shade removed (%)
1	30
2	50
3	50
4	100

Pests and Diseases

The major pests and diseases affecting cocoa are shown in Table 3. Good Agricultural Practices (GAP) related to the use of pesticides, requires farmers to maintain up to date records on the application of pesticides to the crop. These records should include trade names, application rates and dates of application. During the harvesting period use pesticides with a very short harvest interval.

Pest & Diseases	Symptoms	Control/ Management
Plate 2 Thrips *Selenothrips rubrocinctus* (Giard)  Source: http://www.cabi.org/portfolio/0x100/70779.img	Suck sap from leaves resulting in leaf burn and leaf fall.	Minimize plant stress by ensuring proper shading, proper moisture management and good soil fertility management. Spray insecticides (containing abamectin as the active ingredient) to areas of high infestation.
Plate 3 Termites *Neotermes spp.*  Source: http://coralspringstree.com/wp-content/uploads/2012/05/tree-termite-adult-soldier-broward.bmp	Eaten bark and wood.	Prune dead and dying wood, paint wounds with tar or insecticide mixture. Apply neem oil to nests and infected areas. Use insecticides containing alphacypermethrin.

Pest & Diseases	Symptoms	Control/ Management
Plate 4 Black Pod *Phytophthora palmivora* (Butler)  Source: http://www.kissankerala.net:8080/KISSAN-CHDSS/English/Cocoa/Disease/images//thumb/2.jpg	Blackened pods, beans inside are damaged and therefore unmarketable.	Provide adequate drainage to remove excess water from field. Remove excess shade. Prune cocoa branches to allow sunshine into the canopy. Control weeds and manage hedges to have good air flow. Remove and burn infected pods. Harvest mature pods regularly. Spray copper based fungicide at flowering, pod set and when pods are mature.
Plate 5 Witches Broom *Moniliophthora perniciosa* (Stahel) Aime & Phillips-Mora  Source: http://www.ars.usda.gov/is/kids/farm/story3/k8634-1i.jpg	Abnormal growth and death of young flushes, flower cushions, vegetative buds and young pods.	Remove and burn vegetative brooms, diseased blossom cushions and infected pods. Plant resistant varieties.

Rehabiliting Old Cocoa Fields

Rehabilitation of old cocoa fields must be practiced to maintain and also improve yields. Four systems of rehabilitation can be followed.

1. Total replanting: remove all old cocoa trees and other unwanted plants; leave overhead shade and windbreaks which are needed; this is a costly venture.
2. Partial replanting: replace blocks of the cocoa farm annually; in this way income is still derived from the remaining cocoa fields.
3. Underplanting: replant between old cocoa trees preferably with better varieties.
4. Rehabilitating with basal chupons: use where old cocoa trees are of desirable types; where

young basal chupons do not exist, induce them to grow by wounding the tree at the ground level, apply tar and or insecticide to the wound; remove parent tree when the basal chupon is 4 years old. One fifth of the field can be rejuvenated annually.

Harvesting and Bean Extraction

1. Harvest ripening, fully ripe and over ripe pods about every 2 weeks. This minimizes losses to pests and diseases.
2. Use sharp knives in harvesting to prevent damage to blossom cushions and pods.
3. Crack open pods carefully to avoid damaging beans.
4. Remove beans, separating placenta from beans at the same time.
5. Discard diseased pods and beans.

Fermentation

1. Set extracted beans to ferment in wooden boxes within 24 hours. Cover with fresh banana leaves or sacks to keep in heat and moisture.
2. Box size should range from a minimum of 2 feet x 2 feet x 2 feet (60 cm x 60 cm x 60 cm) to a maximum of 5 feet x 5 feet x 5 feet (1.5 m x 1.5 m x 1.5 m). The bottom of the boxes should be slatted ¼ inch (5 mm) apart to allow juices to drain out and for aeration. Each box should have at least one movable side to facilitate turning and bean removal. Locate boxes under a shelter to keep out rain.
3. Turn beans after 2 days and again after another 2 days.
4. Ferment beans for a maximum of 7 days.

Drying

1. Immediately after fermentation dry beans on wooden floors to develop their flavour before storage.
2. Spread beans to a depth of about 2 inches (5 cm).

3. To even out drying, move the beans over frequently (about every hour during the daytime) with a wooden rake or bare feet, making small ridges in the process.
4. Sun drying results in better quality than artificial drying.
5. In good sunny conditions drying will be completed in 7 days but can take longer depending on weather.
6. During drying, keep beans from getting wet.

Cleaning, Grading and Storage

After beans are dried, remove those that are flat, broken, damaged or germinated. Also remove any foreign debris such as dirt, stones, etc. Store beans in jute or woven plastic bags. Storage rooms must be well ventilated, clean and free of odours caused by smoke, chemicals, fertilizers, etc.

Marketing

There are a range of markets existing for dry or wet cocoa beans. Decide which market is most profitable to target depending on a range of factors such as drying facilities, price, availability of labour, distance to market, transport, ability for further processing into bars, balls, sticks, chocolate, etc.

APPENDICES

INSECTICIDES	APPLICATION RATE
Pronto 35 SC	3 - 5 teaspoons/gallon of water
Target	1 - 2 teaspoons/gallon of water
Pirate	½ - 1 teaspoons/gallon of water
Fastac	1 - 2 teaspoons/gallon of water
Caprid	½ - 1 teaspoon/gallon of water
Diazinon (Basudin)	¾ - 1½ pints/acre
Admiral	¼ teaspoon/gallon of water
Dipel	1½ - 2 teaspoons/gallon of water
Aza-direct	1 - 2 teaspoons/gallon of water
Cure	½ - 1 teaspoon/gallon of water
Danitol	1 - 2 teaspoons/gallon of water
Cypro	½ tablespoon/gallon of water
Dimethoate (Perfecthion, Rogor 40)	1 pint/acre
Phosvel	1¼ - 2 pints/acre
Orthene	3.2 ounces/acre
Permethrin (Ambush)	½ teaspoon/gallon of water
Padan 50 WSP	2 - 3 teaspoons/gallon of water
Lannate	1 teaspoon/gallon of water
Decis	½ teaspoon/gallon of water
Kelthane 42%	1¼ lb/acre
Orthene 75S	1 lb/acre
Malathion	½ - 1 pint/acre
Sevin	1½ lb/acre
BT(*Bacillus thruingiensis*)	Label rates
Rotenone	1 - 2 teaspoons/gallon of water
Neem X.	8 - 10 oz/gallon of water
FUNGICIDES	**APPLICATION RATE**
Bellis	2 teaspoon/gallon of water
Acrobat	2 - 4 teaspoon/gallon of water
Mancozeb (Dithane M45)	1.5 lb/acre
Cabendazim	2 teaspoon/gallon of water
Daconil	1½ - 2 pints/acre
Benomyl (Benlate)	6 oz/acre
Captan	2 - 3 teaspoons/gallon of water
Peltar	3 teaspoons/gallon of water
Manzate DF	2 - 4 teaspoons/gallon of water

Bravo	1½ - 2 pints/acre
Tri-Miltox-Forte	3 teaspoons/gallon of water
Botrilex	5 - 200 lbs/acre
Kocide 101	2 - 4 teaspoons/gallon of water
Cupravit	2½ lb/acre
WEEDICIDES	**APPLICATION RATE**
DCPA (Dacthal W-75)	10 lb/acre¬¬¬
Diphenamide	4 - 10 lb/acre
Paraquat (Gramoxone)	1 - 2 pints/acre
Dymid 80W	5 lb/acre
Atrazine 80 (Gesaprim).	1¼ - 1½ lb/acre
Linuron (Lorox)	1 pint/acre
Prometryn (Caparol)	0.8 - 1.6 lb/acre
Sethoxydim (Poast)	1¼ - 3½ lb/acre
Clethodim (Select)	0.094 - 0.25 lb/acre
Prometryn 50WP (Geagard)	2 - 3 lb/acre
Herbicidal Oil (Stoddard Solvent, Kerosene oil)	40 - 80 gallons/acre

APPENDIX I: LIST OF RECOMMENDED PESTICIDES AND APPLICATION RATES

APPENDIX II: GOOD AGRICULTURAL PRACTICES DATA RECORD SHEET

Grower name:

*Name of applicator	Date	Brand and product name	Rate	Size of area/no. of plants treated	Total application (amount of the product used)	Notes/target pest	Start/finis time

*The applicator should be trained or, if not, supervised by a trained or certified person. Proof of training required.