



Introduction

hilippines can be a potential producer of cocoa. The climatic conditions and soil characteristics are conducive to growing cocoa. There is presently an increasing interest from local farmers because local and international demand for cocoa products is way beyond the production capacity of the country and world prices have been constantly favorable. With a positive attitude towards sustainable cacao production in the country, the Philippines can compete globally in the world's supply of cocoa products.

According to statistics, the country's supply reached a deficit of 44,349 metric tons a year (2005) against local consumption. Production was then nearly 5000 metric tons in 2005. Local consumption then reached nearly 50,000 metric tons. There is indeed a large demand for local production of cocoa beans. With the present civil war happening in Ivory Coast which produces about 40% of the world's cacao, major buyers (mostly from the US and Europe) are seeking alternate supply elsewhere. Cacao is considered an equatorial crop (crops that thrives well on regions occupying the equator), the Philippines has a great potential growing cacao.

Selection of Varieties

There are many varieties of cacao but the National Seed Industry Council (NSIC) has registered and approved only 9 varieties/clones of cacao. The NSIC approved clones are BR 25, K 1, K 2, UIT 1, ICS 40, UF 18, S 5, K 4 and K 9.

Five (5) of the nine (9) varieties are as follows:

1. BR25 (CC-99-05)

- o Reddish (red with green) pod color when still young that turns to yellow as it matures.
- o First flowering starts at 16.12 months and fruiting follows at 17.70 months
- o Pod shape is AMELONADO characterized by an ovoid shape without a prominent point and with a diameter greater than 50% of the length.



- o Resistant to insect pests and diseases is moderate.
- 2. ICS 40
 - o Starts to flower at the age of 17.63 months & fruiting follows at 19.63 months.
 - Pod shape is Cundeamor describe as a variety with elongated cylindrical fruit



with ridges, a rugose surface, pronounced bottleneck and sharp point.

- o Moderately resistant to insect pests and diseases
- 3. UIT 1 (CC-99-02)
 - o It flowers at the age of 16.80 months in the stage of first fruiting.
 - o Pod shape is Cundeamor. Pod length is 20.7 cm and width of 8.65 cm.
 - o Canopy diameter is 278 cm. Moderately resistant to insect pests and diseases.
- 4. K 1
 - o It flowers at 23.20 months and bears fruit at 25.10 months
 - Pod shape is Amelonado with superficial ridges and a smooth surface.



- o Pod is red in color while still young and becomes yellow/ orange when mature.
- o It is moderately resistant to known insect pests & diseases



- 5. K 2
 - o It flowers at 21.10 months and bears fruit after three months or at 24.12 months.
 - It is moderately resistant to known insect pests & diseases.



Propagation by seeds

- Collect seeds only from ripe and healthy pods.
- Select seeds that are uniform in size. Discard seeds that are swollen and of different shape
- Select bigger seeds since the possibility that they would produce vigorous & fast growing seedlings are high.
- Remove mucilage that covers the seeds by rubbing the seeds with sawdust or sand.
- Wash the seeds to effectively remove the mucilage.
- Cacao seeds are sensitive to fungal attacks and could lead to non-germination. It is best to soak cleaned seeds in fungicide solution for about 10 minutes. Follow strictly instructions indicated in labels.
- Spread the seeds on wet sacks and cover with wet newspaper for 24 hrs.
- Keep it moist but well ventilated to avoid formation of fungi.
- Start collecting seeds that show sign of germination (a pig tail-like root appears on one side). Usually, germination starts after two days.
- Sow the pre-germinated seeds not more than 1 cm deep in prepared polybags. Be sure seeds are sown with the pigtail-root pointed downwards.
- Use 8" x 10" polybags. The soil must reach 2 to 3 cm from the top of the plastic bag.
- Potting medium
 - o Mix completely composted organic materials to improve the soil characteristics such as water holding capacity, nutrient content and soil texture.
 - If possible sterilize soil by boiling soil with water in drums or other convenient containers. In some cases, spraying formaline solutions also help sterilize soils. Cheapest way to sterilize soil is the use solar drying.
 - o Loamy to sandy loam soils are the most suitable medium in terms of physical property for raising seedlings.
 - o Liming is used for soils with less than pH 5

Nursery Establishment and Management

- Choose site which are near roads.
- · Choose flat grounds.

• Availability of quality water sources like good water table for shallow wells, presence of irrigation canals or other natural water source like river or creeks. Also, free from saline waters.

• Free from water-logging and presence of nearby drainage facilities

• For cacao seedlings, shading material is a must. 0 to 2 month old seedlings require 70 to 80% shade. However, gradual removal of shading is recommended to prepare seedlings for field planting. Shading materials may use materials in the vicinity of the nursery itself. This is to avoid additional expenditures.

• The period of keeping the seedlings in the nursery affects the arrangement of the bags. Polybag arrangement must be systematically carried out to facilitate maintenance and grafting. Normally, a twin row with alternate path of 45 cm in width is recommended. In order to enhance the seedling growth and to avoid the seedling etiolation, the seedlings are usually spaced further apart from each other when the seedlings are 2 to 3 months old.

• The distance is 25 to 30 cm apart starting from the middle point of the polybag. The distance gradually increases when the seed-lings are kept in the nursery for a longer period.



Weeding: Weeds do not normally cause problems in the nursery and those that appear can be removed without much expenditure on labor. On the other hand, weeds growing along spaces in between the blocks may be controlled by cutting down with scythes. The use of herbicide is not recommended. Therefore

weeding could be done manually or by mulching with available materials such as rice hull.

Fertilizer application is carried out after the first leaf hardens and should be based on the result of soil analysis. If analysis is not available, incorporate 15-35 grams of diammonium phosphate (18-48-0) per bag depending on the size of polybag. The use of granular fertilizer is also done when the leaves are dry to avoid leaf scorching.

Culling/Selection: To ensure uniform growth and development of the seedlings to be planted in the field, cull out the poor-growing seedlings in the nursery. This practice may be carried out by removing the bags containing seeds which did not germinate and small, crinkled seedlings.

Transplanting: To reduce the seedling shock during transplanting, it is necessary to rotate the polybag to a few degrees one week before field planting. It is done for the seedlings whose leaves have hardened and especially for those which roots have penetrated the ground. Watering has to be done for a few days later. Field planting must be started at the onset of the rainy season. Unless irrigation is available, field planting during the dry season is not advisable.

Vegetative Propagation

Vegetative propagation gives more advantage in terms of reproduction of true-to-type trees, more uniform growth, early to bear flowers, and the clone perpetuates most if not all important characters of the original seedling mother tree like pod value, bean size, fruit wall thickness and others. Types of vegetative propagation are *patch budding*, *nodal grafting*, *and conventional cleft grafting*.

Patch Grafting is the propagation of true-to-type trees using buds from any of the nine NSIC approved clones while Nodal Grafting promotes propagation on the sides of the seedling using nodes. The Conventional cleft grafting technique is similar to the procedure used in grafting mangoes where rootstocks are cut horizontally leaving only two leaves behind. Scion of selected variety is attached to rootstocks with an inverted V shape and fastened to each other using thin plastic sheet covering all wounds to prevent drying.

Planting and Farm Establishment

Soil Requirement

Best soil is made-up of aggregated clay or loamy sand with 50% sand, 30-40% clay, and 10-20% silt. Deep soil, about 150 cm, highly favors the growth of cacao with pH of 5.0 to 6.5

Climatic Requirement

Temperature ideal for cacao lies between a mean maximum of 30-32°C and mean minimum of 18°C. Altitude of the area should lie between 300-1200 meters above sea level. Suitable temperature is generally found in an altitude up to 700 m. Cacao thrives best in areas under Type IV climate which has an evenly distributed rainfall throughout the year.

Establishment of Shade Crops

Newly planted cocoa trees need shade (25% 75% direct sunlight overall) during their first year. This can be reduced to a 50% level of overall shade in their second year. After that, the pod bearing cocoa trees need to be shaded only about 25% density of direct sunlight for the rest of the cocoa tree's life span.

Permanent shade crops that have a thin canopy,



O - Shade trees X - Cacao trees

tall trunk and do not defoliate seasonally are ideal to intercrop with cocoa trees for long periods. Some suitable crop bearing varieties are coconut, cashew, longan, durian, mango and mangosteen. Both cacao and shade trees can be planted at 6×3 m.

In the case that shade crops do not create enough shade for cocoa seedlings growth, temporary structures can be made from other, easily available materials such as palm fronds, sugar cane leaf, and etc.

Staking and Spacing

• Planting points are to be marked with stakes using suitable size and length of cable wire or guide from straight line planting.

 Most common distance : High density 1.5 to 2.0 x 6.0 m = 2,300 trees/ha. Double hedge row Low density = 3 x 2m = 1666 plants/ha

or 2.5 x 2.5 m = 1600 plants/ha

• Depending on the shade from existing trees and tree crops, and soil fertility, the planting density of cocoa varies from 400-1100 plants/ha. In the case of intercropping in coconut and cashew, the density of cocoa averages about 600 plants/ha. Basal fertilizers are very important to enhance the growth of young cocoa trees in the establishment stage.

Planting

- 1. Right time to plant is during early morning or late afternoon.
- 2. It is not advisable to plant seedling with young and soft flush leaves as they are susceptible to sunburn, planting shocks or stress.
- 3. Best season to plant in the field is during the onset of rainy season.
- 4. Size of the hole should be big enough to accommodate the ball of the soil mass.
- 5. Normally, a hole of 30cm wide x 30cm long and 30cm deep.
- 6. In holing, the surface of soil should be separated from the sub-soil.



Care and Maintenance

Weeding

Manual by ring weeding method 1 meter radius from the stem as removed with the use of sickle.

Fertilization

In the absence of soil analysis (PCARRD, 1989) recommended rates of fertilizer application for various ages of trees as shown in Table 1.1

Table 1.1

Months after field planting	FERTILIZER APPLICATION/PLANT (g)			
	Ν	Р	K	
1	6.4	6.4	6.4	
4	8.5	8.5	8.5	
8	8.5	8.5	8.5	
12	12.8	12.8	12.8	
18	17	17	17	
24	27	27.3	38.5	
TOTAL	80.5	80.5	91.7	

Pruning

Pruning is done to increase cacao production

- Reduce pest and diseases infestation
- Control the shape and height of the tree to ensure easy access for harvesting.

Steps

- 1. Pruning cocoa trees can increase production, make tree maintenance easier, and reduce pest infestation and diseases.
- 2. Maintenance pruning starts with regularly removing the low hanging branches or those branches or those that grow downwards.
- 3. Second remove regularly the chupons on the stem.
- 4. Also remove all shoots and additional branches that are within 60 cm of the jorquette. Removal of shoots is necessary to avoid production of non-essential branches.
- 5. Furthermore, it is important to remove regularly all dead, diseased and badly damaged branches.
- Top pruning of the highest branches (up to 4m) in order to keep the tree short for easy regular harvesting and maintenance.
- 7. In addition to this it is recommended to open the center of the tree by pruning in the shape of a champagne glass in order to reduce humidity and increase sunshine.







Cacao Production Guide

- 8. The cocoa pod borer does not like the sunshine and increased wind. The additional sunshine to the stem will increase flowering as well.
- 9. The best time for heavy pruning is after the high production cycle, approximately one month before the rainy season. After pruning it is recommended to apply fertilizer.
- 10. Pruning has to be done regularly and correctly, results in more pods on the tree with less infestation and diseases.



Pest and Disease Management Most common cacao pests in the Philippines:

1. Cacao Pod Borer (Conopormorpha cramelerella)

- o Regular harvesting (weekly harvesting of all ripe pods) breaks the lifecycle of the pest.
- Sanitation: bury all empty cacao pod husks; remove all other diseased pods, black pods, and pods eaten by animals from the trees
- o Pruning increases the sunlight, which the pest does not favor.
- o Bagging or sleeving of the young pods with newspaper and stapler (or plastic bag)
- o Fertilizer application increases the general health of the tree and in addition increasing cacao production.
- 2. Vascular Streak Dieback (caused by Oncobasidium theobromae)
 - o Sanitation pruning cut off infected branches at 30 cm below the infected area, and burn the infested cuttings
 - o Nurseries should use polyethylene roofing to ensure spores cannot land on the seedlings
 - o Shade on the cacao trees should be reduced to lower humidity.
 - Plant VSD tolerant varieties such as hybrids PA 173 x SCA9, PA 138 x SCA 9, ICS 39 x SCA 6, PA 156 x IMC 67, PCA 156 x SCA 9, ICS 95 x SCA 6, clones PBC 123, PBC 159, ICS & others.

3. Black Pod Rot and Canker Control Method

(caused by Phytophtora palmivora)

- o Frequent harvesting to avoid pathogen sporulation.
- o Harvest all the infested, dead and mummified pods and ideally destroy or bury them.
- o Prune the cacao trees and shade trees to reduce humidity.
- o Have a good drainage system so that the spores cannot spread in puddles of water.
- o Trees that have died due to tree canker should be cut down and destroyed.
- o Scraping off the bark from the infected area and put paint or soap on it.

4. Helopeltis Control method (Helopeltis: a sap-sucking bud) Typically, Helopeltis likes open canopies and sunlight penetration. Still, one should prune the trees carefully and reduce shade if it is too heavy - this is to allow better visibility on the disease and better application of control methods. (Note: if pruning is too rigorous, new chupons will grow which are feeding ground for Helopeltis).

5. Stem Borer Control Method (Zeuzera)

- o Cut off infested braches at 40 cm below the lowest larvae hole. These branches should be destroyed.
- o After pruning of an infested tree, big branches, especially those with stem borer holes, should be burned.
- o The hole can be covered or plugged with mud or wood to prevent the larva to come out, so that it cannot feed and hatch, or cannot breathe.
- o Poking the larvae out with a piece of wire.
- o Squirt some soap solution in the exit hole. After a while, the larva will emerge from the hole, probably driven out by the unpleasant soap fume. Catch and kill the Stem Borer.

Other Pest and Disease

Leaf Eater Damage

Cause: Insects such as caterpillars, cocoa loopers, grasshoppers, locusts, leaf cutting ants, leaf beetles.

Solution: Chemical control is effective. Shade management is also important. Some shade



trees such as Leucaena are often associated with more caterpillar problems. Open sunny conditions attract locusts and grasshoppers. Red weaver ants may be effective in controlling leaf beetles.

BLISTERS and BLACK SPOTS



Sap suckers on young leaves

Cause: Insect such as thrips, aphids, leaf hoppers and pysillids.

Solution: Chemical control. Take care to spray underneath the leaves as well as on top.

Insect sap suckers *Cause:* Thrips or aphids. Solution: Control with chemicals and shade management. Target spraying to affected plants only. Thrips have natural enemies such as pirate bugs watch out for them and avoid spraying them.



Cacao Production Guide

Harvest Management

Pod harvesting

Don't harvest green pods and avoid over ripe pods because bean size and quality will be reduced. Use secateurs to harvest cleanly and safely, to protect flowering cushions

Pod storage

We should collect pods and store for 7 - 9 days for quicker fermentation and better flavor of cocoa beans.

Pod opening and bean removal

The best way is to use a non-sharpened steel blade to crack the pod then twist the pod open. You can also use a wooden hammer or crack two pods together. Discard the placenta, pulp and soft or empty beans, germinated beans and damaged beans from the bean mass. Correct pod disposal is important to avoid pest and disease buildup. The safest ways are composting or burying after drying. Avoid leaving pod husks on the ground, as insects and diseases can spread from these pods.

Bean fermentation

During cocoa bean fermentation, it is important to:

- Turn the bean mass after 2 days (48 hours) and 4 days (96 hrs.)
- Drain the juices (sweatings) from the bean mass
- · Only use properly constructed wooden boxes with slats, or baskets
- · Cover the beans with banana leaves and jute bags or cloth rags
- · Fermentation will be completed in about 5- 6 days
- · All mixing of beans should be made by wooden tools or hands

Bean drying

Once the beans have been fermented they must be dried immediately under the sun on drying trays or baskets turned regularly. It is important to:

- Cover with plastic shelters during rain or remove the beans to a dry spot.
- During drying separate bean clusters, remove pod placenta, & flat, damaged or germinated beans. Avoid using wood fired kilns that produce smoke- this is not an approved drying method and will result in smoke contaminated cocoa!

Bagging and storage

Keep bags of beans on a wooden palette in a dry and ventilated place. Don't put hot beans into plastic bags to avoid mould and moisture increased.

Record keeping.

Record all weight of pods harvested, wet bean fermented, beans dried in a record book, and dates of harvest, fermentation & drying.

PHILIPPINE MANUFACTURERS STANDARDS FOR COCOA BEANS

Parameter	Amount/Description		
Bean count	100		
Fully fermented	80-90%		
Mouldy	3.0% max.		
Slaty? Salty?	3.0% max.		
Insect damaged/infested			
Insect damaged/infested/ germinated	2.5% max.		
Waste/flat beans, fragments loose, shells, nibs	1.0% max.		
Waste, foreign matter	free from foreign matter		
% nibs	85.0% max.		
% shell	15.0% max.		
% moisture	7.0% max.		
рН	5.0-5.7		
Uniformity	not more than 12% of the beans should be outside the range of +/- 1/3 of the average weight		
Odor and flavor	no off flavor from over fermentation, smoky and hammy beans		
Bean cluster	free from bean cluster		
Insects	no live insects on or in the bags of cocoa beans		
Packaging	62.5 kg.		

FARM MAINTENANCE

Maintenance of Infra-facilities

Road regravelling can be done when necessary (at least once a year) to allow easy passage during rainy days.

Canals and Drainage

- · Declogging of canals should be done at least once a month
- The presence of debris during rainy days aggravates silt build-up
- Desalting as needed normally every two years is important before the canal is fully covered with silt and the desalting operation becomes more expensive

OPERATIONAL COSTS

Cost Estimates in the Establishment of a Cacao Nursery

ltem	Quantity	Unit	Price/ Unit (Php)	Cost to produce 1500 seedlings	
Labor (Shade Construction)	-	Man days	120.00	120.00	
Potting	-	piece	.30	.30	
Nursery budding	-	piece	1.00	1.00	
Polyethylene bags		piece	0.68	0.68	
Nursery maintenance		month	1,000.00	1,000.00	
Budding tape		roll	25.00	25.00	
D-ammonium phosphate	30 g	bag	490.00	490.00	
Cacao pods		piece	7.00	7.00	
Seeds/pod	35	piece			
Bud sticks (1m long)		piece	6.00	6.00	
Bud eye/bud stick	20	piece		120.00	

- 1. Based on September 1998 market price
- 2. Assumes that the one contracting takes care of the whole process
- 3. For field budding, cost per piece is Php2.00
- 4. Cost per seedling is Php3.82

Labor Costs in the Establishment (First Year) of One-Hectare Cacao Farm

Activity	Monocrop at 1,500 trees (PHP)	Under Coconut at 1,000 trees (PHP)
Clearing	840.00	840.00
Planting of shade plants	240.00	240.00
Staking	420.00	240.00
Holing/Planting	2120.00	1,200.00
Replanting	120.00	120.00
Weeding/Slashing	4320.00	4,320.00
Fertilizer application	720.00	480.00
Monitoring of pests	120.00	120.00
Spraying	360.00	240.00
Total		7,800.00

Note: Excludes cost of labor for the construction of road, irrigation and drainage

Type, Rate and Cost of Fertilizer Application to Immature Cacao Plants (Per Plant)

Months After Complete Fertilizer			Muriate of Potash		
Planting	Rate (g) Cost (PHP) Rat		Rate (g)	Cost (PHP)	
1	91.4	0.68	-	-	
4	121.4	0.90	-	-	
8	121.4	0.90	-	-	
12	182.8	1.35	-	-	
18	242.8	1.80	-	-	
24	390.0	2.89	37.3	0.25	
Total	1149.8	8.5	37.3	0.25	

Type, Rate and Cost of Fertilizer applied to Immature Cacao Plants (Per Plant)

Months After	Ammophos		Urea		Muriate of Potash	
Planting	Rate (g)	Cost (PHP)	Rate (g)	Cost (PHP)	Rate (g)	Cost (PHP)
1	62	0.43	5.2	0.04	21.3	0.14
4	83	0.58	8.1	0.06	28.3	0.19
8	83	0.58	8.1	0.06	28.3	0.19
12	128	0.90	11.1	0.08	42.7	0.29
18	170	1.19	14.8	0.10	56.7	0.39
24	273	1.91	23.7	0.16	91.0	0.62
Total	799	5.60	71	0.54	268.3	1.82

Note: Ammophos (16-20-0) at Php 350/bag Urea (45-0-0) at Php 340/bag and MOP at Php 340/bag

Rate and Cost of Fertilizers Applied Per Hectare to Immature Cacao (2 years) after Field Planting

Fertilizer	Mon (1,500	ocrop) trees)	Intercrop (1,000 trees)	
Options	Rate (g)	Cost (PHP)	Rate (g)	Cost (PHP)
1. Complete (14-14-14)	1,725	12,762.78	1,149.8	8,508.52
2. Muriate of potash Cost of Combination	56	380.46	37.30	253.64
		13,143.23		8,072.28
1. Ammophos	1,198.50	8,389.50	799.00	5,593.00
2. Urea	106.50	725.20	71.00	482.80
3. Muriate of potash	402.45	2,736.66	2568.30	1,824.44
Cost of Combination		11,850.36		7,900.24

Source: http://www.bar.gov.ph/agfishtech/crops/cacao and Cacao: Techno-Guide For Cacao in the Philippines (Issn:1655-3675)

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