

# COCOA UNITS

FOR

**GRADES 9 - 12**

**CLASSES IN PAPUA NEW GUINEA SCHOOLS**



**Cocoa Coconut Institute  
Papua New Guinea**



**Department of Education**

**First Edition**

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**Written and Developed by the Cocoa Coconut Institute (CCI) Ltd  
of Papua New Guinea,  
P O Box 1846, KOKOPO, ENBP, PNG**

Approved by the National Department of Education for use in  
Grades 9-12 in Secondary Schools in Papua New Guinea Primary Schools

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Mr. Alfred Nongkas was the CCI Industry team leader in the Cocoa Curriculum Project while Mr. Anton Varvaliu provided the administrative support and advice. Mr. Chris Fidelis of CCI provided some graphics and content input while Mr. Godfrid Hannett of NARI Kerevat helped with additional graphics. Their contributions are acknowledged.

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Edited by Dr. Arnold C. PARAPI (PhD-Agriculture Education)  
Cocoa Curriculum Consultant

Cover Page: Agriculture teacher & students at Malabunga Secondary School standing in front of the school cocoa fermentry

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## THE SECRETARY OF EDUCATION'S MESSAGE

The National Department of Education has the responsibility on curriculum matters for the school system of Papua New Guinea. It is the Department of Education that implements government policies and sets the perimeters for school curriculum planning, implementation and evaluation. Therefore I have the duty to approve and recommend this industry and private sector developed cocoa curriculum for use in the school system of our country.

I am very pleased to recognize and welcome the assistance and support given by the commodity crops sub-sector of agriculture for developing the cocoa curriculum following on from the Coffee Industry initiative Corporation of Papua New Guinea. The Cocoa Coconut Research Institute desire to produce this cocoa curriculum for use in the school is commendable. Admittedly, the Department does not have the personally and resources to develop such curriculum and provide quality education for the country therefore, such an endeavor to partner with the Department is appreciated.

In this light of government direction to revert to the old objective based system of education in the country, the Department of Education is in the process of exciting the outcome based system of education. But until a formal decision on the exit strategy is made, the OBE system from which this cocoa curriculum is developed will be accepted by the Department. When the OBE exit strategy is finalized the cocoa curriculum and any other such curriculum will have to be revisited with the view to publishing a second edition to reflect government and Departmental directives.

It has been noted many times that an increasing number students will leave school to return to the villages. In order to be productive and purposeful in the community, the school leavers have to be appropriately skilled with self-employment and entrepreneurial skills. It is the government, and indeed, Departments responsibility to provide a provision of quality and relevant education. This is the reason the Department will promote and welcome the private sector to support the Department in providing such quality and relevant education.

I am honored and privileged to approve and recommend this major commodity crop based cocoa curriculum for use in the school system in the country. Education is a complex process and the Industry based input to the provide quality education is welcome. It is our sincere hope that the schools and teachers will use is effectively and appropriately skills our youth to be production and purposeful citizens of the country.

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**DR. MICHAEL TAPO (EdD)**  
Secretary for Education

## I. THE CHIEF EXECUTIVE OFFICER OF CCI LTD MESSAGE

Cocoa is the second most important cash crop apart from coffee that actually touches the hearts and soul of the rural population. While many farmers along major roads and towns have other alternatives as a means of generating a cash income to support their social, economic and person needs, many rural households livelihood is depended only on cocoa for a cash income.

It is the CCI hope that cocoa industry provides the scientific, managerial and entrepreneurial skills for farmers to earn a high income while meeting the needs of the market or consumers. Cocoa has to be farmed through an entrepreneurial approach by farmers. Cocoa entrepreneurship means growing cocoa to make money and in the process creating self employment opportunities for growers. As many school leavers will be going home to the communities, this cocoa curriculum is designed to skill the school leavers with appropriate coco skills to support them when they leave school. When taught effectively by schools and teachers, it will enable school leavers with the entrepreneurial skills to make living in the communities worthwhile. It is for this reasons, the cocoa curriculum is developed and prepared.

In partnership with the National Department of Education, a partnership the Cocoa Coconut research Institute welcomes whole-heartedly, we hope that the coffee curriculum provides for appropriate and relevant entrepreneurial skills for the school leavers to utilize to grown cocoa successfully. It is the CCI's firm conviction that cocoa is and will, for the years after gas, oil and minerals be an important sustainable and renewable source of cash for our rural population.

The schools should plan, use and evaluate students performances using the knowledge and skills that we have put together a cocoa curriculum and develop positive attitude among the learners to be enterprising in the communities.

As the chief executive of the cocoa industry research and development institute, it is our duty to ensure that such knowledge and skills are appropriately packaged for use in the schools. I sincerely express the cocoa industry's appreciation to those who developed this curriculum. The National Department of Education is commended for considering and approving it for the schools.

Students are encouraged to take an active part in learning to farm cocoa as a cash crop when they leave school. The CCI as a responsible organization remains committed to the empowering the cocoa farmers to grow and process cocoa of high quality to meet market demands while enjoying a reasonable cash income to support their livelihood.

.....  
**DR. EREMAS TADE (PHD)**  
Acting Chief Executive Officer

## INTRODUCTION

The secondary schools cocoa units have been developed for grades 9-12 classes in secondary schools in Papua New Guinea. These cocoa units should be taught in schools in the cocoa growing regions of the country. The cocoa units are to be taught as units of agriculture in grades 9-10 and as units of the applied natural resources management syllabus in the grades 11-12 classes in the secondary schools.

The cocoa units should be taught as practical units of agriculture and the applied natural resource management. These cocoa units are designed to teach students with entrepreneurial and business knowledge, skills and attitude to prepare them to learn about cocoa farming as a cash income generating crop. It is encouraged that the cocoa units must be planned, taught and assessed using experiential and entrepreneurial approach so that the students can use these experiential and entrepreneurial knowledge skills and attitude to making live worth living in the communities after they leave school.

The cocoa units in secondary schools build on the foundation knowledge, skills and attitude learnt from the cocoa unit studied in grades 6-8 classes in the upper schools. The units in cocoa at the secondary schools are developed to teach advanced units such as cocoa field planting and management, cocoa pests and disease control, cocoa harvesting, processing and marketing. As well, a special unit has been developed on entrepreneurial skills so that the students will appreciate the role of cocoa as a business. It is through entrepreneurial skills that special emphasis be given to student learning as these skills are very much needed to earn cash income to live productive and sustainable lives in the communities after they leave school.

Teachers are recommended to follow the assessment requirements as outlined in the secondary agriculture syllabuses and teachers' guides. The teachers should devote much time to teach experiential and entrepreneurial skills and assess the student using practical and field based learning approaches. The cocoa plot in the schools must be established and managed as the land laboratory using these units so that the student learning vital skills for community living.

Students who are going to leave school at grades 10 & 12 and will not be able to proceed to higher levels of education are a major concern and the cocoa units are necessary to prepare them for a life after schooling. The student must have the confidence that when they leave schools they can grow cocoa as a cash crop. Teachers and indeed, the school administration must ensure that the cocoa units are taught and assessed appropriately.

In sum, for the cocoa units to be successfully taught, the school and the teachers must ensure that there is a cocoa teaching and learning field laboratory established in the school. This field learning laboratory provides for the provision of learning by doing. This means that the student must grow cocoa as a learning experience and these experiences will enable them to utilize such skills for community living.

## RATIONALE

Papua New Guinea is increasingly becoming a cash dependent nation. Students of our schools are constantly exposed to the cash economy rather than the simple subsistence society that was experienced 40 or so years ago. That means that the rural population is no longer a subsistence economy and survival in the villages and communities through subsistence means is no longer a viable option and a good possible.

With the emergence of the multi-million kina mining, petroleum and gas industries, the country is experiencing substantial transformation and many communities are moving rapidly towards a cash dependency. However, these mining, petroleum and gas wealth are not going to be available for all citizen and especially those that dwell in the regions these non-renewable resources do not exist.

When the mines are exhausted, the oil reserves have evaporated and the gas fields have escaped into the skies, only the renewable sectors such as agriculture through crops like cocoa, fisheries and forestry will be there to sustain lives in the communities. That means that agriculture and especially cocoa production to earn cash income to sustain their livelihood remains the only viable means to live a production and meaningful life in those communities when the non-renewable sector can no longer provide a sustainable cash income for quality living. The cocoa units grown through experiential and entrepreneurial learning approach remain a sustainable option so that the students learn vital community living knowledge, skills and attitudes.

Many thousands, and hundreds of students leave each year to return to the communities in the rural regions of PNG. An estimated 85% of our citizens are rural based. With the increasing dependence on cash income in our communities, the schools and teachers must prepare the school leavers to create self-employment for the opportunity to earn cash income. It is therefore highly recommended that schools and teachers work diligently and purposefully to educate the school leavers to be entrepreneurial and self-employment to generate cash income for community sustenance. Failure by the schools, teachers and the community to address the issue of a lack of self-employment and to earn an income can have disastrous consequence in social disorder, increase in crime and a host of other undesirable community living expectations.

The Cocoa Coconut Institute has partnered the National Education Department to develop these experiential based entrepreneurial cocoa units for secondary schools to help the country prepare our youth for a better future. These efforts are geared towards sustainable nation building so that schools leavers can be better equipped with a high degree of the self-respect by understanding their role in the community, become self-employed through cocoa as a sustainable source of income and become relevant or purposeful living in the communities when they leave school.

Cocoa production, processing and marketing skills along with the entrepreneurial mind-set, can greatly facilitate the development of a strong and enterprising citizen. With this view, the cocoa units have been developed to support character development to contribute to nation building. The schools and teacher thus have the responsibility to achieve these results.

## AIMS OF COCOA UNITS

The cocoa growing skills have to be mastered and appropriate attitude and values developed for the betterment of our increasing army of school leavers. It is imperative that the cocoa knowledge, skills and attitude prepared, presented and describe in the secondary schools syllabus be planned, taught and assessed appropriately. Teachers and school have that role and responsibility.

The aims of the cocoa units are to prepare students to:

- Gain the necessary skills of farming cocoa species, varieties and clones recommended by the Cocoa Coconut Institute of Papua New Guinea (CCI-PNG)
- Evaluate and make required land selection and prepare the site for cocoa growing.
- Have the appropriate field planting knowledge and skills.
- Understand and explain the important management practices involved at the field.
- Appreciate the importance of providing good nursery care as recommended by the CCI-PNG
- Appreciate the value and importance and procedures of cocoa maintenance requirements.
- Acquire quality experiential knowledge and necessary skills of cocoa Integrated Pests & Disease Management (IPDM)
- Understand specific skills and practices involved in harvesting, processing quality and marketing cocoa as a cash crop.
- Appreciate the need, uses and promote sustainable use of chemical in the cocoa industry
- Acquire the knowledge and skills involved in farming coca as a sustainable cash income generating entrepreneurial activity.

Students will be taught and are expected to develop invaluable knowledge, skills and values by learning the following cocoa units.

- Cocoa history and origin in the world and in PNG
- Cocoa Pod Borer Tolerant varieties
- Nursery practices of cocoa crop
- Field establishment of cocoa in the field.
- Managing the cocoa as a cash crop
- Economic pests of cocoa
- Major Disease of cocoa
- Use of Integrated Pests and Disease Management Technology
- Different processing options for cocoa
- Required inputs of cocoa for a successful cocoa business
- Identify major field problems of cocoa and plan appropriate corrective action(s)
- Safe and sustainable use of farm chemical.
- Cocoa as an entrepreneurial crop



Students who study cocoa units will build appropriate and relevant positive citizenry skills such as:

- Respect for themselves and their community
- Self- confidence and self-worthiness.
- Innovative, creative and enterprising in community life
- Tolerant, persistent, considerate and yet decisive when dealing with social, economic, cultural and spiritual issues affecting the community
- Provide community leadership as and when required
- Be a community resource by providing advice and sourcing assistance for the self, the family and the community
- Develop entrepreneurship by supporting one self and the community
- Develop banking and investment culture for one self and the community
- Productive and purposeful member of the community

# UNIT 1: COCOA ENTREPRENEURSHIP

## TIME: 50 PERIODS

### Introduction

This unit is an in-depth study of cocoa management practices. The targeted areas are Cocoa Entrepreneurship, Cocoa Anatomy and Physiology, Cocoa Soils requirements, Cocoa block rehabilitation, Cocoa Planting Material and Breeding, General Cocoa nursery management, Cocoa Bud Wood Gardens, Insect Pests, synthesis Disease control, Soil Management and control Soil Erosion, Cocoa Processing, Cocoa Quality, Cocoa quarantine requirements and organize Cocoa marketing.

This unit allows students to explore further into cocoa Entrepreneurship, hence the fundamentals studied in Grades 6, 7 and 8 are in progression from the Upper Primary School cocoa units.

Entrepreneurship study introduces students to farming cocoa as a means of income sources. The study is mainly to assist students to appreciate the economic importance of Cocoa individually as a small holder and collectively as in cooperatives societies part from commercially private run plantations.

This unit encourages students to select, use and evaluate a range of agricultural skills and equipment to be used in the cocoa enterprise. Thus, it provides an opportunity to real life situations in the context of cocoa farming.

### Learning Outcomes

The students should be able to:

1. Explain cocoa as a major cash crop in the economic life of the rural population
2. Describe the role of cocoa as an integral part of the social, economic and political life of the rural dweller
3. Name the Provinces that grow cocoa and the three leading cocoa provinces growing in PNG
4. State production capacity of wet and dry beans of a cocoa tree and per hectare
5. Describe the major inputs of cocoa production
6. Discuss the important management issues affecting cocoa production
7. Explain the marketing and pricing regime in cocoa marketing in PNG and how much a one hectare cocoa plot will contribute to family income
8. If we do not farm cocoa, describe the alternative scenario?

### Content

The students will acquire knowledge and skills through the teaching and learning of these contents.

- Definition of Cocoa as a cash crop
- Interpret and perform Entrepreneurship
- Explain the importance of cocoa to the Rural population

- Value Cocoa as an integral part of life
- Identify Leading cocoa producing provinces
- Differentiate Wet and Dry cocoa beans
- Relate cocoa Economic value in terms of living standards/ needs and wants
- Identity Inputs in cocoa production
- Resolve Management issues affecting cocoa production
- Observe Marketing and pricing regime
- Produce Alternatives beside cocoa farming

### **Teaching Strategies**

The students will acquire knowledge and skills through the teaching and learning of these contents using a Case Study method of a chosen cocoa entrepreneur

#### **Teacher Activities**

Lead discussions on a cocoa entrepreneurship Case study. State and explain its requirements. Demonstrate the method on the case study

#### **Students Activities**

Carry the case study in groups and do presentations.

### **Teaching Material**

Cocoa Resource Book

Cocoa teachers' hand book

## UNIT 2: COCOA ANATOMY AND PHYSIOLOGY

TIME: 50 PERIODS

### Introduction

This unit covers parts and functions of the parts of the cocoa tree as a plant. It leads students to define parts of a cocoa plant, state their functions and explain various vital processes essential to their survival of the cocoa tree.

This unit encourages students to identify and explain the range of parts and their functions. They should be able to identify describe essential processes perform by parts of the cocoa plant vital for plants productivity.

### LEARNING OUTCOMES

The students should be able to:

- A) Describe the natural growth habit of a cocoa tree
- B) Label the parts of cocoa
- C) Explain compatibility of cocoa
- D) Describe pollination of cocoa
- E) State how fertilization of cocoa takes place
- F) Describe seed development
- G) Identify a cocoa seed
- H) Demonstrate seed germination

### CONTENT

The students will acquire knowledge and skills through the teaching and learning of these contents.

Explain cocoa plant Growth habit and Natural habitat

Identify the cocoa Botany and describe these parts

1. Root System
2. Stem
3. Branches
4. Leaves
5. Flowers

Interpret Compatibility in cocoa plants

Demonstrate Pollination using Agents

Observe Fertilization in cocoa pods production

Explain the relationship from Fruit to seed through to Seedling germination and growth

## **Teaching Strategies**

The students will translate separate parts of a cocoa plant and their importance in processes in the production of cocoa

### **Teacher Activities**

Collect a cocoa plant sample, preferably a seedling

Carry out a supervised study method on the botany/ parts, functions and processes vital for survival and production

### **Students Activities**

Work in groups to collect cocoa sample

Identify parts

Separate parts

State their functions

Explain the vital processes involving each part

## **Teaching Material**

Cocoa Resource Book

Cocoa teachers' hand book

## UNIT 3: SOILS.      TIME: 50 PERIODS

### Introduction

This covers the very essential medium for cultivation cocoa. Soils are a very complex field of study. The unit will give the students the basic knowledge on various factors of the soil and their importance. Thus the large area of field of study is brief given in the out comes

### LEARNING OUTCOMES

The students should be able to:

- A) Describe Soil Composition
- B) Draw and label Soil profile
- C) Explain Soil structure
- D) Define Consistency
- E) Work out Soil texture
- F) Explain Moisture availability
- G) Descried Root penetration
- H) Comprehension Fertility
- I) State Optimum soil texture for cocoa
- J) Demonstrate Simple method of soil texture assessment
- K) Carry out Method of soil texture assessment (Figure 4.3)
- L) Construct explain and Soil depth
- M) Explain Soil reaction (pH)
- N) List and state function of Soil nutrients (minerals)
- O) Describe Organic matter content
- P) Explain Cation Exchange Capacity (CEC)
- Q) Explain Base Saturation PBS
- R) Define Exchangeable Bases
- S) Compare importance of Drainage
- T) State Soil properties affecting drainage
- U) Show and describe a Slope
- V) Indicate Other soil characteristics- soil colour
- W) Assess stony ground for suitability for cocoa

### Content

The students will acquire knowledge and skills through the teaching and learning of these contents through the concept mapping method

Analysis Soil Composition in its five main components

Compare Soils difference from one another according to:

- A) Soil profile
- A) Soil structure
- B) Consistency
- C) Soil texture

Explain the Soil Texture affects

Evaluate Moisture availability

Describe Root penetration in different soils

### **Compare Fertility in:**

1. Clay tend be more fertile, have more nutrients. Has greater cation exchange
2. Sands have a weak hold on nutrients because of the small total particle surface area and large pore size

### **Identify Optimum soil texture for cocoa as:**

1. The intermediate soil textures ranging from sandy clay loam to sandy clay are desirable
2. Soil of loamy is preferable because nutrients and moisture are retain

### **Apply Simple method of soil texture assessment in:**

Manipulate handful of soil between your thumb and forefinger with sufficient water to a state of maximum stickiness and plasticity

1. Working out all the lumps before applying the tests shown

### **Carry out Method of soil texture assessment in:**

#### **A) Soil Depth**

1. Mature cocoa tree grow on deep well drained soils, have bulky tap root penetrates a depth of 1.5 meters
2. Thin terminal roots penetrate deeper up to 3 meters in the soils
3. A high water table reduces effective soil depth

#### **B) Soil reaction (pH)**

#### **C) Soil nutrients (minerals) and fertility**

Soils provide physical anchor for plants and a reservoir of the chemical elements essential for plant growth. Factors such as the pH level, organic matter content and cation exchange (CEC) of the soil affects the availability of nutrients

Soil nutrients

1. Fifteen elements are essential for plant growth and production
2. Three, carbon, hydrogen and oxygen are supplied by the atmosphere
3. Twelve by the soil. Each has a specific role in plant nutrient cycles

### **Macro-nutrients**

1. Six macro-nutrients are used in relatively large quantities and are called major elements
2. These are Nitrogen, Phosphorous, Potassium, Sulphur, Calcium and Magnesium

## **Micro- nutrients/ trace elements**

These required in smaller quantities. Zinc iron copper and manganese like potassium is import in the process of making chlorophyll but not found in the chlorophyll itself

Availability of individual elements to plants in a particular soil depends on a number of factors:

1. The amount of nutrient present
2. The form in which it is present in the soil
3. Rate at which it is released from mineral particles or organic matter
4. Acidity or alkalinity of soil

Identify the soil Organic matter content

Demonstrate Cation Exchange Capacity (CEC) Measurements

Explain Base Saturation PBS

Describe Exchangeable Bases

Observe how Soil properties affecting drainage where:

1. Soil moisture shortage
2. Poor soil aeration (caused by excess soil moisture)

Study and evaluate soils in relation to Slope where Cocoa trees may be able to establish on steeply sloping land

Study other soil characteristics such as Soil colour

Assessing stony ground suitability for cocoa

Demonstrate that the amount of

1. Quartz stones
2. Gravel of ironstone concretions and of weathering rock and minerals are other criteria to be considered in assessing quality of soil for cocoa

Teaching Strategies

Students should be able to identify parts of the soils, differentiate state functions of soil minerals

Teacher Activities

Conduct demonstrations using soil samples, field study or visit sites relevant.

Students Activities

Work pairs on samples and site visits

**Teaching Material**

Cocoa Resource Book

Cocoa teachers' hand book



## **UNIT 4. COCOA BLOCK REHABILITATION**

### **TIME: 50 PERIODS**

#### **Introduction**

Rehabilitation is the process of bringing a run down and unproductive cocoa block back into production

A cocoa tree can live for over 100 years but depending on how well it is looked after, may be productive for only 15 to 20 years. This is due to poor management such as pruning done badly or not at all leading to over shading, disease and insect infestation. If the block is not too run down rehabilitation may be achieved by restoring existing trees. This is typical involve one or more operation such as pruning, field grafting, fertilizer application, control of pest and diseases, weed control and shade thinning. However, if the trees are so bad, some degree of replanting will be necessary to rehabilitate the block. In the unit the student will cover the five main areas in the block rehabilitation. These are:

1. Reasons for block rehabilitation
2. Types of block rehabilitation
3. Rehabilitation by replanting new tree
4. Considerations in block rehabilitation
5. Other operations associated with block rehabilitation

#### **Learning outcomes**

The students should be able to

- A) Reasons for block rehabilitation
- B) Types of block rehabilitation
- C) Rehabilitation by replanting new tree
- D) Considerations in block rehabilitation
- E) Other operations associated with block rehabilitation

#### **Content**

Students to acquire knowledge and skills through the teaching of this content using demonstrations and hands on field experience

#### **List the reasons for block rehabilitation**

1. Increase the productivity of cocoa in an existing field without increasing the area occupied by the cropping new land
2. Less need for land

#### **Describe the Types of block rehabilitation**

Method one Pruning  
(Refer to unit on pruning)

Method two Field Budding

Selection of cocoa blocks for field budding  
Preparation of mature cocoa trees for budding  
Selection of bud wood  
Bud Grafting the Chupons  
Maintenance and care after bud grafting

### **Method three: Stamping (Rejuvenation)**

#### **Rehabilitation by replanting new tree**

Removal of old unproductive cocoa trees and shade trees at same time  
Methods of Block Rehabilitation by Replanting Trees  
Various approaches to replanting diseased and senile trees  
Method one: Complete block rehabilitation  
Method two: Partial block rehabilitation  
Method three: Under planting

### **Considerations in block rehabilitation**

1. Problems with pests and diseases
2. Over shading
3. Soil erosion

### **Other operations associated with block rehabilitation**

#### **Teaching Strategies**

The students should be able to demonstrate and describe types of cocoa block rehabilitation

#### **Teacher Activities**

Demonstrate the types of cocoa block rehabilitation  
Allocate cocoa plots to students for field practical hands on learning experience

#### **Students Activities**

Carry out rehabilitation skills in their allocated cocoa plots

#### **Teaching Material**

Cocoa Resource Book  
Cocoa teachers' hand book

## UNIT 5: PLANTING MATERIAL-BREEDING

### TIME: 50 PERIODS

#### Introduction

Breeding is a complex process and it is the breeder's job to ensure that farmer must have the correct cocoa tree to produce cocoa in high numbers (high yield) and in the preferred quality by the market or consumers. They are other preferred characteristics such as pest or disease tolerant or resistance, taste type, pod colour, adaptability to climate factors amongst others a breeder should look for when breeding cocoa. In this unit, the focus will be on understanding the **basic principles of cocoa breeding**

#### Learning Outcomes

- A. Define and explain breeding
- B. Describe sexual or asexual (vegetative) reproduction
- C. State features of Trinitario, Criollo and Forasterio
- D. Describe the difference and the relationship between Trinitario, Criollo and Forasterio
- E. Describe budded cocoa
- F. Explain hybrid cocoa and how breeders achieve hybrid cocoa
- G. Discuss how clone is obtained
- H. Demonstrate breeder's role by selecting the appropriate pods size with high yielding and resistance clones.

#### Content

The students will be able to identify Genetic Materials

1. Criollo
2. The Forasterio

Explain that Trinitario is a Hybrid between Criollo and Forasterio

Explain importance of Selection of Characteristics for Genetic Materials towards Quality of beans from Clones and hybrids

Differentiate the difference between HYBRID and a CLONE

Demonstrate Seed selection and treatment

Outline the advantage and disadvantage of clones

1. DESCRIPTION OF THE BIG CLONES-(CCI-BIG series)
2. DESCRIPTION OF THE SMALL CLONES (CCI-SMALL series)

Teaching Strategies

Arrange for experts from CCI or visit CCI to expose students to the research and breeding programme carried out

Teacher Activities

Prepare worksheets for students for the visit by the experts or to CCI

Students Activities

Complete the worksheets

Teaching Material

Cocoa Resource Book

Cocoa teachers' hand book

## UNIT 6: GENERAL NURSERY MANAGEMENT

### TIME: 50 PERIODS

#### Introduction

Nursery management requires a number of important nursery practices. Because nursery is a place to look after small and young plants from seed germination to the stage they are ready for replanting to the field each management practice has to be discussed and understood well by students.

#### Learning Outcomes

The students should be able to

- A. Name the management practices in a nursery
- B. List the types of nursery to be build in the n
- C. Describe water, shade, fertilizer, weed, pest & disease control requirements for cocoa seedlings in the nursery
- D. Discuss control measures and the major management requirements of fertilizer, weed, pest & diseases occurrence in the nursery
- E. Describe other management requirements in a cocoa nursery

#### Content

Students should be able to perform General nursery management of seedlings grown from seed through practical hands on demonstration

Construct Shade, install Water Requirements, apply Fertilizer, carry out Weed Control, perform Disease Control such as Seedling Blight, and apply control on Insect Pests of Cocoa Seedlings such as Grey Weevils  
Identify and describe Damage and apply Chemical Control, Cultural Control or Biological Control on insects such as Cocoa Root Chafer or Mealy Bugs

Carry out Other Aspects of Nursery Management such as:

1. Selecting Seedlings for Planting Out
2. Nursery Records

#### Teaching Strategies

Engage nursery experts and field assistance to set up a nursery

#### Teacher Activities

Organize group practical nursery management practices for

#### Students Activities

Perform nursery management practices by hands on activities

**Teaching Material**

Cocoa Resource Book  
Cocoa teachers' hand book

## **UNIT 7: COCOA BUD WOOD GARDENS**

### **TIME: 50 PERIODS**

#### **Introduction**

Most of the cocoa currently being grown in Papua New Guinea is hybrid material grown from seeds. The new hybrid clones are produced by either juvenile budding or conventional bud grafting, using buds from selected clones. These buds are taken from young shoots, usually called bud wood or bud sticks, from trees grown specifically for the purpose in a small block of cocoa known as a bud wood garden. The establishment and maintenance of a bud wood garden is basically the same as for any other block of cocoa, but attention needs to be paid to some matters, to ensure that the bud wood garden meets its objectives. The major difference between a bud wood garden and a normal block of cocoa is that the "crop" is sticks of bud wood, not beans from pods. This means that the bud wood garden has to be managed differently. These differences are discussed in the section on cocoa bud wood garden maintenance (Section 4.4.1 on the next page).

#### **Learning Outcomes**

- A. Plan a bud wood garden
- B. Plant the Bud wood garden
- C. Describe management requirements of a bud wood garden

#### **Content**

Students should be able to Planning the Bud Wood Garden which include:

1. Timing of operations
2. The size of the bud wood garden
3. Planting the Bud Wood Garden
4. Maintaining the Bud Wood Garden

Construct Drainage, Shade Control and carry out Weed Control

Perform Pruning on Trees in the Bud Wood Garden

Carry out Formation and Immature Pruning

Demonstrate mature pruning and harvesting bud wood

Apply Fertilizer and apply

Other aspects of maintenance

#### **Teaching Strategies**

Set up a Bud wood garden with assistance from CCI

#### **Teacher Activities**

Identify bud wood garden site

Preparations and clearance

Organize material

## **Student Activities**

Hands on preparation and complete assign tasks given

## **Teaching Material**

Cocoa Resource Book  
Cocoa teachers' hand book



## UNIT 8: CONTROLLING INSECT PESTS

TIME: 50 PERIODS

### Introduction

More than 300 kinds of insects feed on cocoa in PNG. Ten regularly cause a lot of damage to cocoa. Not all insects are pests. Insect pests are usually controlled by application of insecticides. Routine applications of broad-spectrum insecticides should not be carried out because:

1. Are expensive
2. Not healthy to human and beneficial insects
3. Contaminated local environment
4. Contaminated cocoa with levels of chemicals residues that make them un-saleable
5. Can create resistance to the chemical in the target species of insects
6. Reduce population of useful predator species, e.g. crazy ants controlling Pantorhytes

Hand operated pneumatic knapsack sprayers should be used on young trees. Motorized knapsack mist blowers for plantations and extension lances on knapsack sprayers for small blocks

All spraying should be done in fine weather when rain is not expected for several hours. The following outcomes would have been achieved at the end of the unit by discussing briefly the following of the insect pests:

- a. Economic importance
- b. Controls measures
- c. Chemical controls
- d. Cultural/ physical controls

### Learning Outcomes

The students should be able to

- A. State the Insect pests in order of economic importance to PNG cocoa industry
- B. Discuss the life cycle of the insect
- C. Describe and demonstrate the damages control techniques
- D. Carry out chemical control techniques when using chemicals
- E. Demonstrate the importance of Safety

### Content

To enhance realization of maximum students potential through

1. Disrupting Pest & Disease cycle at weakest link
2. Environmental discriminately favourable for cocoa.
3. Building plant health through removal of stress factors
4. Enabling cocoa trees both in time & space to withstand pest & disease pressure

Identify the Economical Pests as the main Insect Pests and specific Management recommendations  
Realized the Serious cocoa pests now present in Papua New Guinea

### 1. Cocoa pod borer (*Conopomorpha cramerella*)

Identify the Morphotypes of Pod Borers  
Describe the Ecology of CPB

Explain the Mode of Transmitting the Pest and its Symptoms of infestation

Recognized the Symptoms of CPB

Appreciate the Economic importance in relation to the Status of cocoa in PNG

Perform Controls measures through five rules to contain CPB through:

- Clear weeds and Reduction of Shade
- Cocoa pruning
- Weekly harvesting
- Pod husk burial
- Target spot spraying

- Second important group is made up of caterpillars, which eat leaves  
The Cocoa Weevil, Trunk Longicorns, Mirids or pod suckers, Leaf-eating caterpillars

Describe its Damage and Economic importance through Controls Measures such as:

- Manual/ Hand picking of adults can be done
- Cultural control  
Not a big problem in cocoa inter-planted with coconut as Kurukum ant that lives in coconut palm attacks Pantorhytes adult and eats their eggs
- Removal of alternative plant hosts
- Biological control Cray ants and other ants
- Chemical control.

2. Third group is made up of Grey weevils, Pansepta webworm, Termites

3. Fourth group is made up of Longicorn tip borer, Rhyparid beetle or shot hole, beetle, Husk borer, Root chafer pests, Coffee stem borer (*Zeuzera coffeae*)

Mealy Bug Pests of Cocoa, Thrips

4. Fifth group is made up of more than 300 pests of lesser importance mainly **Vertebrate pests**

Interpret the Control techniques know as the Inter-related- factors is called the Host Insect Environment triangle

Translate Management/ culture control of insects, Biological control of insects and

Chemical control techniques

Determine correct Chemical concentration for chemical control

Manure correct Spraying method where always 'spot' spray in the areas with pest. Do not spray regularly but regularly checked for pests.

Correctly utilize Mist blowers as these are made for a flow rate of 230 ml/minute

Comply with Surfactants that reduce the surface tension of the mixture to increase the area that an amount of mixture can cover. That makes a tank load of mixture go further and so makes the operation cheaper

Apply Stickers to Increase the adhesiveness of the mixture so that it stays on the surface it has been sprayed onto. Sticker is necessary because of frequent heavy rain showers

All safety precautions that apply to herbicides also apply to using insecticides A few more precautions because most insecticides are more toxic to human than herbicides

1. When applying the mixture always wear a facemask, rubber boots and overall
2. These should be washed regularly
3. If feel sick after spraying see a doctor

### **Teaching Strategies**

Done in two parts

- 1) Organize insect Pests Library Research work
- 2) Apply manipulation skill on each group insect pests

### **Teacher Activities**

Prepare assign Library research work

Prepare instructional lesson for practical hand on insect pests control

### **Student Activities**

Perform and evaluate research and practical work

### **Teaching Material**

Cocoa Resource Book

Cocoa teachers' hand book

## UNIT 9. DISEASE CONTROL

TIME: 50 PERIODS

### Introduction

Disease is one of main reasons for losses in cocoa production. Most serious and widespread cocoa diseases in PNG are Black Pod and Stem Canker. Both these diseases are caused by the fungus *Phytophthora*. Vascular Streak Dieback (VSD) is caused by another fungus *Oncobasidium theobromae*. There are other diseases that regularly destroy up to 40% of cocoa crop. To be able to control diseases, growers need to be able to recognize disease the disease causal organism, the symptoms, understand the life cycle and how the diseases organisms can be best controlled and managed. This an area where the students will appreciate the importance of controlling diseases for better yield in cocoa production

### Learning Outcomes

- A. Identify the disease
- B. Describe the lifecycle
- C. Explain the usefulness of the Pathogen – Host- Environment Interaction
- D. Describe the four methods used to prevent disease developing and/or controlling them if they do get established
- E. List and describe the most important diseases of cocoa in PNG are caused by fungus/fungi.
- F. Demonstrate the control measures of the disease

### Content

Students should be able to use Pathogen – Host- Environment Interaction Useful model 'Disease Triangle'

### Explain the Important Points of:

1. Disrupt Pest & Disease cycle at weakest link
2. Environment discriminately favourable for cocoa.
3. Build plant health through removal of stress factors
4. Enable cocoa trees both in time & space to withstand pest & disease pressure to enhance realization of maximum potential

Recognized Factors interacting between host, pathogen and environment determine how serious a disease is through:

1. Population of the pathogen inhabiting a single host
2. Aggressiveness of the pathogen-the pathogen's ability to make a healthy host sick
3. Host susceptibility-ability of host to resist or tolerate the presence of the pathogen
4. Suitability of the environment for the pathogen
5. Suitability of the environment for the host

Value Crop Loss and Crop loss at different Stages

Describe the Four methods used to prevent disease developing and/or controlling them if they do get established

Appreciate that most important diseases of cocoa in PNG are caused by fungus/fungi

Define Specific Diseases of Cocoa in PNG as Seedling and Budding Blight Diseases where Seedling Blight (*Phytophthora palmivora*) in a nursery Synthesis Seedling blight disease symptoms and how to Control seedling blight with the Current control recommendation for blight seed soaking

Characterized Warning where Safety considerations are taken when handling fungicides

Describe Vascular Streak Dieback (VSD) and how VSD spreads especially VSD - Fruiting bodies and rough bark

Synthesis VSD disease symptoms and how to Control VSD using Current control recommendations for VSD

Recognized Pink disease of cocoa through Pink disease symptoms and how to controlling pink diseases using:

1. Cultural control
2. Chemical control

Discuss and differentiate between Small holders and Large areas/ plantations technique of control

Work out *Phytophthora* pod rot disease Infection through the *Phytophthora* Pod Rot Symptoms and how it spreads

Explain the use of resistant planting material in controlling *phytophthora* pod rot as management strategies for controlling other fungal diseases work out the control measures such as:

### **Cultural control**

1. Use of resistant planting material
2. Shade management
3. Appropriate planting densities
4. Canopy management and pruning warning. Avoid severe pruning during flush, flowing or early pod development as it may reduce yield a lot
5. Sanitation

### **Chemical control**

Used only as a last resort

Knapsack sprayers  
Pressure Sprayers are more cost effective than motorized knapsack mist  
blowers as lower rate of chemicals used and spray directed more accurately at  
pods and cherelles  
Current control recommendation for Ppr

### Warning:

Fungicides are poisonous so care must be taken. Wear rubber gloves, a dust  
mask and an eye-shield. If mixture gets on your skin, wash it off immediately  
with soap and water

When to spray  
Used only during the wetter months

Apply other control measures such as Introduce crazy ants to drive tent-building  
ants away

Describe Bark canker as an infectious fungal disease of cocoa trees caused by  
*Phytophthora palmivora* (also causes black pod). Can infect and kill cocoa trees  
of any age, mainly trees over 10 years.  
Bark canker symptoms

Explain how trees get bark canker through:

1. Mechanical damage
2. Infected chupons
3. Black pods
4. Insect damage
5. Apparently undamaged bark

Perform Control measures to:

1. Control by improved management
2. Chemical control
3. Resistance- planting material- some SG2 hybrid clones do have  
reasonable resistance

Recognized Root rot disease and that is caused by different types of fungi  
It can attack many types of trees including *Leucaena* and *Gliricidia*- shade  
trees. Most important root diseases in PNG are White Root Rot caused by the  
*Rigidoporus lignosus* fungus and Brown Root Rot caused by the *Phellinus*  
*noxius* fungus

Tell the Symptoms and how root rot disease spread where Spores are carried  
in air currents released by fruiting bodies of the fungus. As the spores lands on

freshly cut surface of a host tree, grows slowly down the stump into roots, feeding on the wood.

Carry out Disease control where the Disease tree is dug out straight away. Get out all main roots plus any old stump nearby and be burnt

Painting the cut surfaces with one of the following mixtures:

- Mix one part of Garlon with 60 parts of diesel fuel. Add three parts of red copper ('Sandoz') or green copper ('Cuprox' or other brand) to 100 parts of the Garlon/ diesel fuel mixture
- Mix red or green copper with diesel fuel or old engine oil. Add three parts of copper to 100 parts of diesel fuel or engine oil

Warning: Care must be taken. Wear rubber gloves, a dust mask and an eye-shield. If mixture gets on your skin, wash it off immediately with soap and water

**Explain Thread blight disease** as a disease often seen in older, poorly managed cocoa blocks with too much shade and there are two types thread blight disease attack cocoa in PNG which are:

1. White Thread Blight caused by fungus *Marasmius scandens*
2. Horse Hair Blight caused by fungus *Marasmius equicrinus*

It is not a serious thread but indicates the block is not well management, especially shade management

Describe the Symptoms as a typical symptom of both and is the thread like structures growing over infected tree plants

White Thread Blight is characterized by white mycelia (thread-like structures of the fungus) spreading over leaves, petioles and branches as shown in Figure 10.30. It leads to the death of the leaves which remain hanging from the branches by the threads

Horse Hair Blight forms a black tangle of threads through the cocoa canopy, but does not kill the leave

Explain how thread blight spreads which is found in blocks with thick, un-pruned canopies where cocoa branches interlock and the trees are heavily over-shaded

Synthesis control by regular pruning and reduction of shade levels to reduce humidity

Warning: Care must be taken. Wear rubber gloves, a dust mask and an eye-shield. If mixture gets on your skin, wash it off immediately with soap and water

Note the Serious cocoa disease not present in Papua New Guinea

Swollen Shoot viruses

Frosty pod rot Moniliasis or – South & Central America

Cocoa witches room

### Teaching Strategies

Conduct as a research and demonstration unit

### Teacher Activities

Organize research and cocoa block demonstration hands on practical activities

### Student Activities

Implement assigned tasks

### Teaching Material

Cocoa Resource Book

Cocoa teachers' hand book



# UNIT 10: SOIL MANAGEMENT AND SOIL EROSION

## TIME: 50 PERIODS

### Introduction

The main aim of cocoa block management is to maximize

1. Early growth to obtain high early yields
2. Sustained peak yields with good management and good soil conditions

The agronomy of cocoa is more complex than of some other crops like oil palm. There is very strong interaction between nutrition and other agronomic factors. Example, the use of nutrients by cocoa trees decreases with increasing overhead shade. Nutrition should not be a limiting factor for achieving high yield. Fertilizer use is important for maximizing yields in many cocoa growing areas in Papua New Guinea

Environments that are suitable for cocoa growing in Papua New Guinea has been categorized into 29 agro-ecological zones (AEZ) based on:

1. Land form
2. Soil drainage
3. Slope gradient
4. Inundation (flooding)
5. Water retention
6. Annual rainfall (see Hanson, et al 1998).

Classifications are on a national scale and are not sensitive enough to identify small pockets of land in which cocoa may grow well. This unit covers practices where students can realized the importance of soil management

### Learning Outcomes:

- A. State what is involved in Soil management
- B. List and describe Types of erosion
- C. Explain causes of erosion
- D. Describe soil conservation methods
- E. List types of fertilizers and their uses

### Content

Students should be able to carry out Soil management techniques through

1. Land under undisturbed forest or grass is protected from the impact of rainfall
2. Good structure of the topsoil and the presence of leaf litter allow most rainfall. To infiltrate (soak into) the soil, so that there is little run off

Characterized Soil Erosion as an issue and differentiate the Types of erosion as

1. Sheet Erosion or Splash Erosion
2. Rill or Shoe String Erosion
3. Gully Erosion
4. Head Erosion
5. Stream bank erosion

Synthesized the causes of erosion where the major factor is the frequency of high intensity storms: It also depends on:

1. The slope and nature of land surface
2. The vegetation cover
3. The type and fertility of the soil
4. The land use and farming practice

Articulation Prevention and control Methods of prevention and effectively control erosion which requires the use and treatment of various types of land over the whole catchment area

The three major components are:

1. Suitable land use: Each type of land should only be used for a purpose for which it is suited without undue risk of erosion
2. Appropriate soil: Conserving methods of husbandry must be used on each type of land. E.g. when ploughing is done plant along contours and use cover crops when feasible
3. Where necessary, use suitable mechanical conservation measures, such as silt pits or narrow-based ridge terraces

Explain the step involved in controlling erosion through

1. Physical survey and classification of land
2. Mechanical measures for soil conservation
3. Agronomic measures for soil conservation

Synthesized Cocoa nutrient requirements and the Reasons for applying fertilizer:

1. The amount of shade is important that a relationship exist between shade and nutrient requirements.
2. The more shade, the lower the metabolic rate of the tree and thus the lower the rate at which the tree will draw nutrients from the soil.
3. The need to apply fertilizer will vary according to shade levels.
4. In heavier shade a cocoa tree needs less fertilizer and vice versa
5. The standard of management (pest and disease, weed control, shade control) also affects the response to applied fertilizer
6. Fertilizers are a complement to good management, not a substitute for it

Comprehend that Cocoa is grown in PNG on a wide variety of soils of widely varying suitability and the general guide to cocoa soil requirements

Evaluate the Possibility of Nutrient Deficiencies such as:

### **Nitrogen**

1. In high light conditions
2. Induced by an interaction between nitrogen and phosphorous
3. Water logging

### **Phosphorous**

1. Rarely a limiting factor
2. Level in leaves of adult cocoa trees gives a good indication of soil phosphorous levels

### **Potassium**

1. Natural deficiency in parts of New Ireland, New Britain and where soils are derived from coralline material
2. Affected by soil pH
3. Low levels usually shown in leaves

Other Nutrients like:

1. Sulphur
2. Zinc
3. Iron are detected by foliar symptoms or leaf analysis

Value these Important considerations:

1. Inorganic fertilizers are quite expensive and cost of applying it is high
2. Soil suitability should be assess through soil surveys, soil sampling and chemical analysis to determine nutrients status of the soil
3. Fertilizer input should be based on soil analysis, crop yields, shade regime and age of cocoa tree

Knowledge Sampling for nutrient analysis through Soil sampling and Leaf Tissue Sampling

### **PNG Analytical Laboratories Ltd require the following procedures**

1. Leaf sample must be representative of an area uniform in tree age, variety, cultural treatments soil type and appearance
2. A single composite sample should not represent an area greater than 2 ha
3. Samples should be taken from suspected problem area and nearest good area for comparison
4. If inter planted with coconuts, samples should be taken from both crops

## Steps:

To take samples,

1. Select the third leaf on a branch where a new flush is about to emerge
2. Leaves will be completely hardened, exposed rather than non-vigorous under canopy
3. Branches selected and petioles should be removed
4. At least 40 trees should be sampled to give 40 to 80 leaves

Characterized the Types of fertilizer such as:

1. Nitrogen
2. Potassium
3. Trace Element Deficiencies

Organize Timing of fertilizer application which depends on weather patterns and the types of nutrients/fertilizers applied in the Nursery  
Only foliar feeds can be used to stimulate nursery growth  
Young cocoa in the field is aided by well shaded establishment and properly reduced

Comply with Placement of fertilizers and Standard fertilizer Recommendations by Tree Age

Teaching Strategies

Conduct as problem solving unit

Teacher Activities

Use the "present situation with accepted standard or an ideal situation" method  
Organize practical activities

Student Activities

Carry out assigned activities

Teaching Material

Cocoa Resource Book

Cocoa teachers' hand book

# UNIT 11: COCOA BEANS PROCESSING

TIME: 50 PERIODS

## Introduction

Cocoa beans of commerce are seeds. Seeds must undergo many changes before of any value as an export commodity. The reason for the cocoa's popularity as food substance in many parts of the world lies in its unique chocolate flavour. The flavour developed only by means of curing (fermentation and drying) and manufacturing (roasting)

The seeds (beans) from ripe fruits (pods) put through the first stage of curing process- fermentation immediately after harvesting. The second stage of drying a week a week later processes brings changes within cocoa beans responsible for the development of flavour. Fermentation 1- aid mucilaginous bulb removal 2- allow biochemical reactions within the beans necessary to the formation of flavour potential

Unfermented beans do not develop any chocolate flavour when roasted. It produces excessively bitter and astringent and is unacceptable to manufacturers

Drying reduces moisture content of beans necessary for storage and shipment Drying completes fermentation stage in developing the desirable flavour

It is importance student understand the key issues in this unit as it affects the quality of production

## Learning Outcomes

- A) Discuss proper pod breaking
- B) Take correct weighting
- C) Describe Fermentation process
- D) Demonstrate proper Drying and show
  1. Turning
  2. Testing
  3. Sorting
  4. Bagging
  5. Storage

## Content

Students should be able to carry out Pod breaking with consideration of some important rules

1. Do not use knife as cuts beans
2. Avoid rain as it washes mucilage for good fermenting. Remove beans from pod and placenta
3. Put in a plastic or a bag
4. Remove hard, black, germinated or flat beans
5. Leave husk in the block as it attract midges to help pollinate cocoa
6. Taken straight to the fermentry, not delayed

Execute cocoa beans weighing

Describe and facilitate the process of Fermentation  
Label and explain the Pod composition

State why the operators need the follow:

1. A weather proof building
2. Approved fermentry boxes
3. Shovel
4. Small, sharp knife

To keep cutting a few beans and checking the progress of the fermenting  
and drying

5. Patience  
Be patient and not rush work as this may cause low quality work
6. Dealer will require a good quality set of scales with hook

Determine Important Points to be implemented:

1. The wet beans go into fermenting boxes
2. Only fresh wet beans from sound, ripe pods
3. Should be put in the fermenting boxes
4. Wet beans must go into fermenting boxes within 24 hours after breaking the pods

Explain how Turning the beans is done where the fermenting beans must be turned once every day

Note the reason why Turning is very important as it:

1. Ensures even heating of beans
2. Air enters the ferment
3. Lumps get broken up
4. Mould will not form on the beans

If not turned regularly, the beans will be mouldy and bad-smelling and will not ferment properly

Length of ferment

- Cocoa beans should be fermented for five to seven full days

Explain what happens in ferment where Chemical reactions take place that cause certain changes to cocoa beans

Operators can judge their ferments by observing three main physical changes that occur:

1. Colour
2. Temperature
3. Smell

There must be cleaning up after each ferment

Naturalized by CHECKING IF BEANS ARE PROPERLY FERMENTED as:

1. Over-fermented beans are nearly black on the outside and brown-black inside.
2. Under-fermented beans are sometimes deep purple inside. Sometimes the inside is white and "cheesy".

3. Beans that are slightly under-fermented are a light purple colour inside.
4. Beans that did not ferment at all are slaty (a grey colour inside).
5. Beans that are PROPERLY FERMENTED are brown on the outside and either a choco-late-brown (Forastero) or light brown (Criollo) colour on the inside. They have brown liquid inside, and they are brown on the inside of the skin. These beans are ready for drying.
6. Drying  
After fermenting, cocoa beans must be dried on special cocoa driers

Carry correctly Steps in drying

1. Beans dried by sun or kiln pipe heat until the skins are just dry
2. As soon as the skin are just dry, should be left for 12 hours
3. After the rest, beans should be dried during the day only. Use sun or kiln pipes for no more than 6-8 hours each day. Allow beans to rest overnight
4. Have the beans dry in three to four days and not more
5. Over fermented beans should be dried in no more than two days

Give reasons to turning cocoa while drying as Beans need to be turned regularly so that they are dried evenly. Beans stuck together should be separated. Rubbish as placenta or rope must be removed

State the common mistakes in cocoa drying such as:

1. Not letting the cocoa beans have resting times
2. Running drier at too high temperature for too long
3. Allow cocoa to be spoiled by smells from smoke or diesel fumes
4. Uneven drying because of cold spots on the drying bed

Outline that this is overcome by:

1. Make sure drying beds are cleaned well, inside and outside, before putting fermented beans on
2. Make sure all klin and flue (chimney) pipes are sealed and there are no smoke leaks

Perform Tests on the dried beans as:

1. One way is crush some dried beans between our fingers and thumb
2. If dried properly, the inside of the beans break into pieces but
3. The skin of the beans does not break so much
4. Another way is after a resting time. Pick up a handful of cooled beans and squeeze them, when there is cracking noise, means are dry

Sort the dried beans as before bagging, beans are allowed to cool  
Remove flat beans, shrivelled beans, black beans, mouldy beans, small beans, double beans, insect damage beans, bits of broken bean, placentas or rope, stones and other rubbish

Properly do bagging where:

1. Dry cocoa beans must be put in new, clean sacks
2. Filled and weighed to 63.5 kilograms. Sack 1 kilogram and cocoa beans 62.5 kilograms. (i.e. 16 bags are needed for one tonne of dried bean)
3. After filling and weighing the up opening must be stitched with a bagging needle and twine, starting with a knot inside the lip of the bag
4. Each bag marked on one side with the words "PNG COCOA BEANS" over fermentry name and registration number
5. Bags of dried cocoa beans put in s storage shed

Properly do Storage where:

1. Essential to ensure the processed cocoa stays good
2. Sheds must be weather proof and free from damp, insect and animal pest, as weevils and rats, away from smoke and other smell
3. Must be clean all times
4. Cocoa must not be stored for more than three weeks before taken to the exporter

### **Teaching Strategies**

Hands on practical assignments

### **Teacher Activities**

Prepare material for practical activities  
Carry out demonstrations involving students

### **Student Activities**

Perform assigned activities

Teaching Material

Cocoa Resource Book

Cocoa teachers' hand book



## UNIT 12. QUALITY, QUARANTINE AND MARKETING TIME: 50 PERIODS

### Introduction

At the farmer's end of line in cocoa production, the farmer has to sell his/her cocoa. The cocoa beans must be marketable after it has gone through growing, harvesting and process before the farmers gets the reward after which the cocoa leaves our shores for overseas market.

To improve quality of cocoa beans, the conditions and restrictions introduced in the Cocoa Act and Regulation must be complied by all involved in the industry. This is to set quality standards and when implemented will ensure exported cocoa beans meet the chocolate manufacturers' requirements and improve the price paid to growers. Price manufacturers pay will depend partly on world market prices and partly on our cocoa quality

At the end of the unit, the student should appreciate the process as in cocoa growing areas the crop plays a very vital role in their house hold.

### Outcomes

- A. Explain flavour in cocoa production
- B. Describe purity in cocoa production
- C. Explain consistency in cocoa production
- D. State what is Yield of edible material of cocoa
- E. Who is responsible for these factors in cocoa production
- F. List activities involved in marketing and quality control in cocoa production
- G. Describe briefly quality management system in cocoa production

### Content

Students should be able to characterize that Cocoa must taste good and should be of good quality to attract a good price. The issue of quality is dictated by the consumers and so the market conditions determine the criteria in which cocoa has to be produced. Producers have to comply with market requirements or they will lose the market to other producers who are prepared to meet market conditions

Describe the four factors which include:

1 Flavour

2 Purity

Purity means cocoa must be clean

3 Consistency

Consistency means the quality of the cocoa from one producer must be the same all the time. It must not change

4. Yield of edible material

Yield of edible material means how much of the cocoa beans in a bag are useful for making chocolate or cocoa powder.

Outline who is responsible for cocoa quality marketing and quality control?  
Many people share the responsibility for PNG's cocoa quality. They include:

1. The researchers
2. The growers
3. The processors
4. The wet bean dealers
5. The exporters
6. The National Department of Agriculture and livestock (DAL)
7. The Provincial Departments of Primary Industry (DPI)
8. The PNG Cocoa Board
9. The Cocoa Quality Improvement Project

Summarized the quality assurance process that PNG cocoa is put through in preparation for export which includes:

Cocoa to Exporter's Sheds

Sampling Screening

Approach NAQIA for Export Assessment/ NAQIA Assessment

**Note that:**

16 bags of cocoa = 1 tonne

100 cocoa beans cut for grading

Overweight: more than 63.5 kg

Fumigation of cocoa: 24 hours

Describe Marketing and Quality Control involving the exporter and export standards where Bags of processed cocoa beans are taken to a Cocoa Board approved and licensed cocoa exported.

It is the Exporters job to:

1. Make contact with people in other countries who buy cocoa beans
2. Finds out how much they need
3. What they are prepared to pay
4. Uses this to set the D.I.S. (Delivered-in-store) price he/she can offer, then buys cocoa to satisfy the needs of his buyers

**Note:** The cocoa must be of export quality. Must meet export standards, Papua New Guinea standard. To meet PNG Export Standard, the cocoa should be:

All cocoa must be inspected before being sold to an exporter. These should be inspected twice

1. By the exporter's own Cocoa Quality Assessors Inspection by cocoa quality assessors,

Agriculture Quarantine Officers from DAL Agriculture Protection Division  
or be Inspected by agricultural quarantine officers

2. Making sure the quality standards for exported cocoa are met and maintained

Explain the following processes:

Permanent rejection, Temporary rejection, Acceptance, Fumigation

Outline the Quality management system as the operation of the management system. The operation of the quality management system involves:

1. DPI Extension Officers
2. Cocoa Board Inspectors
3. Exporters' assessors and
4. DAL Quarantine Officers

### **Teaching Strategies**

Research assignment exercise

### **Teacher Activities**

Organize field trip or experts visit  
Prepare assignments

### **Student Activities**

Research and do assignments

### **Teaching Material**

Cocoa Resource Book  
Cocoa teachers' hand book

## ASSESSMENT AND CERTIFICATION

### Assessment in Cocoa

There are two aspects of assessment in cocoa units: Practical assessment tasks and theory assessment tasks. Within practical assessment there are sections, namely portfolio and demonstration of cocoa skills using hands.

It is important that there is a balance spread of assessment during the unit. This means activities done by the students are marked progressively throughout the course of the unit over a period of time rather than at the end of the unit. Students can keep these in their portfolios and at the end of the unit of work teachers can then add up all the marks as contained in the portfolios and award them as the final practical marks out of 60%.

Theory tests can be done as close book tests, homework exercises, field activities orally or written tests using pen and paper to evaluate the theoretical competency of each student. The total mark for each theory test is 40%. For details of both practical and theory activities, teachers can refer to Cocoa Teaching Resource Book for Secondary Teachers in PNG Schools. While School Develop Unit-Cocoa has its own assessment package, teachers must make sure to follow the guidelines of assessments given in the agriculture syllabuses and agriculture teacher's guides so it is within the policy framework. Syllabuses are policy documents and they give direction as how optional units are assessed.

Cocoa assessments accounts for the internal marks out of 200 for this school develop unit. Cocoa unit must meet the requirements for internal assessment as specified in the Secondary Assessment, Examination and Certification Handbook.

**Assessment task: Theory test                      Theory: 80 marks**

**Practical/Experiential Activities                  Practical: 120 marks**

**Total =200 marks**

## Assessment and Certification

### Assessment of the Cocoa Units

There are two parts to the assessment of student performance when teaching the cocoa units. There two parts of assessment are the theory assessment and practical assessment. Theory assessment is calculated to 40% while practical marks are worked out to be 60% to make 100 percent. Each of the theory and practical assessable areas are assessed and combined to give the student's overall assessment in the school certificate.

Teachers must ensure that they follow the guidelines of assessments given in the agriculture syllabuses and agriculture teacher's guides so it is within the policy framework. Syllabuses are policy documents and they give direction as how optional units are assessed. Using the Department guidelines, the teachers can then refer to the teachers' resource books for the content to establish the assessable areas for assessment.

The assessments are progressive and should not be terminal or a summative in nature. Continuously assessment allows for the teacher to monitor progress of student performance while the student is given the opportunity to average out his or her ability for a fair assessment of their performance. The one off or summative assessment does not represent the true ability level of students.

Theory tests can be done as close book tests, homework exercises, field activities orally or written tests using pen and paper to evaluate the theoretical competency of each student. For details of both practical and theory activities, teachers can refer to Cocoa Teaching Resource Book for Secondary Teachers in PNG Schools and use the outcomes and content to set the test, assignment for assessment.

Teachers are very familiar with the theory assess but in the practical assessment, we recommend that the students are given a demonstration of the assessable tasks by the teacher then the students are allowed to practice the skills for assessment. The practical tasks must be experiential based in that these tasks or skills must be done and assessed in the field where the skills are actually conducted.

Students can keep the assessment marks (tests, assignment and practical) marks in their portfolios or journals and at the end of the unit of work the teachers can then add up all the marks as contained in the portfolios and award them the final practical marks. Each unit should be assessed and combined to make the total after which the assessment is converted to the required percentage of theory and practical to determine a grade.

Assessments for cocoa units that are planned and taught form the internal marks out of 100. The assessment of cocoa units must meet the requirements for internal assessment specifications described in the Secondary Assessment, Examination and Certification Handbook. We advise that the school and teachers follow the recommendations.

## **Certification of Cocoa Curriculum**

A School Certificate at the end of Grade 10 or Grade 12 and in the cocoa curriculum a Cocoa Certificate will be awarded. Each student studying the cocoa as units of agriculture or applied natural resource management should receive a certificate in cocoa production.

The certificate can be used by the students to find gainful formal employment in the cocoa industry, cocoa related agro industries, and can be used to secure small loans to set their cocoa projects for self-employment entrepreneurial activity. The cocoa certificate can be used as evidence to further their studies in higher learning institutions.

## REFERENCES

- The Cocoa Manual (May 1996). Induction Training Manual, The Cocoa Coconut Institute, Papua New Guinea
- National Department of Education (2006). Agriculture - Upper Secondary Syllabus, Waigani, Papua New Guinea
- National Department of Education (2004). National Curriculum Statement. Waigani, Papua New Guinea
- National Department of Education (1984) National Curriculum Statement. Waigani, Papua New Guinea
- National Department of Education (1984) Classroom Testing. Waigani. Papua New Guinea
- Coffee Industry Corporation Ltd (2008). The Coffee Curriculum (Four Texts). Treid Pacific Printer, Papua New Guinea

## Cocoa Is an Entrepreneurial crop

The cocoa units of MAL provide the prerequisite knowledge, skills and attitude for cocoa farming as an experiential and entrepreneurial activity. Cocoa as an entrepreneurial crop means that it has to be farmed as a business adopting business principle and attitude necessary to make money to support the cocoa farming communities.

The secondary coffee units build on the learning from the MAL unit. It introduces important and higher levels skills and what it takes to grow cocoa as a commercial crop. It presents production, management processing and marketing knowledge, skills and attitude necessary for cocoa farming, and in the process, helps student live positively in the communities after they leave school.

Cocoa has to be grown as a commercial cash crop so that much needed rural income is generated whole as the same time, bring in foreign exchange for the country. It is vital that the crop as a business is well understood and promoted. The schools and teachers have the land, knowledge and skills to plan, teach and assess it impact under the business model. The aspects of farm investment and banking as an investment are also important skills to be taught at the secondary schools. Such skills make learning of the cocoa units especially relevant.



Malabunga Secondary School Agriculture Teachers, Students in Cocoa Management Plot

(Photo by Arnold C. PARAPI)



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