



PESTS & DISEASES OF CACAO



TABLE OF CONTENTS

	Page
Introduction	3-4
I. Pests	5
1. Mealybug	5-6
2. Cacao Pod Borer	7-8
3. Cacao Weevil	9
4. Cacao Termite	10-11
5. Cacao Mirid	12-13
II. Diseases	14
1. Black Pod Rot	14-15
2. Swollen Shoot Virus Disease	16-17
3. Frosty pod Rot	18-19

INTRODUCTION

Cacao (*Theobroma cacao*) belongs to the family of Malvaceae, a fast growing tropical forest plant, capable of being cultivated in association with other trees providing additional goods like timber, firewood, fruits, construction materials, honey, resin and medicines.

It is one of the most valuable crops cultivated worldwide.

Cacao are grown for the production of dried beans which are the source of cocoa liquor, cocoa butter,

cocoa cake and cocoa powder (Pohlan and Perez, 2010).

The cacao tree can reach up to 8 to 12 meters tall . It has a tap root of about 2 meters deep. Its stem is straight, its wood is light and white while its bark is thin, smooth and brownish.

The flower are produced in clusters directly on the trunk and older branches and are about 1 to 2 cm in diameter. Unlike any other flowers worldwide which are pollinated by bees and butterflies, cacao flowers are pollinated by tiny flies *Forcipomyia* midges from the order Diptera. Cacao leaves are alternate having the length of 10-40 cm and 5-20 cm width. Its fruits are called "pods" which is ovoid 15-30 cm long and 8-10 cm wide, 500 g in weight and yellow to orange color when ripe.



The pod contains 20-60 seeds called "beans" embedded in a white pulp. It needs 14-28 pods to produce a kilo of dry beans. The beans are the main ingredient used in the production of chocolate.

Soil made up of 50% loamy, 30% clay, and 20% silt with 15 cm depth favors the growth of cacao. The ideal temperature lies between 18°C to 32°C. The altitude should be in between 300 to 1200 meters above sea level. Cacao thrives best in areas where rainfall is evenly distributed throughout the year.

During the 20th century, Cacao production spread considerably over tropical areas of America, Africa and Asia. Cacao expansion in Africa and Asia came with the emergence of major pests and diseases which have adapted to the crop from their local host

plants. The most infamous examples are the cacao mirids *Sahlbergella singularis* and *Distantiella theobroma* and the black pod rot disease due to *Phytophthora palmivora*.

In Latin America, witches broom disease caused by the Basidiomycete fungus *Moniliophthora perniciosa* highly impacted cacao production in Brazil in the 1990's. In the Southeast Asia the cacao pod borer *Conopomorpha cramerella* became the major pest in the mid 1980's. It is considered the main threat for cocoa production in most Asian countries since the early 20th century (Babin, 2018).

Pest and diseases are responsible for higher cost of production, health and environmental issues due to too much use of pesticides and fungicides leading to lower investment in cacao farming.

PESTS

1. Mealy Bug

Order: Hemiptera
Family: Sternorrhyncha
Scientific name: *Planococcus minor*

DESCRIPTION

The mealy bug is a native of South Asia. It is a polyphagous pest that can potentially damage many tropical and subtropical plants. In addition to its polyphagous nature, the pest is highly invasive that can also be spread to traded commodities such as fruits.

DAMAGE

Feeding activity of the mealybug causes reduced yield, lower plant or fruit quality, stunted growth, discoloration and leaf loss.

The mealybug also excretes amounts of honeydew into the plant where sooty molds grow and build up on the leaves, fruits and other parts of the plant. The molds can cover so much area that it can interfere with the plants normal photosynthetic activity.



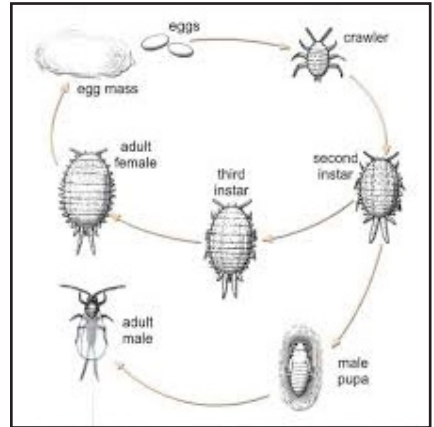
Adult female mealy bugs



Cacao fruit infested with mealy bugs.

Life cycle

Female mealybug develop through three nymphal stages before becoming reproductive. They lay eggs in a waxy cocoon. Males develop through two additional stages (pupal) and emerge as winged adults which bear little resemblance to the juveniles. The adult females are very similar to the juveniles in appearance, the only difference is that they are larger in size.



References:

FRANCIS, A.W., et. al.(2012). The passionvine mealybug, *Planococcus minor* (Maskell) (Hemiptera: Pseudococcidae), and its natural enemies in cacao agroecosystem in Trinidad. Retrieved March 29, 2020 from https://www.worldcocoafoundation.org/wp-content/uploads/files_mf/francis2012.pdf.

BARKER, G. and HUYNH, M. (2016). Identifying mealybug on the inland of Australia citrus. Retrieved March 29, 2020 from https://www.pir.sa.gov.au/__data/assets/pdf_file/0007/285532/Identifying_Mealybugs_on_Inland_Australian_Citrus_Fact_Sheet.pdf.

2. Cacao Pod Borer

Order: Lepidoptera
Family: Gracillariidae
Scientific name:
Conopomorpha cramerella



DESCRIPTION

It is a widespread in South and Southeast Asia. The moth can be found on the underside of the branches during the day, but the moth is predominantly active at night. Because of its dark colouring that blends well with its surroundings it is difficult to visually detect it. Many people consider the cacao pod borer to be the most important pest of cacao in many parts of Southeast Asia. With limited control, losses are between 20-50% for smallholders. In sever cases, over half the potential crop is lost.

DAMAGE

The most obvious visual indication of cacao pod borer is the external damage to the pod. It include the holes caused by the larvae by tunneling into the husk and the premature uneven ripening/yellowing of the pod by internal feeding activities.





Life cycle

a. Egg

The egg is laid on the surface of the pods. After 1-2 weeks the egg hatch and the tunneling begins.

b. Larvae

The larvae can tunnel through the husk into the pulp around the beans and into the placenta that hold the bean together. The larvae undergo 3-5 moults in 14-18 days. They exit the pod through the holes they make in the husk wall. The larvae crawl or lower themselves on a silken thread to dried leaves on the ground or weeds, spin an oval brown cocoon and pupate.

c. Adult

The larva pupate for 5-7 days and then the adult moth emerges. It is a mosquito size about 5-7 mm long which are active at night. It has brown with bright yellow patches at the tip of the forewings. They have long antennae which are swept backwards when they are at rest.

Reference:

JACKSON, G. (2017). Pacific pests and pathogens—fact sheets cacao pod borer. Retrieved March 30, 2020 on http://www.pestnet.org/fact_sheets/cocoa_pod_borer_175.pdf.

3. Cacao Weevil

Order: Coleoptera

Family: Curculionidae

Scientific Name:

Pantorhytes biplagiatus



DESCRIPTION

It is considered the most serious pest and possibly the most worst pest of cacao in Papua New Guinea. It belong to the family curculionidae which is primarily Philippine and Papuan in distribution. This insect is considered to be one of the stem borer insects of cacao.



DAMAGE

Adults of this insect can feed on the young cacao shoots and flowers but the one who can do more damage is the larvae. The larvae bore into the trunk and branches, making tunnels 1-3 cm deep. Often the tunnels are made at or near the junction of branches and the trunk. The damage is potential to weaken the tree causing tip die back, death of branches and even death of the tree.

Reference:

JACKSON, G. and TSATSIA, H. (2017). Pacific pests and pathogens-facts sheets cacao weevil borer. Retrieved March 30, 2020 from https://www.pestnet.org/fact_sheets/cocoa_weevil_borer_061.pdf.

4. Cacao Termite

Order: Termite

Family: Termitidae

Scientific Name:

Macrotermes bellicosus



Damage caused by termites



DESCRIPTION

It is generally referred to a harvester termites that are mainly found in Africa, Middle East and Asia.

Termites attack cacao plant on the field by attacking the trunks and pods causing the plant and pods to dry up after severe infestation. The tunnels made by termites weaken the plant or may give access to fungus and other diseases.

Life Cycle

The termite life cycle follows three stages: egg, nymph and the adult stage. Every termite in the colony will be identical in the first two stages but their appearance and job with the colony will differ considerably depending on what role they take in adulthood. After the nymph stage, the termite will either become a worker, a soldier and a reproductive. The worker build and feed the other termites, the soldier protect the colony and the reproductives breed and grow the colony.

Egg

The average termite egg will hatch one month after being laid.

Nymph

After the egg hatch, the nymph comes out. They feed on cellulose derived from wood or plant materials but they have no way of feeding themselves so the workers feed the nymph until they mature. The nymph will reach maturity after 3-4 molts.

Adult

After the nymph stage, the termite now will become a soldier, a reproductive or a worker termite. The one who comprise more on the population of the colony is the worker termites. They are 2-15mm long and have a life span of 1-2 years. They are the ones who do more damage to plants because of their foraging and tunneling behavior.

References:

OYEDOKUN A. V. et. al. (2017). Pesticidal efficacy of tree tropical herbal plants' leaf extracts against *macrotermes bellicosus*, an emerging pest of cacao, *theobroma cacao* l. Retrieved March 31, 2020 from http://www.jbiopest.com/users/lw8/efiles/vol_4_2_252c.

BREDA PEST MANAGEMENT. 2019. The life cycle of termite colony. Retrieved March 31, 2020 from https://dynamix-cdn.s3.amazonaws.com/bredapest2019com/bredapest2019com_802129314.pdf.



5. Cacao Mirid

Order: Hemiptera

Family: Miridae

Scientific Name: *Sahlbergella singularis*
Distantiella theobroma
Helopeltis sp.



Sahlbergella singularis

DESCRIPTION

Cacao production is constrained by several factors including aged trees, declining soil fertility levels, poor maintenance practices and attack by pests and diseases. Mirids have been reported as the main pest for cacao. Apart from species belonging to the *Helopeltis* genus which are confined only on cacao pods, mirids feed on fruits, twigs/branches, shoots and trunks of their host plant. *Sahlbergella singularis* and *Distantiella theobroma* are considered to be the most economically prejudicial species of mirids to cacao farming.



Helopeltis sp.

DAMAGE

Both the nymph and adult attack fruits and shoots. Feeding activities of mirids are characterized by the dark markings or lesions.

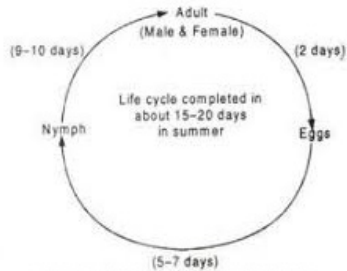
Life Cycle

Egg

Eggs are laid 2 days after the copulation. They are laid on the surface of the host plant like leaves, shoots, petioles or on the buds. The eggs are elongated and sausage shaped. After 5-7 days the egg hatch depending on the temperature. If it is warmer hatching will be faster.

Nymph

The nymph looks like spider in appearance because it bears delicate, elongated legs. The nymph suck the sap of the host plant and undergo five moults to attain maturity.



Adult

The adult only live for 8-13 days. Mirids will undergo 8 generations per year and each female can produce up to 70 eggs.

Reference:

MAHOB, RJ et al. (2018). Assessment of the effect of cacao mosquito mirid true bug; *helopeltis* sp. (hemipteran: miridae) on cocoa (*theobroma cacao* L.) production in Cameroon (Central Africa). Retrieved March 31, 2020 from https://www.researchgate.net/publication/329633241_Assessment_of_the_effect_of_cocoa_mosquito_mirid_true_bug_Helopeltis.



1. Cacao Black Pod Rot

Order: Peronosporales

Family: Peronosporaceae

Scientific Name: *Phytophthora palmivora*



DESCRIPTION

Cacao production are hindered by many diseases and one of this is the cacao black pod rot which is caused by the fungus *Phytophthora sp.*

Cacao black pod rot is particularly economically a serious problem in all cacao producing regions of the world. Annual yield losses due to black pod rot may range from 20%-30% and can reach to 30%-90% in severe cases. It is reported to be one of the main cause of pod losses in Southeast Asia.

SYMPTOMS

The most recognized symptom of *Phytophthora* infection in the field is the apparition of black pods.

The pods are infected at any location but it occurs most often at the tip or stem end and more frequently on pods close to the soil. The main symptoms are firm, spreading, chocolate brown lesions that eventually can cover the whole pod.

When the husk infection is achieved, the fungus invades the internal pod fissures and causes discoloration and shriveling of the cacao beans. Diseased pods eventually become black and mummify.



Reference:

YANELIS G.A. et. al. (2012). Management of black pod rot in cacao (*Theobroma cacao* L.): a review. Retrieved April 1, 2020 from https://www.researchgate.net/publication/231868260_Management_of_black_pod_rot_in_cacao_Theobroma_cacao_L_a_review.

2. Cacao Swollen Shoot Virus Disease

Order: Ortervirales

Family: Caulimoviridae

DESCRIPTION

Cacao swollen shoot virus disease is a serious constraint to production of cacao in west Africa, particularly in Ghana where the disease was first recognized in 1936. It can cause defoliation, dieback and severe yield losses of the plant. The cacao swollen shoot virus disease can infect cacao plant at any stage of development. Cacao swollen shoot virus can be transmitted by mealy bug that feed on sap of the cacao plant. It is thought to be transmitted through cacao seeds, but the virus has been transmitted by grafting and by medical tools used in the field. Once a cacao tree become infected with the virus, it can not be cured.

SYMPTOMS

- Reddening of primary veins in young leaves
- Yellow bonding along the main veins of the leaves
- Vein clearing in leaves, sometimes producing a fernlike pattern
- Chlorosis or flecking and mottling of mature leaves
- Abnormal shaped pods, usually smaller and spherical
- Stem and root swelling



Swelling of the stem



Dieback



Chlorosis or yellow clearing along the major veins creating a fern-like pattern



Red vein bonding in young leaves

Reference:

GILMOUR, M., CROYZER, J., and KOUAME, C.
(n.d.) Retrieved on April 1, 2020 on <https://www.worldagroforestry.org/sites/default/files/Brochure-Cocoa-Swollen-Shoot-Virus-Disease.pdf>

3. Frosty Pod Rot

Order: Agaricales
Family: Marasmiaceae
Scientific Name:
Moniliophthora roreri

DESCRIPTION

Frosty pod rot is able to thrive under a wide range of environmental conditions from sea level to over 1,000 m above sea level and from dry to very humid zones. Losses are highly variable ranging from 10% to 100% and is dependent on factors such as length of time the disease is present in the field, age of the crop, disease management practices, presence of neighboring affected plantations and weather conditions.

The high level of adaptation to different environments



and the huge numbers of long-lived spores that are generated by each infection have made *Moniliophthora roreri* invader of new geographical regions. An average of 30% loss have been reported by most countries however, losses can exceed 90% under favorable conditions for the pathogen. These conditions include continuous rainfall and high temperature (20°C to 30°C).

SYMPTOMS

The fungus only affect the plant on fruiting stage. The plant parts affected are the fruits or pods and seeds. The fruits of 3 months or younger are more susceptible to the fungus but as they become more mature, they become less susceptible.

The symptoms appear only on pods and their nature is dependent on the age of the pods when it was infected.

References:

GRIFITH, W. G. (2004). Witches brooms and frosty pods: threat to world cacao production. Retrieved April 2, 2020 from <https://users.aber.ac.uk/gwg/pdf/griffith-wbdbiologist.pdf>.

MORA, P.W. and WILKINSON M. J. (2007). Frosty pods of cacao: a disease with a limited geographical range but unlimited potential of damage. Retrieved April 2, 2020 from <http://apsjournals.apsnet.org/doi/pdf/10.1094/PHTO-97-12-1644.pdf>.

Moniliophthora roreri (frosty pod rot) datasheet. (n.d.) Retrieved April 2, 2020 from <https://www.micaf.gov.jm/sites/default/files/pdfs/Frosty%20pod%20rot%20Datasheet.pdf>.

Infection at 3 months and older

Pods that are infected at very young show slightly chlorotic swelling and sometimes distortion followed by general necrosis before the pod reaches half of its size. The seed mass may become soft and watery.



For more information, you may contact:

Department of Agriculture-Regional Field Office
Cordillera Administrative Region (DA-RFO CAR)
Regional Crop Protection Center (RCPC)

3rd/F Livestock Building, BABRC Compound,
Barangay Dontogan, Baguio City, 2600
Contact Details: (074) 444-9874/+63 999-991-9150
Email:bombyxmori.car@gmail.com