Climate Smart Cassava Cultivation
Introductory Training Manual

Red Stripe GROW JAMAICA

DESNOES & GEDDES FOUNDATION
IMPACTING LIVES, ENRICHING COMMUNITIES

IDB | LAB

Background

- Red Stripe started a local sourcing initiative named 'Project Grow' in 2013 to replace imported high maltose corn syrup (HMCS) with 40% cassava starch in its brewing process by 2020.

- Red Stripe will contract local farmers under an Outgrower Farmer programme to cultivate high-yielding high-starch cassava varieties

- The Desnoes & Geddes Foundation, through funding from the IDB Multilateral International Fund (MIF), will provide technical extension support, agronomic and business training, as well as conduct research to identify additional high yielding and high-starch cassava varieties and complementary crops

Why Cassava?

- Readily available crop in Jamaica
- Perennial crop with ease of planting
- Relatively low input requirement, relatively rapid growth,
- Year-round availability
- High carbohydrate content –accounting for more than 75% of dry basis
- Low protein and lipid content limiting need to refine

Training Content

1. Site Selection
2. Land Preparation
3. Variety Identification
4. Planting Cassava
5. Crop Nutrition and Water Management
6. Pest and Disease Identification
7. Weed Management
8. Pesticide Safe Use and Management
9. Record Keeping
10. Agro-Ecosystems Analysis
11. Harvesting

1. Site Selection

Site Selection

IDEAL CONDITIONS:

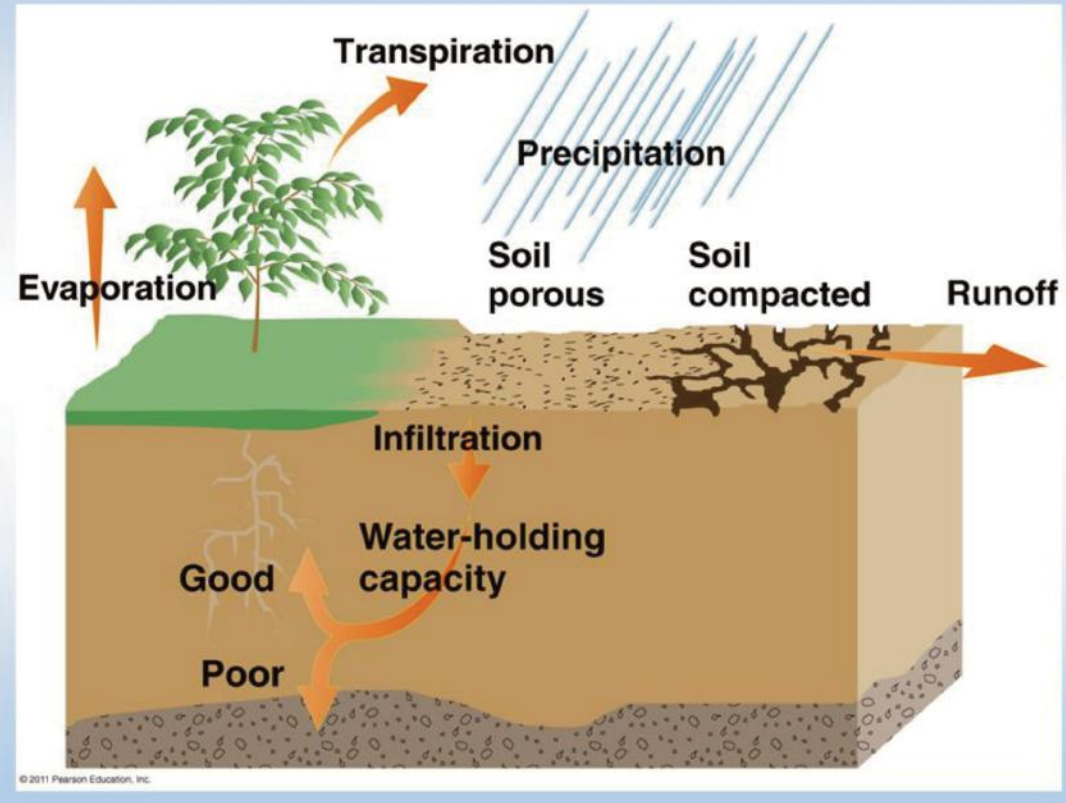
- Flat to gentle sloping land
- Loam soil
- Water access

Site Selection

FACTORS TO CONSIDER:

- **Heavy clays retain more moisture than sandy or loam soils, which is not conducive to healthy tuber development.**
- **Lands with relatively steeper slopes generally require greater manual labour.**
- **Water access gives better control over crop development.**

Plant-soil-water relationship



Site Selection

ENSURE:

- **Easy access to water**
- **Available soil nutrient (conduct a soil analysis where necessary)**
- **Accessibility (roads & equipment)**
- **Adequate drainage**
- **Not subject to wild fluctuations in weather**

2. Land Preparation

Land Preparation

STEPS IN THE PROCESS:

1. Clearing (removing all shrubs/ stones)
2. Ripping
3. Harrowing
4. Furrowing

Land Preparation

IT IS IMPORTANT TO KNOW THE SOIL CHARACTERISTICS OF A GIVEN FIELD IN ORDER TO:

- **Choose the optimal degree of loosening required;**
- **The timing and depth of work;**
- **The direction of subsoiling with respect to both the slope of the surface and the orientation of subsurface drains, if applicable;**
- **The requirements for drains for draining soils or moisture retention.**

Land Preparation
Clearing

FACTORS TO CONSIDER:

- The level of land clearing that is required is dependent on the field conditions. Heavily vegetative lands may require heavy equipment such as a D6 for removing shrubs and small trees.
- Terrain topography (land grading)
- Disposal of vegetation/ top surface material
- Land that has been fallow for sometime may require significant investment to clear.

Land Preparation
Clearing

FACTORS TO CONSIDER IN LAND CLEARING:

- **Equipment availability, especially for the type of vegetation to be cleared;**
- **Terrain topography (land grading);**
- **Disposal of vegetation/ top surface material;**
- **Land that has been fallow for sometime may require significant investment to clear.**

Land Preparation
Ripping

Step 1 Clearing

- This operation is the removal of trees, shrubs and other vegetation from the area that will be cultivated. The removal of boulders and stones is also a part of the process.

- Land clearing, however, is a continuous process until the land can be prepared based on the requirement of the crop. After the first clearance operation/process, rock picking and chemical weed management may occur.

Land Preparation
Ripping

Step 1 Clearing

- A ripper breaks up surface crusts and opens a narrow slot or furrow in the soil, about 5–10 cm deep. Unlike a "plough", a ripper does not turn the soil over.

- Ideally, rippers or chisel cultivators should be capable of handling surface residues, either by using cutting discs in front of the chisels or by providing sufficient horizontal and vertical clearance between shanks and frame to allow a free flow of residues through the equipment.

Land Preparation
Harrowing/Ploughing

Step 3 Harrowing also called Ploughing

- There should be a minimum of 2 cuts/passes horizontally as best practice.
- Plough to a depth of no less than 1.5ft.

Land Preparation
Harrowing/Ploughing

REASONS FOR HARROWING/PLOUGING:

- **Soil Inversion**
- **Soil clod reduction for root development and access to nutrients and water.**

Land Preparation
Furrowing/Ridging

Step 4 Step 4 -

- An east-west row orientation is preferred to maximize light absorption, but this is not always possible

Objectives of Ridging:

- Root Development
- Better drainage

Land Preparation
Furrowing/Ridging

FACTORS TO CONSIDER:

- If using ridges, refine soil, and construct ridge at no less than 1.5ft in height for manual planting.
- Ensure the orientation and grade of fields are designed to have free drainage of excess water.

Land Preparation

3. Cassava Varieties

Variety Selection
Cassava Cultivar: MCOL 22

- **The MCOL 22 cultivar possesses seven (7) leaves which are dark green in colour and has a reddish petiole. There are eight (8) commercial roots on this variety which are sweet with a cream root pulp and a yellow orange cortex.**

SOURCE: MICAF-Bodles Research Station

Variety Selection
Cassava Cultivar: CM 849

- **CM 849 has nine (9) leaf lobes with a dark green leaf colour and the central leaflet shape is oblong-lanceolate. CM 849 has an average eight (8) commercial roots. The root pulp colour is cream with a dark brown skin. It is sweet in taste.**

Variety Selection
Cassava Cultivar: CM 516

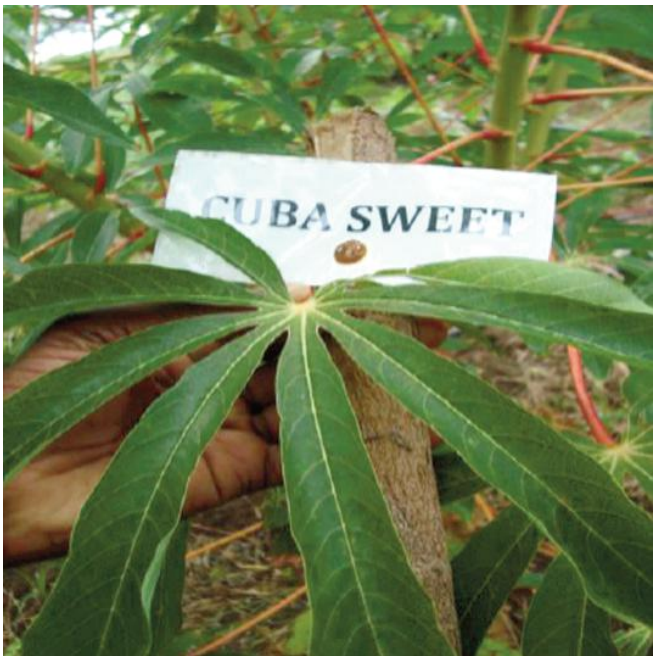
- **CM 516 has seven 97) leaf lobes with the central leaflet having an elliptic-lanceolate shape and dark green leaves. There are on average 7 - 8 commercial roots per plant when planted vertically. The colour of the root pulp (parenchyma) is white with a smooth root epidermal texture.**

Variety Selection
Cassava Cultivar: BRA 383

- **BRA 383 has nine (9) leaf lobes, dark green colour leaves and a linear pyramidal shape. BRA 383 has on average eight (8) commercial roots and dark brown external root colour. The pulp is cream and the root cortex is pink. This cultivar is intermediate in taste. This cultivar has silver stems with a bright red petiole.**

Variety Selection
Cassava Cultivar: Cuba Sweet

- **Cuba Sweet has seven (7) leaf lobes, elliptic-lanceolate central leaves with a dark green colour and a red petiole. The average number of commercial rooths is seven (7). The root is dark brown in colour and the root pulp (parenchyma) is cream with a sweet taste.**



Variety Selection
Cassava Cultivar: MCOL 2215

- **MCOL 2215 has nine (9) leaf lobes, with dark green colour and lanceolate central leaflets. The root pulp is cream with a pink cortex; MCOL 2215 has on average six (6) commercial roots; the external colour of the tubers is dark brown. It has a sweet taste.Branching varies from 3 - 5 months; the optical buds are purple green in colour.**

Variety Selection

Cassava Cultivar: CM 2776-5

- **CM 2776-5 has seven (7) leaf lobes with light green leaves, the central leaflet is lanceolate shaped. This cultivar has on average nine (9) commercial roots with a pink root cortex; a root pulp (parenchyma) and dark brown external colour with a sweet taste. The epidermal texture of the root is smooth.**

Variety Selection
Cassava Cultivar: CM 2772-3

- **CM 2772-3 has nine (9) leaf lobes with a dark green colour; the central leaf lobes have a lanceolate shape. CM 2772-3 has on average 10 commercial roots. The root pulp (parenchyma) is cream with a white or cream root cortex with an intermediate taste, neither sweet nor bitter.The petiole is bright reddish green, with the red colour located closest to the leaf and stem of the cassava plant.**

Variety Selection
Cassava Cultivar: Blue Bud

- **Blue Bud has seven (7) leaf lobes; the central leaflet is elliptic-lanceolate in shape and the leaves are light green in colour. This cultivar has on average six (6) commercial roots and is very sweet in taste. The pulp is cream-coloured with a slight yellow colour. The external root is dark brown in appearance.**

Variety Selection
Cassava Cultivar: Real Sweet

- **Real Sweet has seven (7) leaf lobes with the central leaflet having a lanceolate shape and light green colour. The storage root pulp is white while the root cortex is pink. It is easy to peel and has a sweet taste (raw) and a smooth epidermal texture.**

Variety Selection
Cassava Cultivar: CM 6119-5

- **CM 6119-5 has seven (7) leaf lobes and the leaves are dark green. The central leaflet has an obovate lanceolate shape. The root pulp (parenchyma) is yellow and sweet (raw). The cultivar has very good sprouting ability compared to other cultivars. The leaf petriole is red with a golden exterior colour. CM 6119-5 has an average of seven (7) commercial roots.**

4. Planting Cassava

Planting Cassava
Preparing Planting Material

- **Select material that is not old (7-12 mth);**
- **Preferably the middle-section of the stem (not the hard base nor the green/soft top section of stem);**
- **Inspect for any signs of pest and remove or reject (e.g. wisp, scales).**

Planting Cassava
Preparing Planting Material

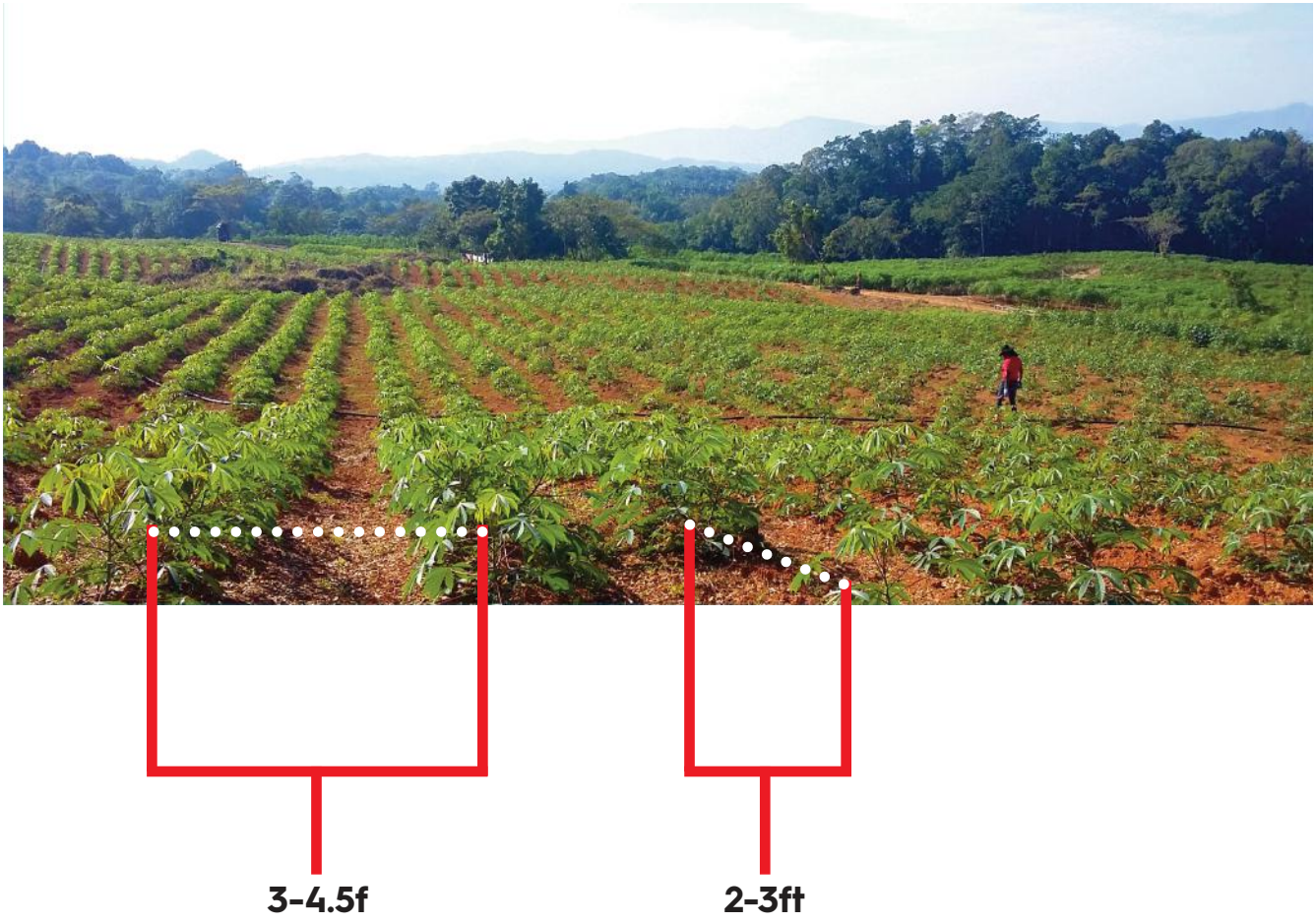
Ideal planting material

Planting Cassava
Preparing Planting Material

- **Prepare cuttings of 4-6 inches or 4-6 nodes for manual planting.**
- **Dip-treat cuttings in approved insecticide and fungicide and allow to air-dry.**

Planting Cassava
Preparing Planting Material

- **Sticks should be planted 2 to 4 days after receipt/ harvesting sticks.**
- **Sticks are planted horizontally at 3-4.5ft between rows by 2-3ft within row.**



5. Crop Nutrition & Water Management

Crop Nutrition & Water Management

Proper nutrition management in cassava is highly important for good health and production of the crop. While this is so, cassava has a few tolerable properties that differentiate it from other crops.

- **Cassava prefers good soil but can also grow in poor soils.**
- **It can tolerate low pH levels.**
- **It can tolerate higher level of soluble aluminium and low available phosphorus.**
- **It grows in soil where other crops fail.**

Crop Nutrition & Water Management
Nutrient Availability Guide/pH

Cassava has its specific nutritional requirements. This includes both key macro and micro nutrients.

Macro: Nitrogen, Phosphorus, Potassium (N:P:K)
Micro: Calcium, Magnesium
N- aids in foliage development
P- aids in root development and health
K- aids starch and tuber development
Ca- boosts root and plant health, for nutrient uptake
Mg- boosts leaf health and nutrient uptake

Cassava will be fertilized using the approved fertilizer programme.*

**Detailed soil analysis and fertilizer recommendation will guide the fertilizer programme).*

Nutrient Uptake of Cassava
(Howerler, 2000)

Plant Part	Yield (t/ha)	N	P
Roots	28.87	67.1 (kg)	11.2(kg)
Whole Plant		179.5(kg)	22.7(kg)
otal		246.6(kg)	33.9(kg)

The degree of nutrient removal depends on the yield level. Hence, continuous production without replacement of the nutrient loss in the soil will reduce the soil productivity.

Red Stripe General Fertilizer Recommendation

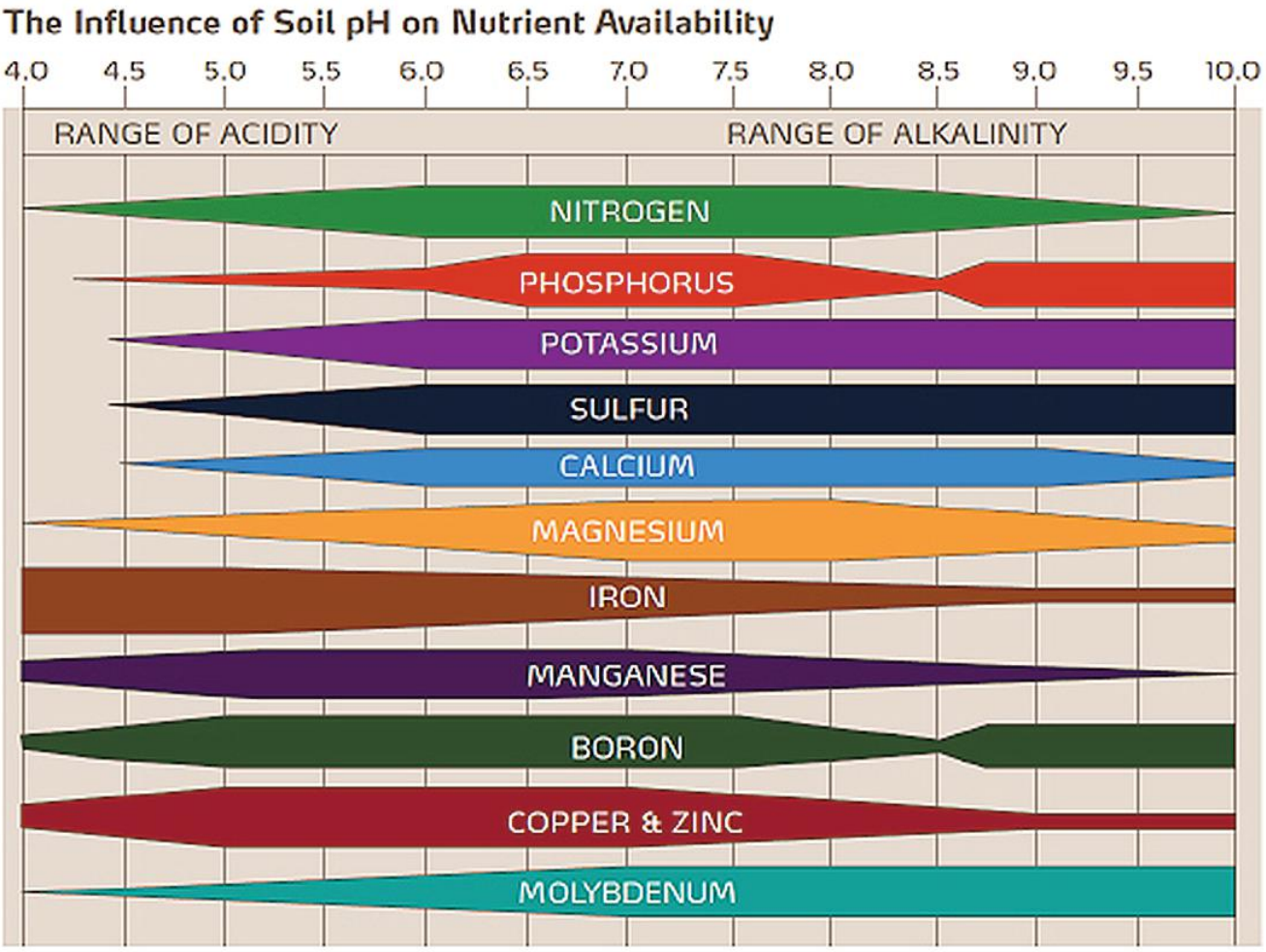
The general recommendation for soil which has not been analyzed is six (6) bags or 600 lbs of fertilizer per acre.

That is:

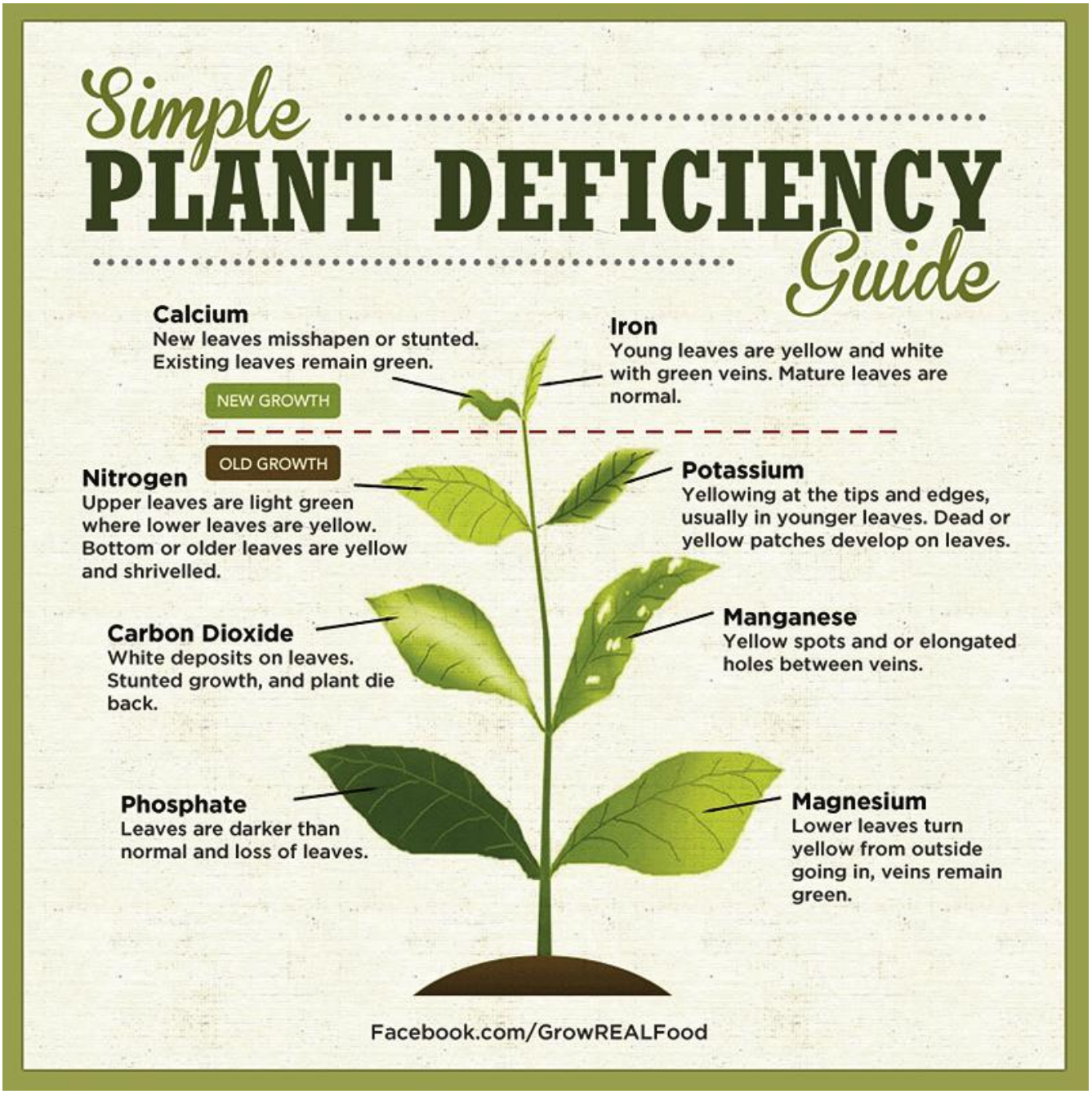
Three (3) bags of (14-28-14)
Three (3) bags of (15-5-35).

Apply fertilizer at 5-10 cm depth and 15 cm away from the plant. Cover and apply irrigation water.
The use of compost or organic fertilizers is highly recommended.

Crop Nutrition & Water Management
Nutrient Availability Guide/pH



Crop Nutrition & Water Management
Nutritional Deficiency



Crop Nutrition & Water Management
Nutritional Deficiency

Nitrogen Deficiency leaves have a uniform light green or yellowish colour, the bottom and yellow leaves tend to fall off.

Calcium Deficiency new leaves, stunned or shrivelled

Nutritional Deficiency

Phosphorus **Plants are deficient in this mineral are generally short and spindly with thin stems, small and narrow leaves and short petioles. The leaves are darker than normal and there is normally loss of leaves.**

Nutritional Deficiency

Potassium Deficiency plants that are deficient in this mineral are generally short and highly branched. There is yellowing at the tips and outer leaves, and brown and yellow dead patches on leaves.

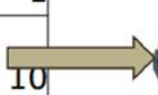
Water Management

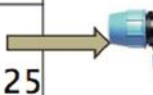
- Like all other crops, cassava requires water for proper growth.
- 1700m^3 per ha per crop cycle
- The crop should receive at least 60% of that within the first 4-6 months
- It is critical for fertilizer uptake
- Too much water at the later stages of the crop causes high water content and low starch content
- Proper drainage and drain management can control moisture in the soil
- Too much water at the later stages of the crop also causes root rot

Water Management
Components of a Standard Irrigation Kit

Item	UOM	Items required for 5 acres
PVC Ball valve 1 1/2" threaded	unit	10
Screen Filter (3")	unit	1
P.E. Elbow 40mm 90degree	unit	10
P.E. Tee 40mmX40mmX40 mm	unit	25
P.E. Adaptor 40mm –1.5"	unit	10
PVC Female Adaptor 1.5"	unit	10
PE pipe 40mm	Meter (100m per role)	1,000
P.E. dripline 16mm (2ft drip spacing 2L)	Meter (400m per roll)	17,200





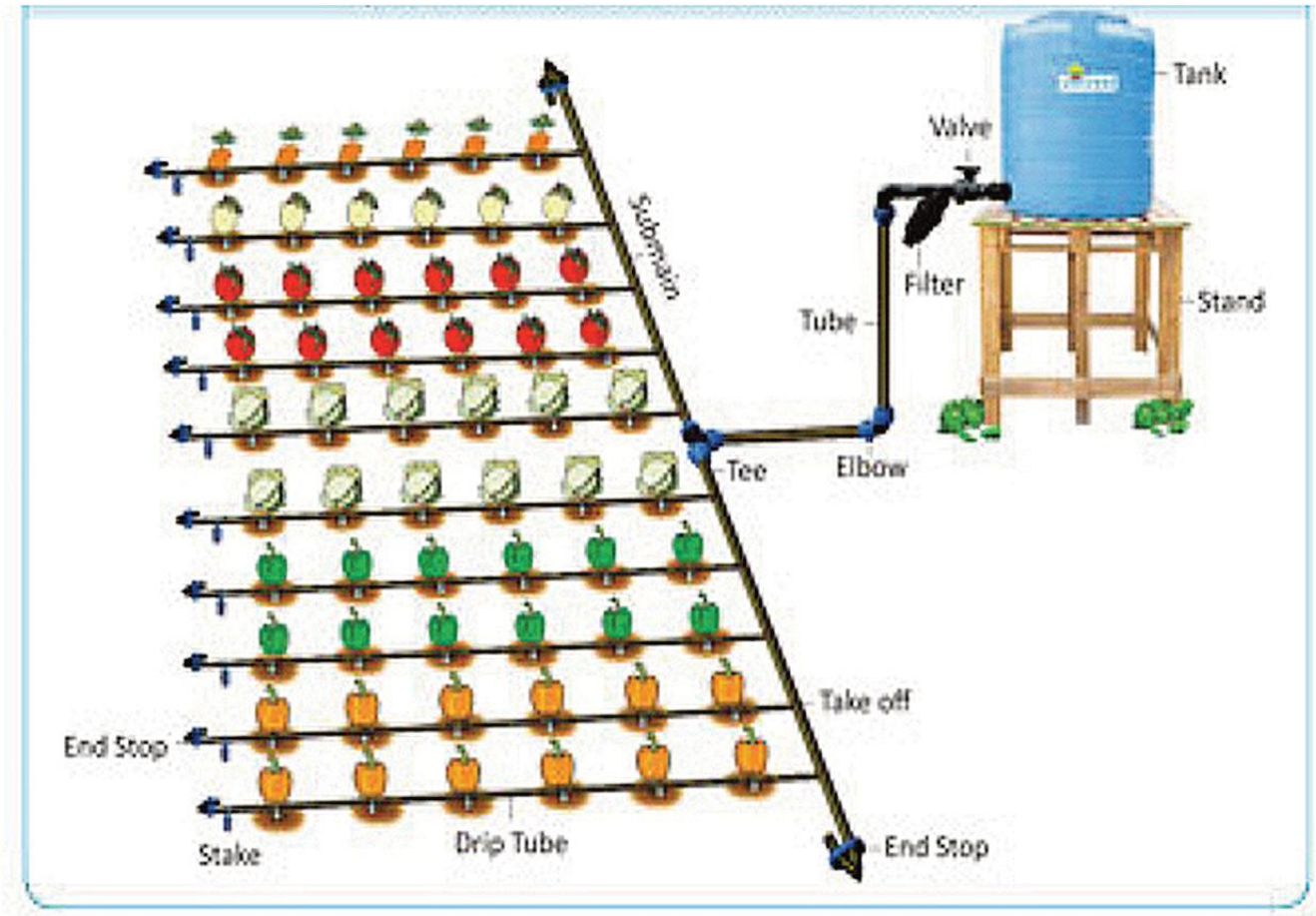


Water Management
Components of a Standard Irrigation Kit

Item	UOM	Items required for 5 acres
16mm Head Connector for drip line	unit	250
P.E End Plug 40mm	unit	10
Endline 16mm	unit	250
Teflon Tape	unit	10
PVC Reducer 3" -2"	unit	10
PVC Reducer 2" - 1 1/2"	unit	10
PE Coupling 16mm (for reg. dripline)	unit	1,500
PE Coupling 40mm	unit	20
Punch for Head Connector 7.5mm	unit	2

Crop Nutrition & Water Management

Basic Irrigation Set-up



6. Pest & Disease Identification

Pest & Disease Identification
What is a Pest?

- **A pest is a plant, animal, insect or other organism that attacks crops, food, livestock; causing injury, economic loss and mortality**

Pest & Disease Identification

- Cassava is susceptible to many pests and diseases, therefore, proper pest identification and the appropriate strategies must be implemented for effective management (Integrated Pest Management).
- Scouting
- Look for eggs
- Early detection is the key

Some of the pests and diseases that cassava is susceptible to are:

- Aphids
- Thrips
- Caterpillars
- Mites
- Stem borers
- Termites
- Crickets
- Cassava mosaic virus
- Rodents (rats and mongooses)
- Brown and white leaf spot disease
- Weeds
- Super Elongation

Pest & Disease Identification
Cassava Bud Worm

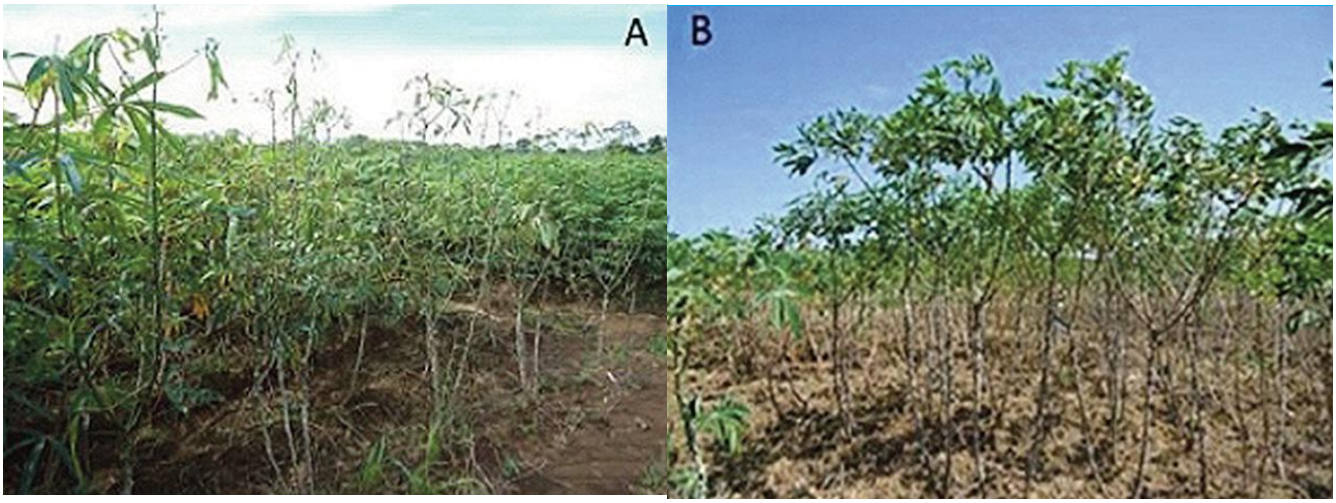
Cassava Bud Worm - Whitish Larvae, multiple stem growth at damaged nodes and branches

Origin - eggs from a shiny blue fly that lays among young leaves

Pest & Disease Identification
Super Elongation

Curling in young leaves and canker in stems and petioles and extra long stem nodes

Origin - From a fungus, Sphaceloma Manihotcola



Pest & Disease Identification
Cassava Stem Borer

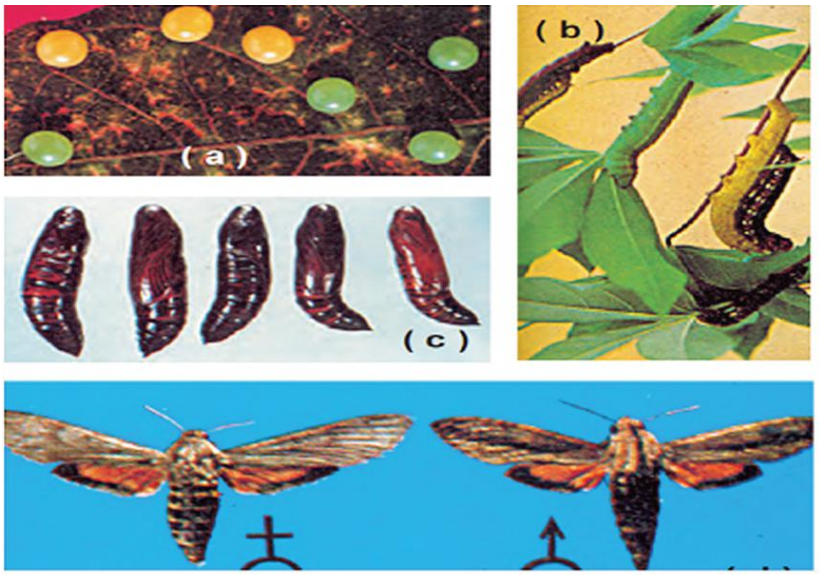
Dark - bodied adults, saw dust at roots and stems damaged

Origin - Black beetle, bores stems and lays eggs that feed on sap

Pest & Disease Identification
Cassava Horn Worm

Black/ dark - green caterpillar, eggs under leaf- multicolour, damage to stems and new leaves

Origin - large grayish - brown moth larvae. The moth larvae is a large caterpillar.



a) Eggs b) larva c) pupa d) male and female adult

Pest & Disease Identification
Brown Leaf Spot

This is a fungal disease, characterized by large angular brown spots. It prefers wet conditions and is spread by rainwater and sprinkler splash.

Pest & Disease Identification
Cassava Mosaic Disease

Yellow patches on leaves mixed with the normal green colour of leaves. Can lead to 20-90% loss.

Origin - caused by a group of Gemini viruses in the genus Begomovirus from the family Geminiviridae

Pest & Disease Identification
White Leaf Spot

Fungal disease
Lesions are yellow/white circles sunken at top and under leaf. Reduces photosynthesis in plants.

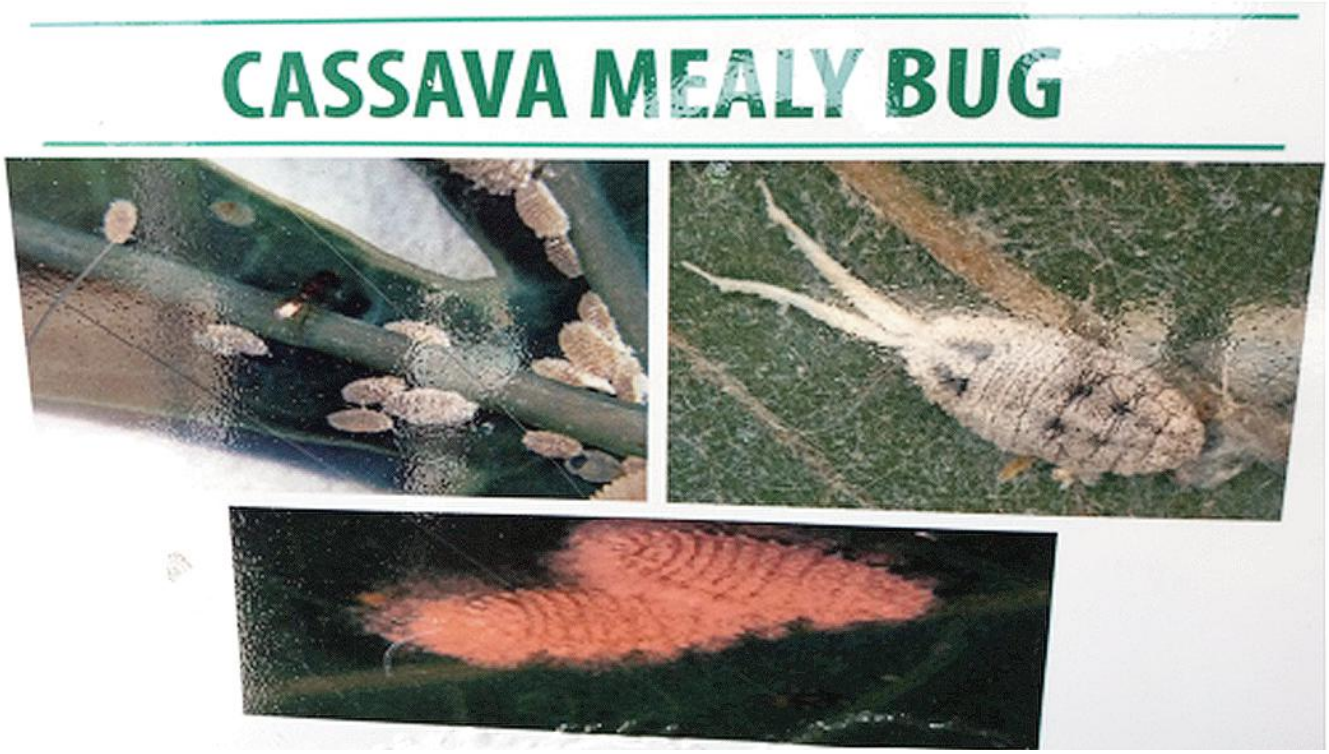
Pest & Disease Identification
Green Mite

Leaves develop yellow dot-sized spots along the veins. Badly infested leaves wither and fall while others develop a silvery-brown appearance, and yellowing of damaged areas.

Pest & Disease Identification
Cassava Mealy Bug

Sucks sap out of leaf causing curling and resetting of plant's thermal shoot. This results in stem deformation. It also inhibits plant growth, causing dwarfism. Mealy bugs also produce sooty mould, reducing photosynthesis in plants.

Mealy bugs are characterized by their soft body covered in a white powdery wax, as if they were dusted with flour.



Pest & Disease Identification
Weeds

Weeds and herbs - Grass and Broad leaf species

Pest & Disease Identification
Cassava Wet Rot

The infected tissues inside the bulky roots are slightly discoloured and exude liquid on pressure. The black mycelial bundles penetrate the tissues, where they grow, forming small cavities that contain an off-white mycelium. The infected roots have a characteristic odour of decaying wood.

Pest & Disease Identification
Termites

They feed on propagation material (stakes), roots, or young developing plants. The presence of termites is mainly characterized by the galleries they make in the attacked parts, such as roots or newly planted stake. Can reduce yield by up to 30%.

Pest & Disease Identification
Treatment & Prevention

Disease/ Pest	Identification	Treatment/Prevention
Thrips	White bodied and yellow species, deformation in young leaves	Insecticide
Super Elongation	Curling in young leaves and cankers in stems	Copper oxychloride or copper sulphate based fungicide
Termites	White/brownish bodied with red heads. holes in tubers and roots	Contact Insecticide
White Grubs	White bodied larvae found in some soils, cause heavy wilting of young plants3(1months old) and drying up	Insecticide at treatment
Cassava Mites	Silver/grey scaling on back of leaves and yellowing of damaged areas	Insecticide or Acaricide
Cassava Hornworm	Black/ dark greenCaterpillar, eggsunder leaf-multicolor, damage to stems and new leaves	Insecticide
Cassava Stem Borer	Dark bodied adults, saw dust at roots and stems damaged	Systemic Insecticide
Cassava Bud Worm	Whitish Larvae, multiple stem growth at damaged nodes, and branches	Systemic Insecticide
White Leaf Spot	Yellow/White lesions circlesunken at top and under leaf	copper oxychloridebased fungicides, mixed in mineral oil
Whiteflies	It causes deformation, curling, and yellowishgreen mottling in apical and middle leaves Manifested by sooty mold, yellowingand desiccation ofbasal and middle leaves Transmit virus as well as damage plant.	Insecticide, best to use neem based products

7. Weed Management

Weed Management
What is a weed?

A weed is any plant growing where it is not wanted and causes economic losses to cultivated crops.

Weed Management
Importance to Cassava Cultivation

- **Weed management is important to control pests, reduce competition and reduce overall cost of production and profitability of any farming enterprise.**

- **In the case of cassava it is imperative that there be no weeds in the first 45 days as this will severely impact the growth of the plant be cause of an increasing competition for nutrients in the early stage of the crop development.**

Weed Management
Importance to Cassava Cultivation

- **Physical**
- **Biological**
- **Cultural**
- **Chemical**

Weed Management
Integrated Weed Management

- **Weed management in cassava cropping systems typically consists of crop rotation, manual weeding, herbicides, and cultivation.**
- **Proper land preparation will allow for a minimum of two weeding sessions for the crop life.**
- **Manual and chemical weed management (using approved chemicals) methods will be employed.**
- **Weed management is important to control pests and reduce competition.**

Weed Management
Integrated Weed Management

Pre-Plant Weed Management

- Proper land preparation – ploughing, harrowing, furrowing and use of stale bed technique
- Manage weed seed bank
- Border weed control

Pre-Plant Weed Management

- Manual
- Chemical

Integrated Weed Management

Herbicides

- **Pre-emergent**

- **Pre-emergent herbicides prevent the germination of certain weed seeds and can be applied pre-planting or post-planting**
  Products include: Diuron, Pendimethalin (prowl)

Post-emergent contact & systemic

- **Must be applied pre-planting or post-planting but before cassava has germinated.**

- **Products include: Glyphosate and Paraquat**

Post-emergent selective

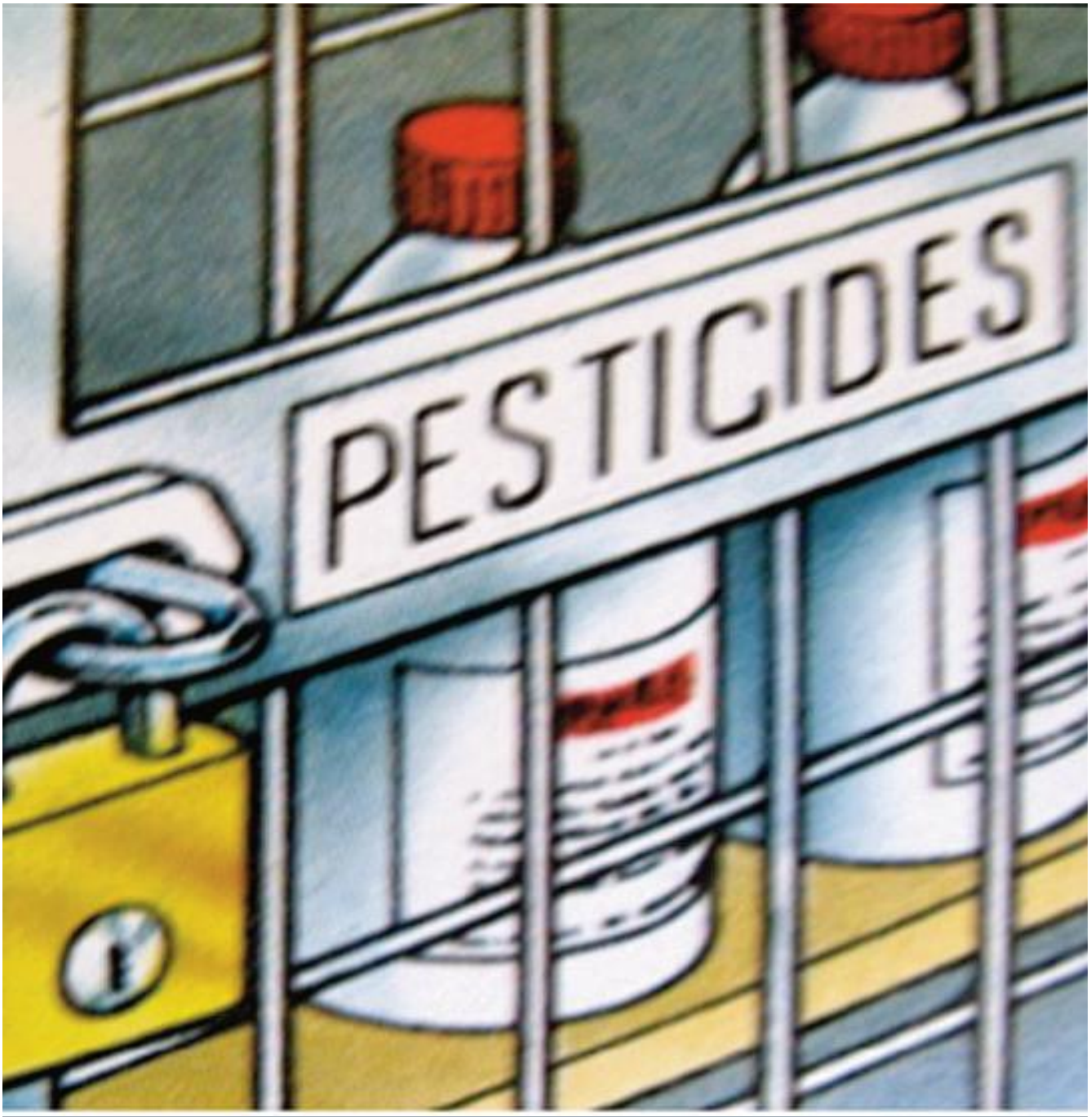
- These are applied after germination of cassava and the emergence of weeds.

- They are designed to control weeds of the grass species.
  Product include: Fusilade

Weed Management
Approved Chemicals

FACTORS TO CONSIDER:

- **Fusillade** (Post Emergent Grass killer)
- **Gramoxone** (None-Selective Post Emergent Contact)
- **Dual Gold** (Selective Pre-Emergent Grass killer)
- **Prowl** (Selective Pre-Emergent Grass killer)
- **Glyphosate** (None-Selective Systemic)
- **Penzene** (Selective Pre-Emergent Grass killer)
- **Paraquat** (None-Selective Post Emergent Contact)



8. Pesticide Safe Use & Management

Pesticide Safe Use & Management
What is a pesticide?

A substance used for destroying insects or other organisms harmful to cultivated plants or animals.

Pesticide Safe Use & Management
Classification by Type of Pest

Pesticide group	Pest
■ Insecticides	*Insects*
■ lAcaricides	*Acari (mites & ticks)*
■ lNematicides	*Nematodes*
■ lMolluscocides	*Molluscs (slugs & snails)*
■ lRodenticides	*Rodents (rats)*
■ lFungicides	*Fungi*
■ lHerbicides	*Weeds*

Classification by Mode of Action

- **Contact:** Kills after direct contact with pest
- **Stomach:** Kills after pest feeds on treated material.
- **Systemic pesticides:** are chemicals that are actually absorbed by a plant when applied to seeds, soil, or leaves. The chemicals then circulate throughout the plant's tissues, killing the insects that feed on them.

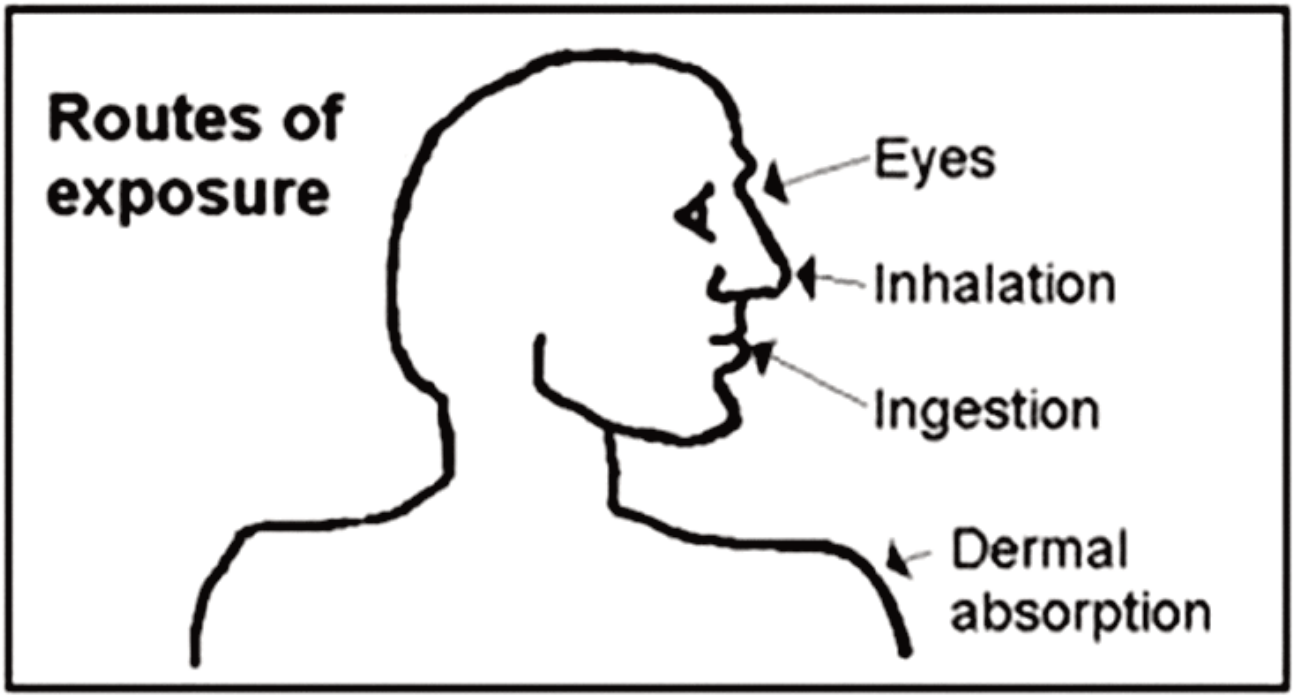
Pesticide Hazards

- **Hazard = Exposure + Toxicity**
- **Nearly all pesticides are toxic.**
- **They differ only in the degree of toxicity.**
- **Pesticides are potentially dangerous to people if exposure is excessive.**

Pesticide Safe Use & Management
Pesticide Hazards- Toxicity & Exposure

Toxicity
The toxicity of a pesticide is its capacity or ability to cause injury or illness.

Exposure
How a person comes in contact with hazardous chemicals: Inhale, ingestion, skin contact



Pesticide Safe Use & Management
Pesticide Health Hazards

- Poisoning
- Nerve illnesses e.g. seizures, loss of consciousness
- Blood illnesses e.g. Pulmonary edema
- Skin irritation
- Vision impairments
- Respiratory illnesses
- Rage and excessive behaviour
- Diarrhea and vomiting

Pesticide Environmental Hazards

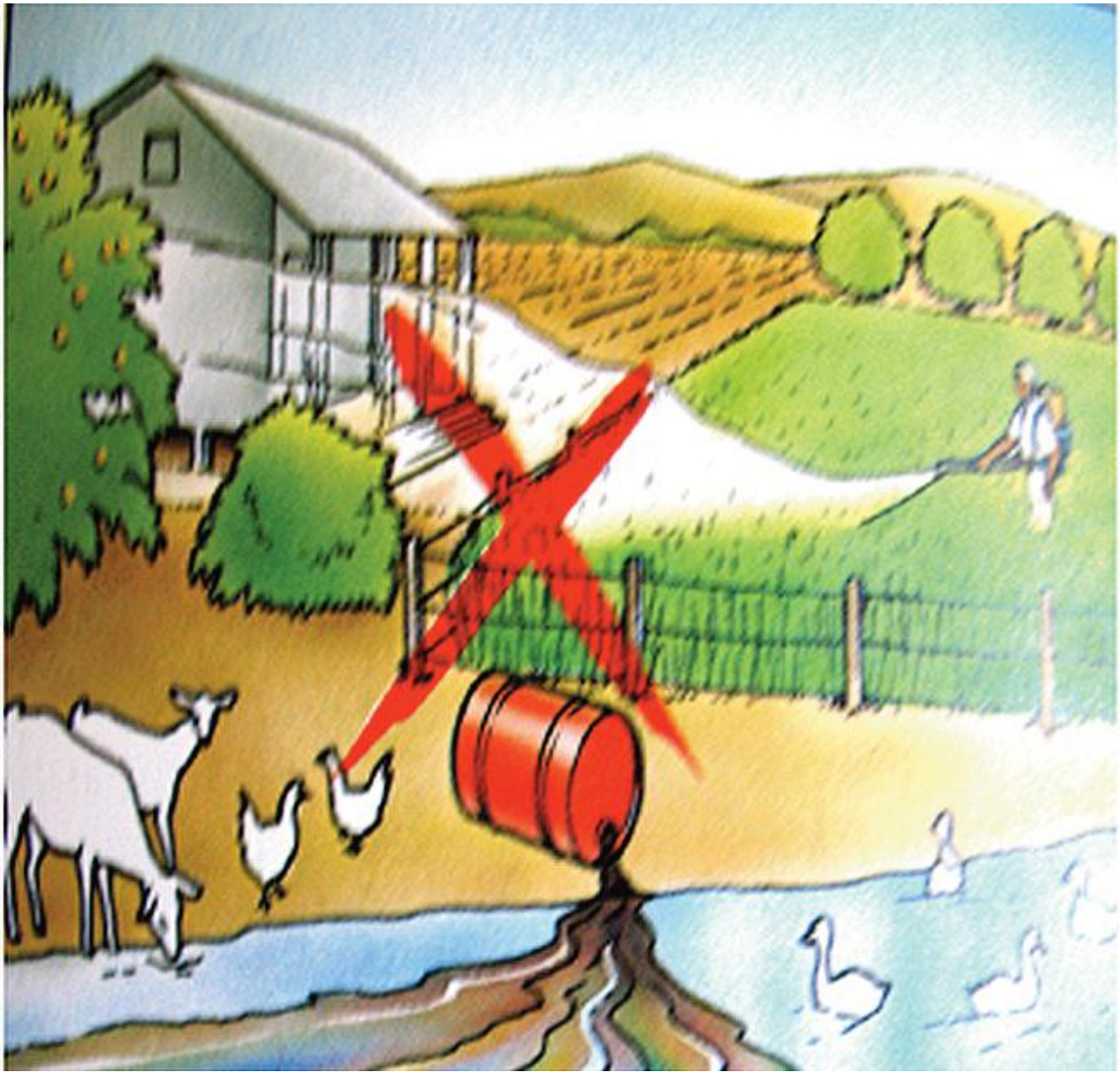
- Water contamination
- Involuntary exposure in food
- Loss of food source and food from animals
- Destruction of natural habitats
- Air pollution
- Food contamination
- Loss of plants and animals

Pesticide Safe Use & Management
Cause of Injury

Direct contact: with pesticide during the handling.

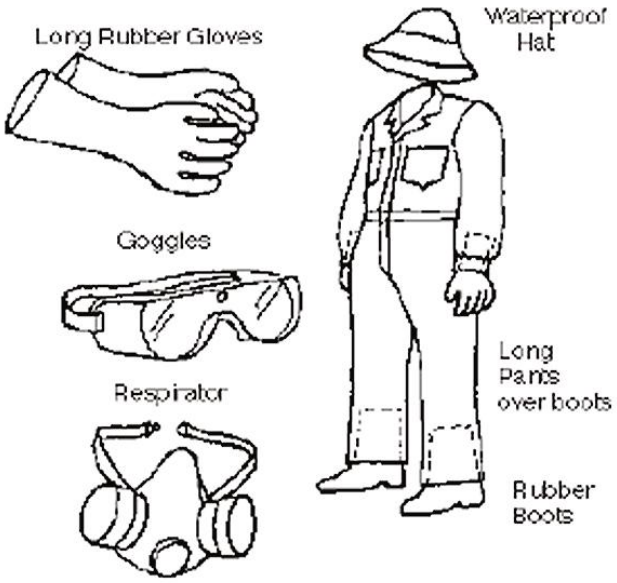
Pesticide Safe Use & Management
Cause of Injury

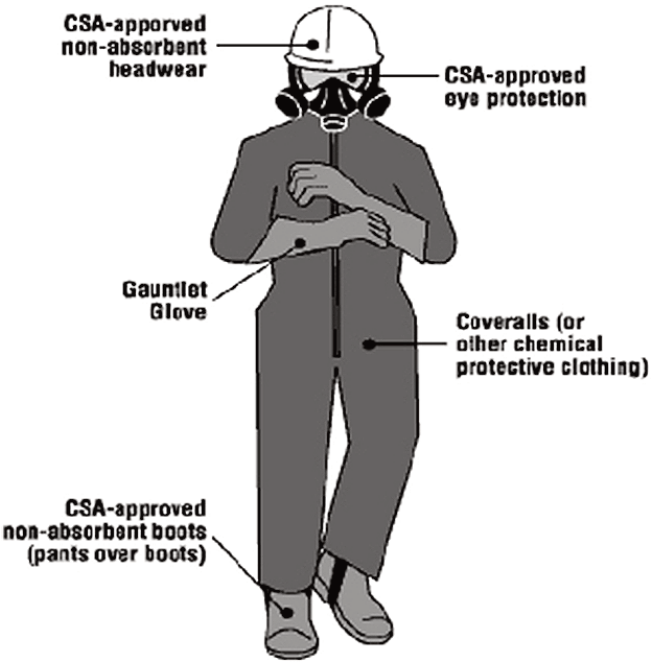
Indirect contact: **Contact through contaminated natural resources such as treated soil or polluted water or from residues following an application.**



Wash hands before eating

Pesticide Safe Use & Management
Personal Protective Equipment (P.P.E.)





Pesticide Safe Use & Management
Product Stewardship

KEY DEFINITIONS

- **Product** (or pesticide product) means the pesticide active ingredient(s) and other components, in the form in which it is packaged and sold.

- **Active ingredient** means the biologically active part of the pesticide.

- **Trade/Brand name:** A brand name is the name of the distinctive product, service, or concept i.e. the name by which a product is marketed.
  Example **Glyphosate** is marketed as Round Up by some company in parts of the world.

PESTICIDE LABELS

Should be visible.

Should be concise.

Should be practical and easily understood.

Should have the possible environmental impacts if not used and dispose of properly.

Should have an MSDS (material safety data sheet).

Uses of Herbicides

SYSTEMIC

[GLYPHOSATE]

LONGER EFFECT (NON-RESURGENCE OF WEEDS)

RESULTS IN WILT OF WEEDS –THROUGH SYSTEMIC ACTION

CONTACT

[GRAMOXONE]

ACTS ON IMPACT

SHORTER PERIOD OF EFFECT

QUICKER RESURGENCE OF WEEDS

EFFECT APPEARS AS PLANT 'BURN'

Herbicides

Active ingredient	Trade Name	Weeds controlled
Fluazifop	Fusilade DX, II,	Selective post emergent grass
Paraquat	Gramoxone, Firestorm, Parazone, Scorcher and Paraquat	Broad Spectrum Post emergent contact
Diquat	Reglone, Reward	Broad Spectrum Post emergent contact
Glyphosate	Roundup, Glyphosate, Glyphos Max, Glyphos and Glyphos AG.	Broad Spectrum Post emergent systemic
Pendimethalin	Prowl, Prowl H2O, Pendulum, Pendant and Penzene	Broad spectrum Pre-emergent contact

Pesticide Safe Use & Management
Fungicides

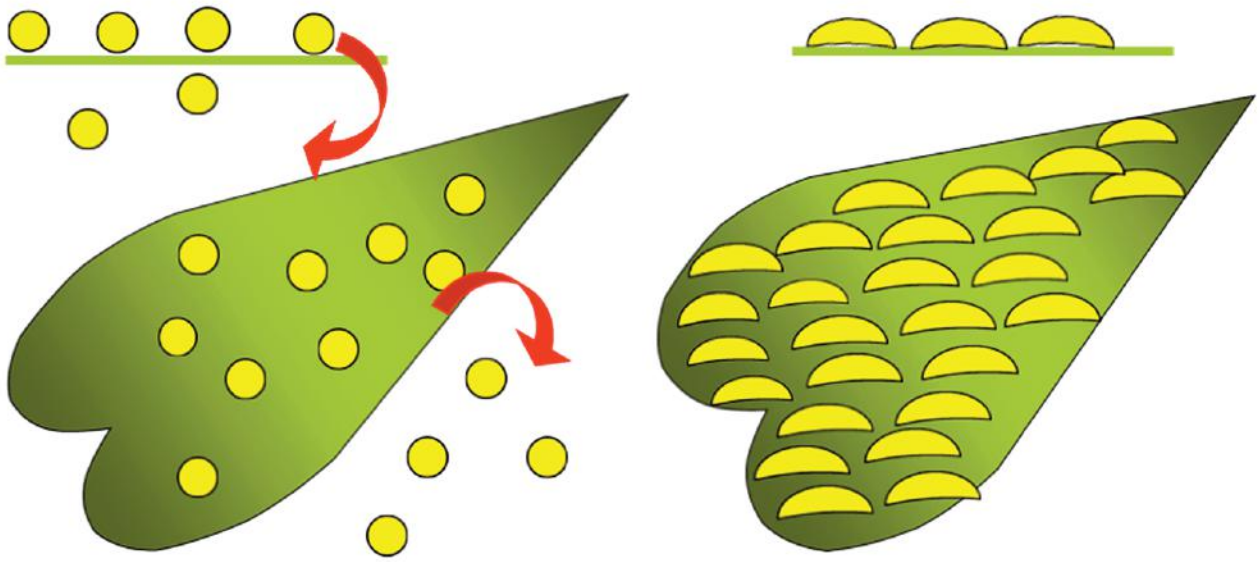
Active ingredients	Trade Name	Pest or disease controlled
Copper Sulphate Pentahydrate	Phyton-27	Bacterial and fungal disease (broad spectrum)
Benomyl	Benlate	Fungal diseases (Broad spectrum) very toxic
Carbendazim	Bavistin	Fungal Diseases (Broad spectrum)
Fosetyl - Aluminium	Alliette	Gummosis, Pythium and Blight
Daconil	Bravo	Fungal Diseases (Broad spectrum)
Propiconazole	Tilt	Fungal Diseases (Broad Spectrum systemic)
Metalaxyl & Mancozeb	Ridomyl	Fungal diseases (selective systemic)
Mancozeb	Dithane, Sancozeb and Mancozeb	Fungal Diseases (Broad spectrum)

Insecticides

Active ingredients	Trade Name	Pest or disease controlled
Profenofos	Selecron	Aphids, Scales, Mealy bug, Leaf miner and White flies. (contact and systemic)
Acetamiprid	Caprid	Aphids, Scales, Mealy bug, Leaf miner and White flies. (contact and systemic)
Thiamethoxam	Actara 25 WG, Engeo	Aphids, Scales, Mealy bug, Leaf miner and White flies. (contact and systemic)
Diazinon	Diazinon	Aphids, Ants, Worms, Thrips, Beetles and Crickets. (contact)
Lambda-cyhalothrin	Karate, Caratrax 5EC	Aphids, Scales, Fruit flies, Caterpillar, Leaf miner and White flies. (contact)

Pesticide Safe Use & Management
Use of Spreader Stickers

- **Spreader stickers are adjuvants added to the spray mix, intended to help coverage of the product on the plant material and to slow chemical residue loss.**



Pesticide Safe & And Management
Factors to Consider Before Applying Pesticides

- Dose Rate
- Volume Rate
- Nozzle Type
- Spraying Techniques
- Spray Pressure
- Type Of Equipment To Use
- Type Of Pest
- Type Of Chemical
- Mode Of Action Of Chemical
- The Person Applying The Chemical

Pesticide Safe & And Management
Pesticide Formulations

SOLIDS

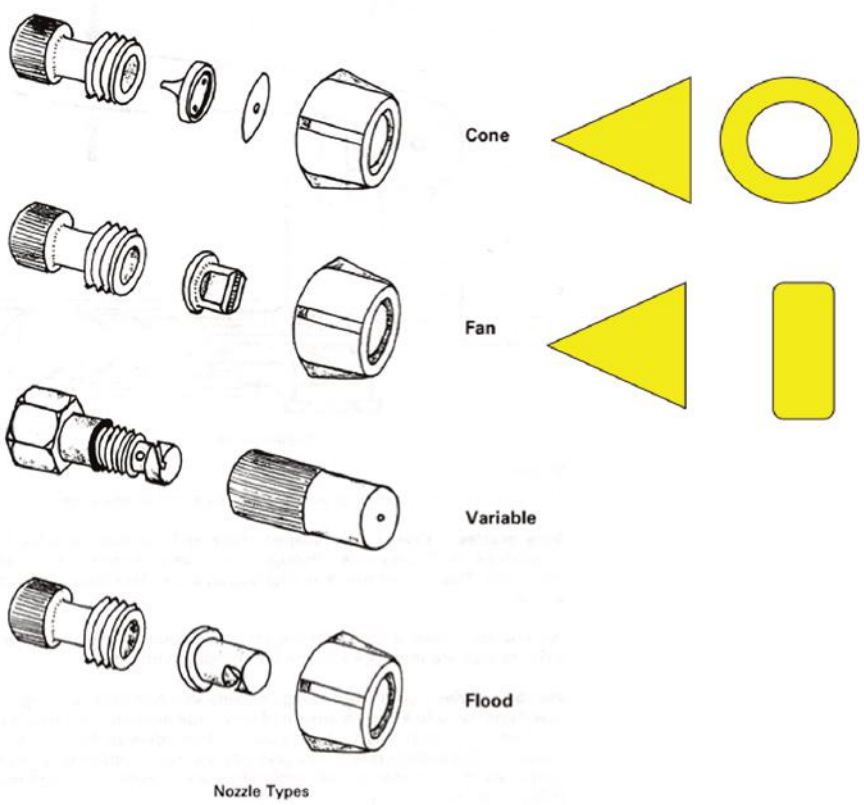
- WETTABLE POWDERS (WP)
- SOLUBLE POWDERS (SP)
- GRANULES (G)
- BAITS (B)

LIQUIDS

- EMULSIFIABLE CONCENTRATES (EC)
- SOLUTIONS (S)

Types of Nozzles

Orientation of spray

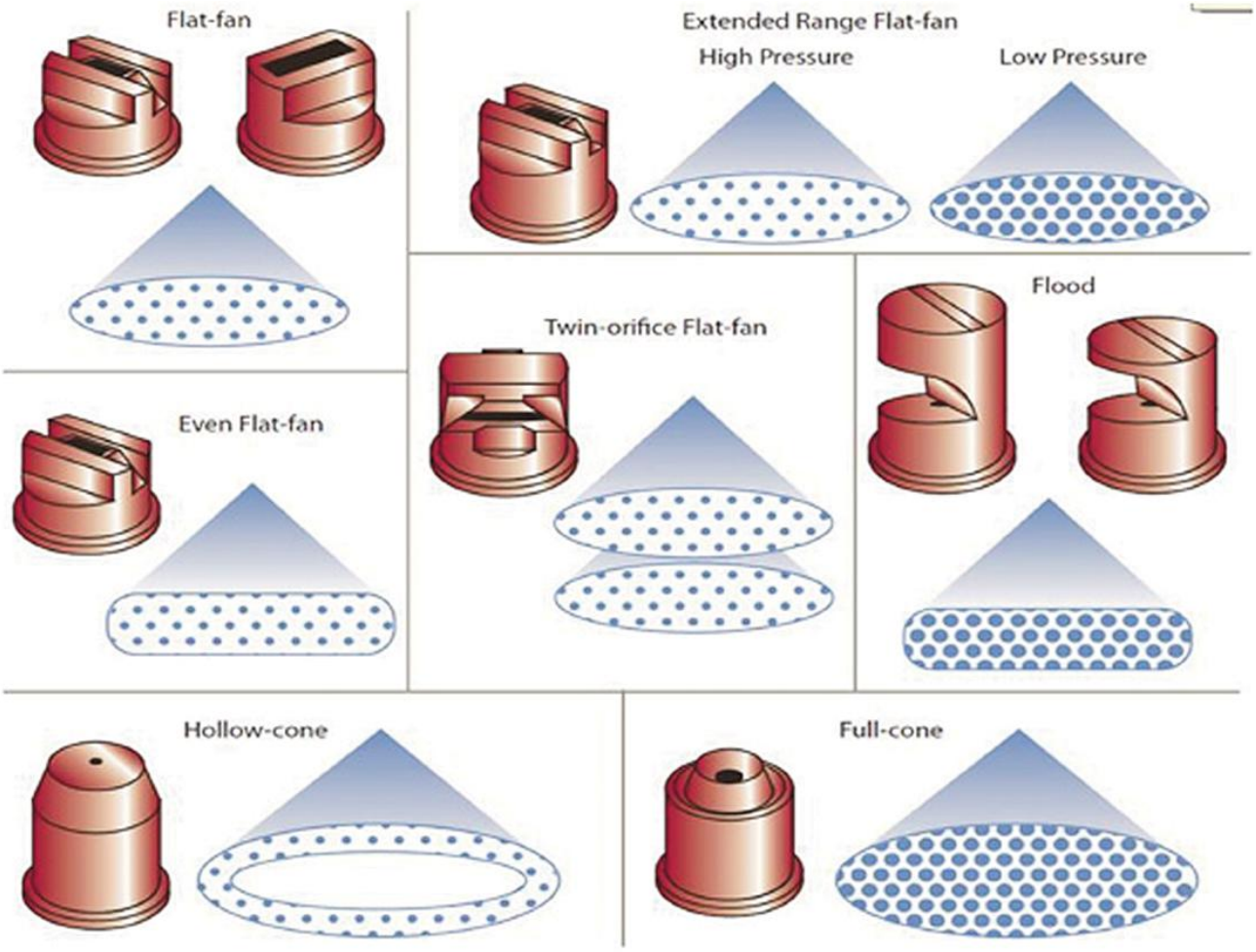


Nozzle Types

Cone nozzle is one of the best choice for insecticide and fungicide applications

Fan nozzle is one of the best choice for insecticide and fungicide applications

Pesticide Safe & And Management
Types of Nozzles



Pesticide Safe & And Management
Types of Nozzles

	 Even Flat Fan	 Twin Even Flat Fan	 Hollow Cone	 Full Cone	 Disc and Core Cone
Herbicides					
Pre-emerge	**Very Good**	**Good**	**Very Good**	**Good**	
Post-emerge Contact	**Good**	**Very Good**			
Post-emerge Systemic	**Very Good**	**Good**			
Fungicides					
Contact	**Good**		**Good**		**Very Good**
Systemic	**Very Good**				**Good**
Insecticides					
Contact		**Very Good**	**Very Good**		**Very Good**
Systemic	**Very Good**				**Good**
Growth Regulations	**Good**			**Very Good**	

Pesticide Safe Use & Management
Best Practices

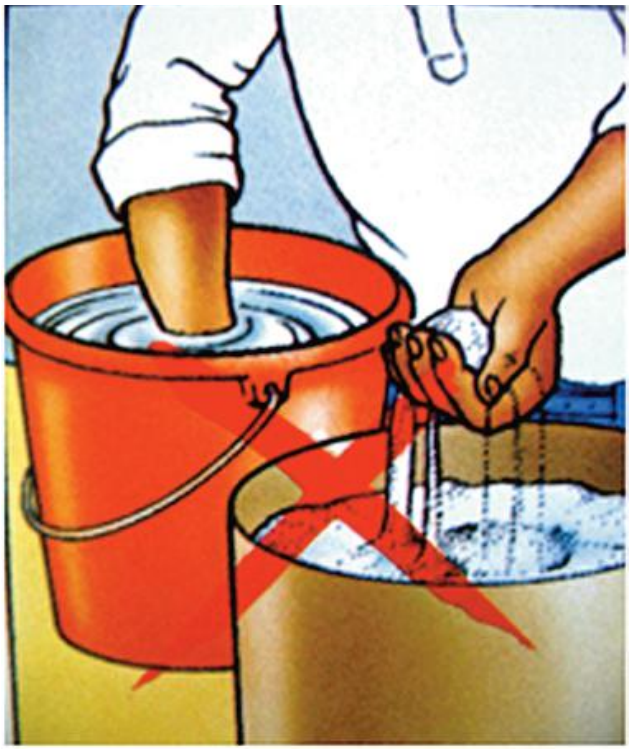
- Use calibrated equipment to apply chemicals.
- Mix according to the label
- Mix the amount of CHEMICAL that is NEEDED
- Monitor the weather conditions
- Wind conditions should be less than 10km/hour when applying chemicals to fields, in other words don't apply on a very windy day.
- Forecasts should be free of heavy rainfall for a minimum of 24 hours after application.

Pesticide Safe Use & Management
Best Practices

DO NOT APPLY PESTICIDES WHEN IT IS LIKELY TO RAIN.

DO NOT SPRAY OR DUST INTO THE WIND.

Pesticide Safe Use & Management
Best Practices



Pesticide Safe Use & Management
Disposal

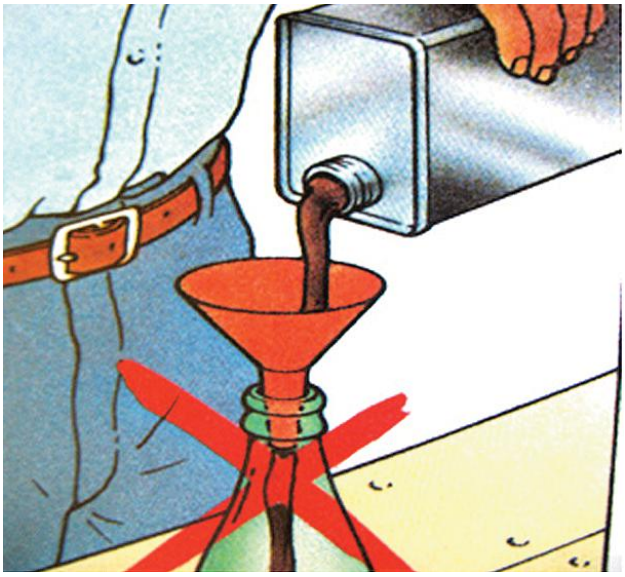
- Dispose of containers according to labels and MSDS.
- Ensure to have a charcoal pit, away from underground water source, for residual waste.
- Ask pesticide suppliers and manufacturers.
- Triple rinse and puncture containers.

Pesticide Safe Use & Management
Disposal Factors to Consider

DISPOSE OF PESTICIDES CONTAINERS AND CONTAMINATED PRODUCE PROPERLY

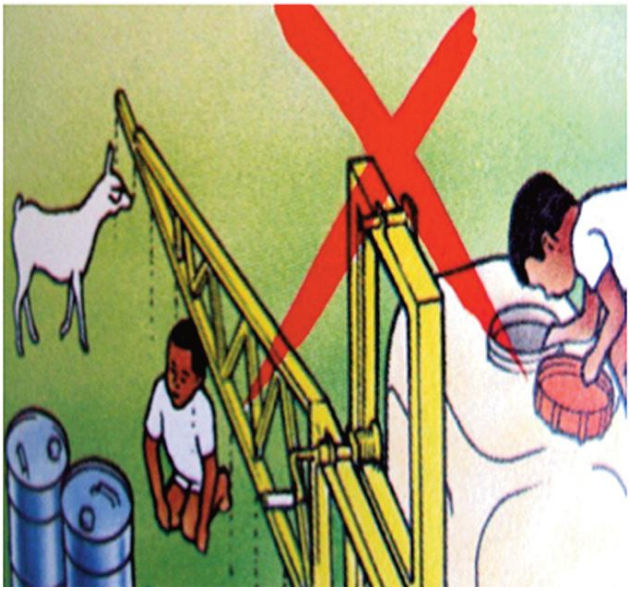
Pesticide Safe Use & Management
Disposal Factors to Consider

DO NOT REPACK CHEMICAL CONTAINERS OR REUSE.



Pesticide Safe Use & Management
Disposal Factors to Consider

NEVER LEAVE EMPTY CHEMICAL CONTAINERS LYING AROUND CHILDREN OR ANIMALS



First Aid

INHALATION

- Move victim to fresh air.
- If not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible.
- Call poison control centre or doctor for treatment advice.

INGESTION

- If swallowed call a doctor or nearest hospital for treatment advice.
- Do not induce vomiting unless directed by a physician or a poison control centre.
- If spontaneous vomiting occurs, have victim lean forward with head down to avoid choking on vomit, rinse mouth and administer water.

First Aid

EYE CONTACT

- Flush eyes with clean water, holding eyelids apart for a minimum of 15 - 20 minutes.
- Call poison control centre or doctor for treatment advice.

SKIN CONTACT

- Immediately remove contaminated clothing and wash skin, hair and fingernails thoroughly with soap and water.
- Flush skin with running water.
- Obtain medical attention if irritation occurs.

Pesticide Safe Use & Management
First Aid

Remove the persons' clothing immediately safely. Wash off the individual with clean water

Pesticide Safe Use & Management
First Aid

- **Always remember to observe re-entry time after spraying.**
- **Always remember to observe withdrawal (post-harvest interval) periods after spraying as well.**

PROJECT GROW
OUTGROWER tuber certificate & invoice LOGBOOK

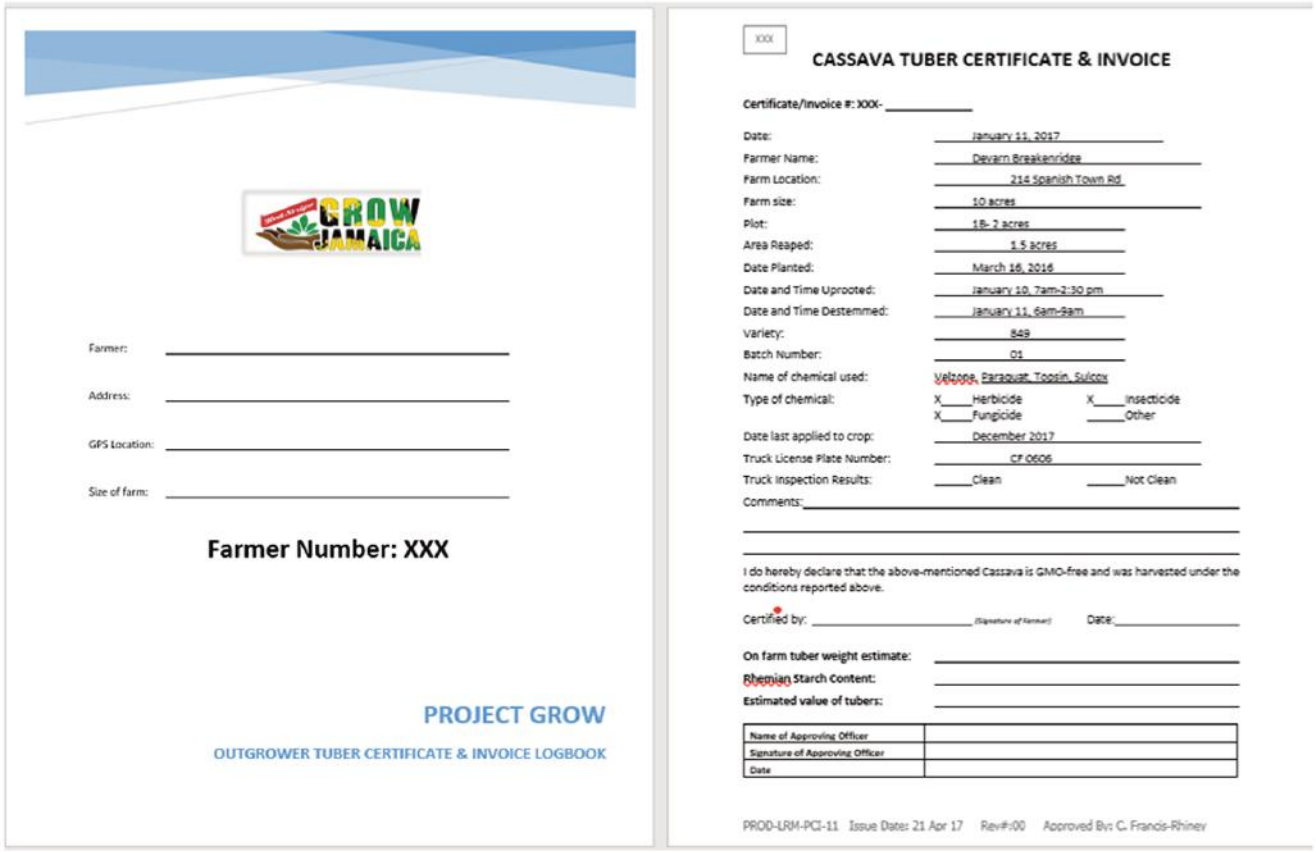
9. Record Keeping

Record Keeping
Traceability

Record Keeping
Traceability

- What?
- When?
- Where?
- How?
- Crop Production Logbook
- Product Certificate and Invoice

Record Keeping
Product Certificate and Invoice



Farmer: _____

Address: _____

GPS Location: _____

Size of farm: _____

Farmer Number: XXX

PROJECT GROW

OUTGROWER TUBER CERTIFICATE & INVOICE LOGBOOK

XXX

CASSAVA TUBER CERTIFICATE & INVOICE

Certificate/Invoice #: XXX- _____

Date: January 11, 2017
Farmer Name: Devarn Breakenridge
Farm Location: 214 Spanish Town Rd
Farm size: 10 acres
Plot: 1B- 2 acres
Area Reaped: 1.5 acres
Date Planted: March 16, 2016
Date and Time Uprooted: January 10, 7am-2:30 pm
Date and Time Destemmed: January 11, 6am-9am
Variety: 849
Batch Number: 01
Name of chemical used: Velpone, Paraquat, Topsin, Sulcox
Type of chemical: X Herbicide X Insecticide X Fungicide ___ Other
Date last applied to crop: December 2017
Truck License Plate Number: CF 0606
Truck Inspection Results: ___ Clean ___ Not Clean
Comments: _____

I do hereby declare that the above-mentioned Cassava is GMO-free and was harvested under the conditions reported above.

Certified by: _____ (Signature of Farmer) Date: _____

On farm tuber weight estimate: _____
Rhemian Starch Content: _____
Estimated value of tubers: _____

Name of Approving Officer	
Signature of Approving Officer	
Date	

PROD-LRM-PCI-11 Issue Date: 21 Apr 17 Rev#:00 Approved By: C. Francis-Rhiney

Record Keeping
Crop Production Log Sheet

XXX Name of farmer: Plot/block name: Red Stripe Rep:
Farmer signature: Plot/block size: Sign & Date:

Land Preparation	
Date Prepared	
Methods used	
Prepared by	
Comments:	
Planting Material	
Source	
Variety	
Pests present? (Y/N)	
If yes, type of pest	
Treatment? (Y/N)	
If yes, treated by	
Chemicals used	
Date treated	
Comments:	

Planting	
Date planted	
Planting method	
Planting distance	
No. plants per row	
Stand count 3 weeks (%)	
Stand count 2 months (%)	
Comments:	

Harvesting	Projected	Actual	Actual	Actual
Reaping Date				
Yield per plant				
Yield per acre				
Harvesting	Projected	Actual	Actual	Actual
Reaping Date				
Yield per plant				
Yield per acre				
Comments:				

Batch number						
Date uprooted						
Time uprooted						
Date de-stemmed						
Time de-shemreed						
Total mass (kg)						

Pest Control

Date	Type of pest	Method	Pesticide used	Application rate (g/l/ area)	Results/ Remarks

PROD-LRM-OCP-11 Issue Date: 3Feb17 Rev Date: 21Apr17 Rev#:01 Approved By: C. Francis-Rhiney

XXX Name of farmer: Plot/block name: Red Stripe Rep:
Farmer signature: Plot/block size: Sign & Date:

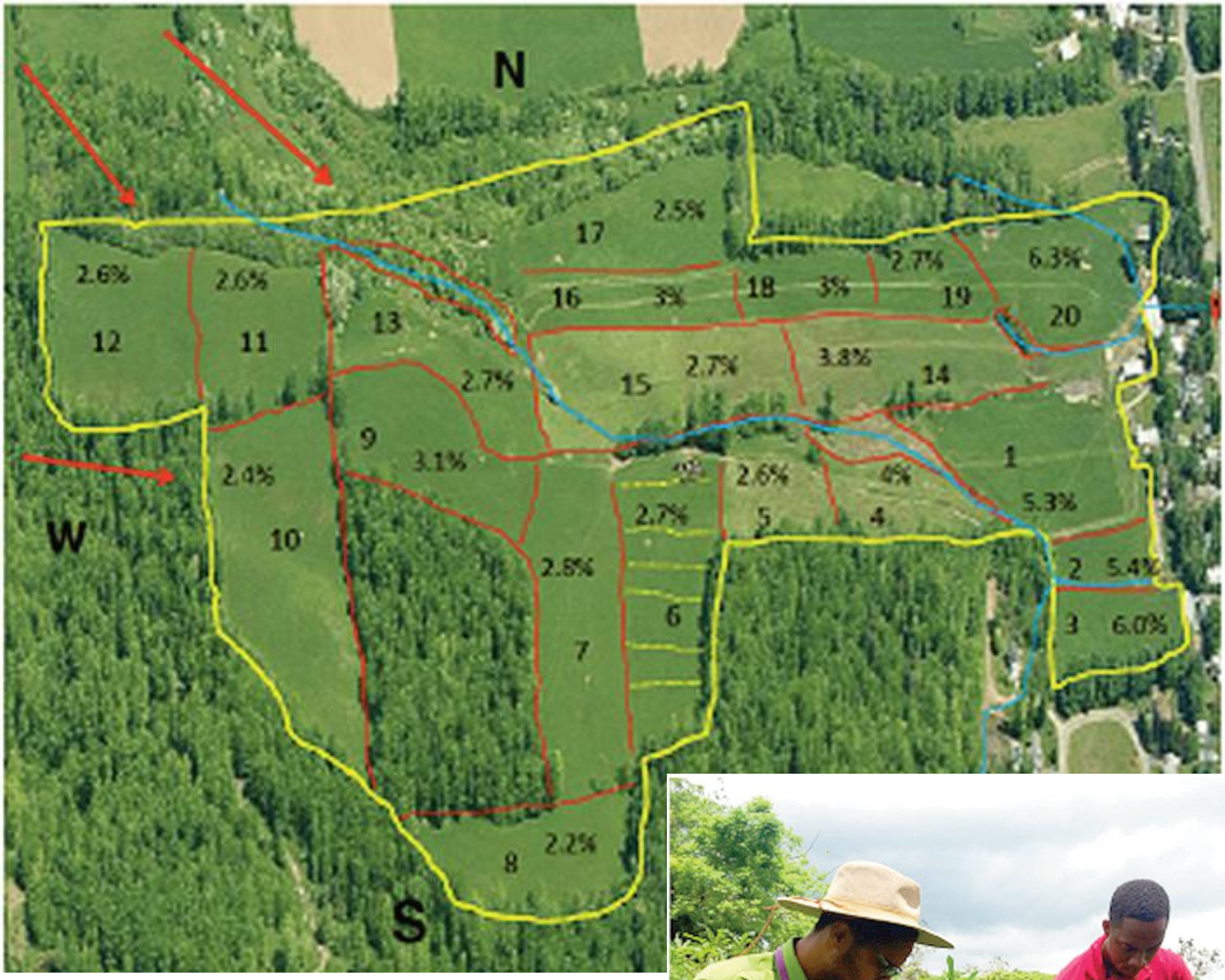
Fertilization

Date	Application method	Quantity	Type	Comments

Irrigation

	Volume (m^3)	Remarks	Date	Volume (m^3)	Remarks

PROD-LRM-OCP-11 Issue Date: 3Feb17 Rev Date: 21Apr17 Rev#:01 Approved By: C. Francis-Rhiney



10. AESA & Mapping Agro-Ecosystems Analysis & Mapping

Agro-Ecosystems Analysis & Mapping
Overview

- **AESA and Mapping are the basic practices necessary for the cassava farmer to carry out Good Land Husbandry, Integrated Crop Management and Integrated Pest Management. This includes Land Preparation, Land Husbandry (drains, borders, gully plugs), Crop Health and Nutrition, Disease and Pest. AESA should be carried out each week and then recorded.**

- **Farmers should ensure they have sketch maps of their farms to be able to manage the progress of their farms and cassava plots. Multiple copies enable the farmers to track different activities on the map over time. Farmers should consider these to ensure they grow a healthy cassava crop.**

AESA & Mapping
Agro-Ecosystems Analysis

- **Agro-Ecosystems Analysis – this involves a detailed inspection of farm plots to collect data and specimens for analysis and decision-making. The practice includes scouting of the plot for any forms of pest, topography and changes in land formation, diseases and virus, plant health, water and irrigation use or needs and plant stand.**

- **Scouting- this is the first essential step. It is the walk-through and inspection of the cassava plots. The exercise involves the inspection of leaves, stems, trunks, soil, irrigation equipment, other plants and habitats of other organisms. This allows the farmer to collect known and unknown plants and animals from the field.**

- **Analysis- this is the second step to analyze what was collected and observed in order to make a decision about how to best manage the situation or to ask for assistance from the relevant authorities.**

- **Action- all that is collected should be recorded along with the steps taken for management to reduce a reoccurrence. The actions should also take into account the economic impact and age of crop and impact of chemicals for use.**

AESA & Mapping
Agro-Ecosystems Analysis

Mapping is the detailed sketch of the farm to identify the location of buildings, water sources, boundaries/fences, pathways and roads, bridges, electrical or telephone poles, bridges, other man-made structures, planted areas identifying varieties location and the directional arrow. The map requires a legend; while the farm may not be drawn to scale it must be a true representation of it.

- Maps advise where the cassava is to be planted and where each specific variety is planted so the farmer is able to better understand what varieties produce best on their farm and how different areas on the farm influence tuber weight and starch. The farmer is able to also identify the soil type and nutrients available in different areas, for nutrition, land preparation and pest management.

11. Harvesting

Harvesting

The harvesting of cassava involves pre- and post-harvest activities.

Harvesting Considerations/Factors

Harvesting Considerations:

- Cassava harvesting is mainly done semi-mechanized.
- The slope of the land and availability of tractor play a key role in determining the mode of harvesting (semi-mechanized or fully manual).
- Knowing the crop stand, pre-harvest aids the farmer to estimate the length of time it may take to harvest given the equipment and labour availability.
- The Red Stripe harvesting schedule should be observed and discussed with an extension officer before any pre-harvest activities.
- Ensure Crop Production Booklet is up to date.

Harvesting
Pre-harvest Activities

Pre-harvest activities

Reduce irrigation approximately one (1) month prior to harvesting. Observe the Pre-Harvest Intervals of ALL pesticides used.

Scout and look for signs of root rot, rodent damage, pest and disease infestations.

All branches, stones and logs should be removed from field for easy access by labourers and tractor.

Prior to harvesting, cassava stems should be cut to a height of about 25 cm or lower to facilitate ground clearance of the tractor/ clearance for uprooting (manually).

Harvesting
Harvest

- Cut stems (planting material) must be removed from the field.
- If drip irrigation is used, remove drip lines and fittings.
- Fields should be cleared of weeds, vines that can present a challenge in uprooting.
- Uproot and de-stem tubers.

Harvesting
Post-Harvest Activities

Post-harvest activities

- Try not to damage tubers.
- Load tubers in clean crates or bags.
- Load tubers on Red Stripe truck and cover with clean tarpaulin.
- Tubers must be delivered to the factory within 12 hrs.