Maize PRODUCTION Guide

MINISTRY OF
FOOD & AGRICULTURE
REPUBLIC OF GHANA

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MAIZE PRODUCTION

This production guide was developed to complement existing Information, Education and Communication (IEC) materials available on the Agronomy of selected commodities under the “Planting forFood and Jobs” campaign.It is designed for use by Agricultural Extension Agents and other farmers who can equally use to train their colleague farmers.

TABLE OF CONTENT

1.0 INTRODUCTION

Botanical name:*Zea mays*

Maize is an annual grass in the Gramineae family, which includes such plants as wheat, rye, barley, rice, sorghum, millet and sugarcane.
Maize is the most important cereal in Ghana in terms of utilization. Its production has increased over the years due to population growth, changing consumption trends and industrial applications. It is a major source of carbohydrate for humans and animals (poultry and livestock) and is cultivated in all agro-ecological zones. Maize is an annual crop where every part of the maize plant has economic value; the grain, leaves, stalk, husk, tassel and cob can all be used to produce a large variety of food and non-food products.

Typical maize farm

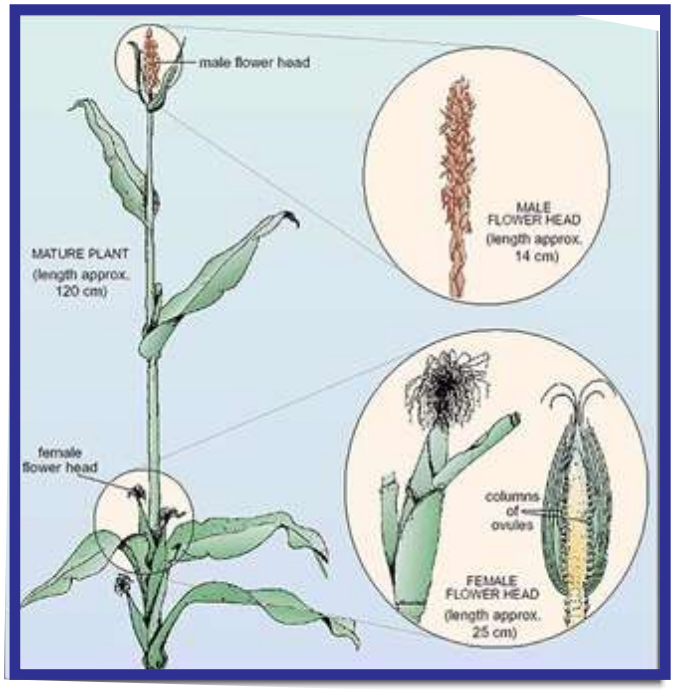
Maize is produced under diverse ecological conditions in different parts of the country. The reasons for such large adoption and expansion of maize cultivation in Ghana include:

- Adaptability to diverse environmental conditions.
- Maize is the highest yielding crop among all cereals grown in Ghana. This is because of its being very efficient converter of carbon dioxide and water to carbohydrate.

Though Maize farmers are well aware of the advantages of Maize, limited access to quality grains is one of the most important constraints to increased production and productivity. The grain production practices of Maize require knowledge and skill in order to maximize the productivity and income of farmers. It is important to follow the right field operations and post-harvest procedures.

1.1 The Maize plant and developmental stage

The crop is known to be botanically unique among cereal crops. It is monoecious plant with separate male and female parts on different parts of the same plant



Maize plant showing male and female parts

The male flowers are born terminally in a structure known as tassel and the female flowers are born laterally in auxiliary shoot called ear and produces grains on lateral ears.

1.2. Maize plant growth and development

Maize plant development stage can be divided into four major phases that are important in field operation. These are planting to emergence, vegetative, reproductive and maturity stages.

(i) Planting to Emergence

Germination and seedling growth depends on soil moisture, temperature, and soil aeration. Germination may start at temperatures as low as 8-10^{0}C but occurs fastest between 28-32 ^{0}C. With adequate moisture, optimum temperature and proper planting depth, seedlings can emerge in 7 to 8 days and produce healthy and normal seedlings.

(ii) Vegetative stage

This stage lasts from emergency to tasseling. It is during the vegetative stage that the plant establishes full potential of photosynthetic capacity to convert carbon dioxide and water into carbohydrates and develop strong and healthy plants. Shortage of moisture and nutrient during this stage will cause high yield reduction.

(iii) Reproductive stage

The reproductive stage (tasseling and silking) is the critical stage in the life of the maize plant where pollination and seed set takes place. It is during this stage that enough moisture and plant nutrient be available to the crop. Moisture stress during tasseling and silking can reduce the final size and weight of the kernels.

Tasseling marks the transition from the vegetative phase to the reproductive phase and is less sensitive to environmental stress than silking.

(i) Physiological maturity

Approximately 50 to 60 days after pollination, most grains will reach physiological maturity. This is the end of the grain filling process in which the dry weight of the grain no longer increases. Grain filling takes place in three stages. These are:

- **Blister stage:** Kernels are filled with clear fluid.
- **Milk stage:** Kernels are filled with a white, milky fluid
- **Dough stage**: Kernels are filled with a white paste. The top part of the kernels is filled with solid starch.

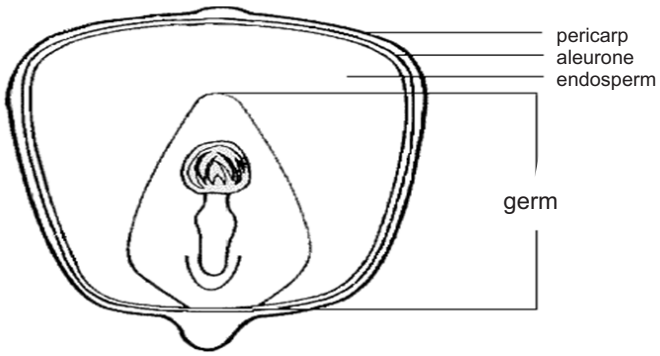
Black layer development in the kernels is an indication for the end of grain filling. Kernels in the middle region of the ear are the first to reach the black layer followed by those at the tip kernels at the base of the ear mature last. Physiologically mature kernels contain 30 to 40% moisture content.

Visible black layer

1.3. Parts of Maize Kernels and types of grain

1.3.1 Maize kernel

A mature maize kernel is made up of three main parts: The seed coat or pericarp, the starchy endosperm and the embryo which will develop into a new plant.



Maize Kernel

- **The seed coat** or pericarp is outer layer that protects both the endosperm and the embryo.
- **The endosperm** serves as the main source of energy for thegrowing seedling.
- **The embryo (germ)** grows into a new plant when placed in moist and warm soils.

1.3.2 Types of Grain

Type of maize grain is classified into five groups based on theappearance and texture of its kernel. The major ones are:

- **Dent maize** is characterized by a depression or dent in the crown ofthe seed.

- **Flint maize**, the kernels are hard, shiny and contain little soft starch. It is generally believed that Flint maize has better storage capacity because of its hard endosperm.

- **Pop kernels** are usually small in size and pop up when roasted.

1.0 SITE SELECTION/CLIMATIC REQUIREMENTS

Maize is generally adaptable to different environmental factors. Consider the following in selecting a site for maize production: cropping history (inherent fertility, natural weed population and common pest and disease incidences), topography (slope), soil type, accessibility. Select well-drained deep, loamy soils containing sufficient plant nutrients (including organic matter). Sandy, gravelly and shallow soils should be avoided, whenever possible. Low lying areas are usually poorly drained and easily get waterlogged thus reducing yield. Avoid planting maize in shady areas.

Maize planted on newly cleared land will usually yield more than maize planted on land which has been continuously cropped, especially in the forest and transition zones. This is because soil fertility is highest and weeds are less of a problem on newly cleared land. Land which has been cropped for several years needs fertilizer for good yields.

- The choice of site is dependent on the vegetation and topography.
- Maize can be grown on a wide variety of soils, but performs best on well-drained, well-aerated, deep warm loamy soils containing adequate plant nutrients (organic matter and well supplied with available nutrients).
- It can be grown successfully on soils with a pH of 5.0 -7.0. Outside this pH range results in nutrient deficiency as a result of unavailability of nutrients and mineral toxicity. The optimum temperature for plant growth and development ranges from 30°C-34°C.
- Examine inherent fertility, natural weed population and common pest problems before planting. There should not be any problem of water logging in the field.

Choosing sites with access to transport to facilitate the delivery of inputs such as seeds and fertilizers as well as to deliver the harvested grains to customers

3.0 VARIETAL SELECTION

Plant an improved variety for highest yield. Maize varieties are selected based on their distinctive characteristics. Selection of a maize variety should also be based on weather information, topography, soil type, ecology in your locality. The most suitable variety is the one best meeting consumer preference and industrial use as well as adapting to the changing climatic conditions (drought, pest and disease tolerance, earliness among others)

Based on the maturing duration, maize varieties in Ghana can be broadly categorized as

- Early maturing varieties (90-95 days)
- Medium duration varieties (105-110 days)
- Long duration varieties (> 110 days and longer)

Some of the maize varieties released in Ghana and their characteristics are presented in the table below:

Variety	Preferred Ecology	Days to Maturity	Potential Yield (Mt/ha)	Other Attributes
Obatanpa	All ecologies	110	4.6	White seed colour, dent kernel, OPV
CSIR-Abontem	Guinea & Sudan Savannah	75-80	4.7	OPV, Yellow seed colour, flint/dent kernel type
CSIR-Omankwa	Coastal Savannah	90 days	5.0	OPV, white seed colour, flint/dent kernel
CSIR-Sanzalsima	Guinea Savannah, Sudan Savannah, Forest -Savannah Transition and	110 days	5.4	OPV, White grain colour, flint-dent kernel, drought tolerant, lodging tolerant
CSIR-Wangdataa	Guinea Savannah, Sudan Savannah, Forest -Savannah Transition	90-95	4.7	White grain colour, Flint-Dent grain type, drought tolerant, lodging tolerant

Variety	Preferred Ecology	Days to Maturity	Potential Yield (Mt/ha)	Other Attributes
CSIR-Bihilifa	Guinea Savannah, Sudan Savannah, Forest-Savannah Transition	90	4.6	Striga tolerant, drought tolerant, lodging tolerant
CSIR Sika Aburo (Pan 53)	All ecologies	105-110		Hybrid, Purple with cream base seed colour, flint/dent kernel type
RMG-Obaapa (Lake 601)	Forest, Guinea Savannah and Transition		9.0	Hybrid, drought tolerant to common pest and diseases, flint type grain
CSIR-CRI Ɔpeaburo	Forest and Forest Transition	110-115	7.5	Moderately tolerant to drought, flint type

4.0 LAND PREPARATION

On land that has been fallowed for 2 years or more, practice traditional land clearing techniques common in each agro-ecology. Farmers with access to tractors or bullocks can plough and harrow their fields before planting. The following steps can be followed when preparing the land for cultivation;

- Land for maize production can be prepared manually or mechanically depending on the cropping history of the field. Clear the land by slashing or applying herbicides, and plough and harrow across the slope of the land.

NB: Plant 9kg/acre for OPV's (Open Pollinated Varieties)Maize and 10kg/acre for Hybrid Maize.

Before planting, you have to do germination test. The steps are as follows:

Germination test

Always obtain seed from certified seed outlets where seed viability and variety purity can be guaranteed. Seeds should be sorted to ensure that they arefree from diseases, pest infestation and weeds. Soybean seeds lose viability rapidly if not properly processed and stored under optimum condition. This results in poor germination. It is therefore important to conduct germination test to help you decide on the seed quality and the seeding rate. Perform germination test as follows:

- Count 100 seeds.
- Prepare seed bed, water it and make shallow trenches about 5cm deep.
- Place the seeds in shallow trenches about 5cm deep, cover with 3cm layer of soil and water well.
- Count number of seeds germinated/seedlings that emerged at the end of the week.

Germination Test

NOTE: If 90 seeds germinated, plant one or two seeds per hole depending on variety, but one or two seeds is preferable.

No. of emerged seedlings	No. of Seeds hill to plant
70-84	3
50-69	4 (or get beeer seek)
0-50	Obtain new seeds

- Rippers can also be used across the slope to increase water percolation where there is hard pan within the root zone. It is important to carry out soil test to know the soil suitability for maize cultivation.
- The soil should be ready for planting two weeks in advance in order to allow weed seeds to germinate

5.0 PLANTING

Planting is the most critical phase in the establishment of a new crop on a prepared field. Some steps to consider before planting maize includes seed selection, germination test and seed treatment. Altering planting dates can be used to escape diseases and pest incidence.

5.1 When to plant

Planting time or periods differ according to agro-ecology, season and maturity group of the variety. Sow after the rains have stabilized to avoid wilting. Planting time should be informed by local weather information.

- Plant fields using certified seeds that are free from weed seeds, insect and diseases from recommended Agro Input shops and seed companies.
- Planting can be done either mechanically or manually by hand at the onset of the rains or when the soil is moist.
- Maize can be planted on flat land or on ridges with one (1) or two (2) seeds per stand/hole depending on the variety.
- Early planting in the season has been observed to be the most important single factor in increasing yield and escaping pest attack.
- Depth of planting maize is important in protecting it against rodents, birds and drying. Usually 5-7 cm deep is considered ideal.

Table 1: Plant spacing

Between rows	Within rows
75cm	25-45cm

NB: Plant 9kg/acre for OPV's (Open Pollinated Varieties)Maize and 10kg/acre for Hybrid Maize.Before planting, you have to do germination test. The steps are as follows:

5.1 RECOMMENDED PLANTING PERIODS FOR DIFFERENT AGRO-ECOLOGICAL ZONES IN GHANA

Location	Planting period	Recommended variety for early planting	Late planting
Major season			
Forest	Early March-end of April	Mamaba, Obatanpa, Sanzal-sima, Opeaburo, Aseda, Honampa, Ewul-boyu, Kpariyura, Sarimaz 1, Tintim	Omankwa, Afriyie, Aburohemaa, Denbea, Obotantim, Abontem, Kunjo-Wari, Wang-dataa, Abeefo Aburo, Aburo Legon,WACCI -M-1218
Transition	Mid-March-end of April	Mamaba, Ewul-boyu, Obatanpa, Sanzal-sima, Kpari-Faako, Kpariyura, Sarimaz 1	Omankwa, Afriyie, Obotantim, Abontem, Kunjo-Wari, Wang-dataa, Denbea, Wang-basig, Aburo Legon, Abeefo Aburo, WACCI-M-1218
Coastal	savannah End of March-end of April	Mamaba, Obatanpa, Kpari -Faako, Kpariyura, Sarimaz 1	Mamaba, Omankwa, Abontem, Obatanpa, Abeefo Aburo, WACCI-M-1218, Aburo Legon

Location	Planting period	Recommended variety for early planting	Late planting
Major season			
Guinea/Sudan savannah	End of May-early July	Mamaba, Ewul-boyu, Obatanpa, Sanzal- sima, Tintim, Opeaburo, Kpari-Faako, Kpariyura, Sarimaz 1	Omankwa, Afriyie, Obotantim, Abontem, Kunjo-Wari, Wang-dataa, Wang-basig, Denbea
Minor season			
Forest	Mid July-early Sept.	Mamaba, Obatanpa, Sanzal-sima, Tintim, Opeaburo, Aseda, Ewul-boyu, Kpari-Faako, Aburo Legon, Abeefo Aburo,WACCI-M-1218	Omankwa, Afriyie, Obotantim, Abontem, Kunjo-Wari, Abeefo Aburo
Transition	Mid July through August-early Sept.	Mamaba, Obatanpa, Sanzal-sima, Tintim, Opeaburo, Aseda, Ewul-boyu, Kpari-Faako, Aburo Legon, Abeefo Aburo, WACCI-M-1218	Omankwa, Afriyie, Abontem, Obotantim, Kunjor-wari, Denbea, Wang-basig
Coastal Savannah	Mid July-Mid Aug.	Mamaba, Obatanpa, Sanzal-sima, Tintim, Opeaburo, Aseda, Ewul-boyu, Kpari-Faako, Aburo Legon, Abeefo Aburo,WACCI-M-1218	Not applicable

6.0 NUTRIENT MANAGEMENT - FERTILIZER APPLICATION

Nutrient management is the process of managing the amount, source, timing, and methods of nutrient application with the goal of optimizing farm productivity while minimizing nutrient losses that could create environmental problems.Conducting periodic soil tests helps in determining the nutrient (organic and inorganic) needs of maize and makes the appropriate fertilizer recommendations.

Some of the nutrient management techniques including composting manure, crop residues, controlled release and deep placement technologies for inorganic fertilizers.

The compound fertilizer commonly used is NPK 15-15-15. Apply 5bags of the 50kg compound fertilizer 10-14days after planting and top dress at tasselling/booting with 2½ bags of Sulphate of Ammonia or 1½ bags of Urea per hectare. Apply 5-7tons of organic manure per hectare.
For an acre of land, apply 2 bags of 50kg compound fertilizer and I bag of 50kg urea fertilizer.

NOTE:*Practice crop rotation to maintain soil fertility and to reduce pest population.*

Crop	Agro-Ecology	Recommended Fertilizer Formulae for Blends
Maize	Forest-Savannah Transition Zone	N-P2O5-K2O: 15-20-20+0.7 Zn (6 bags/ha + 2 bags/ha urea)
Maize	Guinea Savannah zone	N-P2O5-K2O: 15-20-20 (4 bags/ha + 2 bags/ha urea)

7.0 WEED CONTROL/MANAGEMENT

Weeds compete with the maize plant for water, nutrient, space and light. The early stage of the maize plant (3 weeks old) is very sensitive to weed competition. Weed control should therefore be regular.

There are two main methods of control;

- **Mechanical methods**: this involves the use of simple farm tools and implements such as hoes and cutlasses in controlling weeds. Weeding should be done twice or three times and it must start as early as possible because a young maize plant is very sensitive to weed competition. Twice hand weeding, the first one at 25 – 35 days after planting and the second at knee height and slashing weeds at flowering stage is recommended for proper weed control.

- **Chemical methods:** this method of weed control involves the use of recommended and appropriate selective weedicide.In chemical weed control the use of pre-emergence herbicides at a rate of 3-5L/Ha supplemented by hand weeding gives good result in Maize production.

7.1 AFLATOXIN AND AFLASAFE

Aflatoxins are poisons produced by the fungus (mould) *Aspergillus flavus* and closely related mould. *Aspergillus flavus* resides in soils and both dead and decaying organic matter. Aflatoxin contaminates maize, groundnuts, sorghum and other crops including rice and dried chillies. Aflatoxins pose health risks to humans and animals even at low concentrations. Aflatoxins-contaminated crops typically are forced into low-value markets. Aflatoxin contamination begins in the field, and increases during storage and transportation. Insect damage also increases fungal growth and aflatoxin contamination.

Due to the incidence of aflatoxin which contaminates the pods and renders it unwholesome, ensure that the crop is at the rifht stage for applying aflasafe. For maize apply Aflasafe 2-3 weeks before tassels appear also known as **'flowering'** by side-dressing along the rows on the soil surface. Aflasafe is a 100% natural product and environmentally friendly that fights Aflatoxin. Aflasafe effectively
controls aflatoxin during crop development, harvesting and storage. Aflasafe needs moisture. Apply when the soil is wet (after rain or irrigation). Ensure that all agronomic practices (weeding, applying of basal and top-dressing fertilizers etc.) have been done. This is in order to avoid burying Aflasafe in the soil. Aflasafe must stay above ground. Broadcast evenly at rate of 4kg/acre or 10kg/ha. Wash hands thoroughly with soap and water after application.

Farmer applying Aflasafe

Aflasafe

Moulds infested maize

7.2 PESTS MANAGEMENT

(a)Insect Pest

(i)**Fall armyworm** (*Spodoptera frugiperda*) (FAW):In Ghana, it has been found mainly on maize, but was also reported on groundnut, cowpea, sugarcane, onion, millet and chili pepper.

Signs and Symptoms

- White scratches on leaves
- Small shot holes "window pane" in leaves emerging from the whorl/tunnel
- Sawdust-like frass (poo) on leaves.
- Severe adult feeding results in ragged appearance of leaves, tassel/or ears.
- Deep feeding in whorl destroys developing tassel.
- Larvae may enter through the side of the ear and feed on developing kernels, reducing grain quality and yield.

White scratches on leaves Window pane/holes on leaves Feeding damage at the growing point

Ragged appearance of affected plants **Feeding damage on tassel**

Management

Prevention

- Gather and burn all stubbles after harvest
- Rotate with non-host crops (e.g. cassava, yam etc.)
- Regularly weed the farm and its surroundings
- Plant your crops at the same time – avoid having plots of different ages

Monitoring

- Start monitoring for signs and symptoms of FAW 1 week after germination for early detection and effective control
- Look for egg masses on the stem, upper / lower surfaces of the leaves
- Look for patches of small “window pane” holes to large ragged elongated holes on the leaves emerging from the whorl
- Look for light green to dark brown caterpillars with stripes down bodies on the leaves or in the whorl
- Large caterpillars have a distinct inverted Y-shape marking on the face between the eyes and four dark spots aligned in a square at the last but one body segment
- Check for saw dust-like frass (faecal matter)

Control

Apply control measures when two FAW caterpillars are seen or when two or more plants are affected

- Handpick and destroy egg masses and caterpillars.
- Apply biopesticides e.g. Bacillus thuringiensis late in the afternoon
- Apply organic products e.g. Maltodextrin, Ethyl palmitate, Neem-based products
- Rotate recommended insecticides with different modes of action forresistance management.

ii African Armyworm (*Spodoptera exempta*): The African armyworm is a migratory moth. The larvae (caterpillars) are important pests of pastures and cereal crops maily in Africa south of the Sahara, Yemen and certain countries of the Pacific region.Only small numbers of the caterpillars occur on pastures but periodically when the populations increase and mass migration of moths occur, they can cover many thousands of square kilometres and traversing international boundaries. They travel from field to field in great numbers, hence the name "armyworm”. Outbreaksare observed during the onset of wet seasons when dry grasslands produce new growth and cereal crops are planted.

Signs and Symptoms

- Gross damage to foliage, growing points and young stems
- Severe infestation results in total defoliation

Adult African army worm

Caterpillar of S. frugiperda causing damage

Management

Prevention

- Remove weeds such as Amaranthus and wild grass species that harbor armyworm larvae
- Avoid planting close to overgrazed grasslands which provide food and refuge for caterpillars
- Remove alternate host plants such as millet, sorghum, rice, leafy vegetables etc.

Monitoring

- Start monitoring immediately after germination
- Visit farm daily to inspect for defoliation (chewed leaves), feeding frass and caterpillars (which are grey green with yellow stripes along the back). Examine soft stems, and developing shoots for hidden caterpillars
- Set pheromone traps and examine weekly

Control

- Pick egg masses when you see them on the underside of the leaves and destroy them
- Pick and destroy colonies of widely dispersed caterpillars if possible
- Spray crop with Lambda-Cyhalothrin product and Cymethoate

(iii) Maize Stem borers (*Busseola fusca*): Damage is caused by the caterpillars which first feed on young leaves, but then enter into the stems. During the early stage of crop

growth, the caterpillars may kill the growing points of the plantcausing what is known as dead-heart (the youngest leaves can be easily pulled off).

Signs and Symptoms

- Early stage larvae can be found in the whorl leaves
- Later stage larvae can be found inside the stem
- Fresh feeding marks on funnel leaves
- Small holes or 'windows' in straight lines across the newest leaves
- Presence of dead hearts
- Fresh holes in tunnelled stems for late larvae stages
- Frass usually near the hole

Larva symptoms on stem

Fresh feed markings on leaves

Dead heart

Management

Prevention

- Remove infested stems and stubbles from the previous harvest and destroy by composting or shred for mulch and use in plantain farm away from maize
- Rotate maize with cassava, root crops or legumes and come back to plant maize after 2 years
- Modify sowing periods by planting early in the major and minor seasons to avoid periods of heavy infestation
- Intercrop with legumes such as cowpea, or cassava to reduce the incidence of stem borer infestation on maize

Monitoring

- Start monitoring immediately after germination
- Visit fam regularly to inspect for defoliation (chewed leaves), feeding frass and caterpillars (grey green white yellow stripes along the back). Examine soft stems and developing shoots for hidden caterpillars
- Take direct control action when eggs are present on 2 to 5% of seedlings or when 10-25% of plant s show signs of feeding damage
- Set pheromone traps (placed 20cm apart) and examine pheromone traps weekly

Control

- Apply Chlopyriphos ethyl-based products at a rate of 60-70mls per 15L water.
- Spray Lambda-cyhalothrin product at 40mls/15L water

(iv)Striga

Commonly known as witch-weed, they are characterized by bright-green stems and leaves and small brightly colored and attractive flowers.
Witch-weed parasitizes maize, millet, sorghum, sugarcane, rice, legumes, and a range of weedy grasses. It is capable of significantly reducing yields, in some cases wiping out the entire crop.
It attaches itself to the root of the maize plant and it is difficult to control when established.

Signs and Symptoms

- Look out for crop plants which are stunted, yellow, scorched and wilted even when the soil is moist. These symptoms are similar to nutritional deficiencies or drought
- Regularly (at least every two weeks) check for Striga flowers and seed development to prevent seed set, spread and buildup of seed bank in the field

Management

- Intercropping and shade and suppress striga e.g. use Desmodium, beans, cowpeas, groundnuts or green grams for maize
- Delay planting until seasonal rains have set in to reduce host plant water loss
- Keep farm tools, machinery and feet clean to prevent the spread of seed
- Limit movement of livestock in infested areas as seed can spread through their hooves and gut
- Plant striga tolerant varieties such as Obatanpa, Abontem, Omankwa.
- Continuously uproot and burn crop stubble and striga, before flowering and seed setting to reduce seed bank

(v) Larger Grain Borer (LGB) Prostephanus *truncatus*: It is a pest of stored maize and dried cassava. Both adults and larvae feed internally on maize grains and an infestation can start in the field (when the cob is still on the plant) but most damage occurs in storage.

Signs and Symptoms

- For early detection, look out for adults and powder from damaged grain
- In severe infestations maize turns into powder

LGB feeding on grain Damage on dried maize cob

Management

Prevention

- Remove and burn infected crop residue of the previous season
- Timely harvesting of matured cob to avoid infestations from the field
- Ensure that only undamaged cobs are selected immediately after harvest, shelled and grains dried properly
- Inspect grains during drying to ensure that they are properly dried and sieve grain to remove debris before storage

Control

- Use clean storage facilities, ensure cracks, crevices and holes are sealed
- Bring grain out of store after storing for about a month and dry for about three days to kill LGB if they are present
- Store grain in undamaged sacks or in an airtight chamber (hematic bags) and seal
- Apply Aluminum phosphide 56% (Phostoxin, Temaphos, Bextoxin, Agroxin Tablet). 3 tablets per tonne
- Primiphos- methyl+Permethrin (Antuka EC, Metallic Super, Super Guard). Apply powder at 50g+90kg of maize (1 maxi bag). Apply liquid at 300ml per 2L for 1000kg (10 maxi bags) of maize and mix well.
- Biological control agent *Teretrius nigrescens* has been released against the pest on maize and cassava chips in the country and is working effectively. The use of chemicals should be used with caution. In case of severe infestation, the National Plant Protection Organisation (PPRSD) should be contacted for immediate release of natural enemies

(b)DISEASES

(i) Maize streak virus: Long streak parallel to the leaf vein developing to alternate dark and light green variegated stripes.

Signs and Symptom

- Pale spots or flecks on leaves. The spots initially are white to yellowish spots which, may join together to form longer streaks. These streaks are narrow, more or less broken which runs parallel along the leaves
- Presence of hopping insects on the underside of leaves (leaf hoppers). These are the vectors that carry the Maize streak virus
- The whole plant becomes stunted with small cobs if infection happens before the 4-5 leaf stage
- Possible abnormal bunching on flowers and shoot

Management Prevention

- Plant large areas of maize fields at once to make the crop less vulnerable to maize leafhopper infestation
- Inspect the field regularly when the maize is small, looking for diseased plants
- Uproot infected plants when they first show signs of disease. This will keep the disease from spreading to healthy plants. Put the whole plant in a sack so the leafhoppers do not move to other plants
- Keep the fields free from weeds, in particular grasses to keep the vectors away and reduce disease transmission
- Remove cereal crop residues since they serve as an infestation source

Monitoring

- Monitor plants at least a week from seedling to vegetative, particularly when there is high rainfall since this is when leafhopper populations can be high

Control

- Take action as soon as one plant shows disease symptom
- When there are 3 to 10 leaf hoppers on 100 plants, it is likely that the disease will spread if existing in the area

- If MSV is present in the area, take action against the vector (leaf hopper) by spraying with an Imidalcloprid based product.

8.0 HARVESTING

Harvesting maize on time is very important to maximize yields, minimizes grain losses and quality deterioration. The use of weather information is important in timing harvesting. Timely harvesting and post-harvest operations leads to preservation of grain quality, minimization of grain losses and reduction of cost.
Maize should be harvested at physiological maturity. Harvesting should coincide with bright sunshine and dry weather. Avoid late harvesting to reduce lodging, ear rot and insect problems.

Maize is harvested when it reaches physiologically maturity between 90days to 115days depending on the variety. It can either be harvested in a fresh state or when dried.Harvesting can be done by use of Combine harvester or by hand plucking. Combine harvester is used to harvest when the moisture level ofmature cob drops below 24% to 18%.The maize is then dried to moisture level of 12% for market and storage.

NOTE: during drying process, the sign of well dried maize; is when you take a grain and bite it, if it is hard then it is dried but when not, then not well dried. During the drying process the kernels arespread across raised pallets to ensure even drying. The moisture level should be at 10% if the maize should be stored for long period in order to prevent mold and aflatoxins development that leads to post harvest loses and food safety challenges.

Matured maize ready for harvesting

9.0 Post-Harvest Management and Grain processing techniques

This includes drying, sorting, shelling, cleaning, treating and bagging and storage of grain before distribution.

(I) Drying

Maize should attain the pre-determined moisture content of (13-14 %) after being harvested and shelled. Field drying in the sun is commonly practiced. The grain should not be left in the field for long because of risk of insects and diseases damage. For commercial purposes, dryers can be used.

Drying of maize

(ii)Sorting

Cobs are sorted to discard off-types, moldy damaged or doubtful and diseased ears etc. Sorting of the cobs can be done either at the farm or at the site of shelling.

(iii)Shelling

The sorted ears are shelled when the moisture content of the seed reaches 13-14 %. Very low moisture contents may result in more grain damage during shelling. It is important to use clean and dry (preferably cemented or plastic sheet)threshing floor to avoid contamination by inert matter and absorption of moisture from the floor.

Mini silos with rodents guard

Metallic silos

Super grain bag

9.2 Management of storage diseases

Sanitation measures, selection of uninfected cobs for storage, drying to a proper moisture content, etc. can reduce mould infection in storage. Grain moisture can increase in storage due to insect infestation; hence, controlling insect pests can control molds. To prevent spoilage by storage fungi, the moisture content of starchy cereals grains should not exceed 13%.