

## **MAIZE PRODUCTION**

### **GENERAL INTRODUCTION**

Maize is one of the major staple foods in Uganda. Its production has increased over the years as people change their consumption trends. It has evolved from a purely subsistence to a successful commercial crop. Maize in Uganda is sold mainly for food in schools, relief by World Food Programme (WFP) or export to neighbouring countries such as Kenya, Rwanda and Burundi.

Maize production has improved with the adoption of improved technologies by farmers. These technologies include improved seeds like hybrid and open pollinated varieties, timely planting, proper spacing and timely weeding and harvesting. Use of fertilizers for soil fertility improvement has been encouraged as well as minimum or zero-tillage by use of herbicides. On average, 1,500,000 MT (UBOS, 2007) is estimated as the annual maize production. Of this, about 90% is used for national human consumption, locally and region and 10% for feeds.

Climatically, maize can be produced in most parts of the country except in the most arid parts of Karamoja. However, efforts are underway to develop suitable varieties for the region. Nutritionally, maize is very nutritious as a starchy food. It also has an appreciable level of protein especially Quality Protein Maize (QPM) which has higher levels of essential amino acids.

The handbook will serve as a key training tool for transforming maize production from a predominantly subsistence, low input and low productivity activity, to one that is predominantly commercialized. This is aimed at improving household incomes of rural farmers who form the majority of the population in Uganda. This is in line with the Uganda Government's policy of Plan for Modernization of Agriculture (PMA).

### **FIELD MANAGEMENT PRACTICES**

A fairly rough seedbed is preferable since it encourages water infiltration and resists erosion to a greater extent than a fine seedbed and yet would allow germination. If planting is to be done by hand, each seed can be placed at the correct depth by hand even on a rough seedbed. With machine planting, a fine seedbed is necessary to avoid interference from large clods. This will allow even, uniform and rapid germination and create a relatively weed-free environment. However, a fine seedbed has the risk of soil erosion (especially when the field is on a slope), silting, soil compaction that will lead to poor aeration. For proper germination maize requires moist soil and this should be taken care of no matter what kind of land preparation to be used.

## **SOIL TYPE AND LAND SELECTION**

Maize can be grown on a wide variety of soils, but performs best on well-drained, well-aerated, deep warm loams and silt loams containing adequate organic matter and well supplied with available nutrients. Although it grows on a wide range of soils, it does not yield well on poor sandy soils, except with heavy application of fertilizers on heavy clay soils, deep cultivation and ridging is necessary to improve drainage. Maize is suited for off-season cropping in swamps provided drainage is adequate (though planting in swamps is not always recommended for environmental reasons). It does not tolerate water logging; it can be killed if it stands in water for as long as two days.

Maize can be grown successfully on soils with a pH of 5.0 - 7.0 but a moderately acid environment of pH 6.0 - 7.0 is optimum. Outside the range results in nutrient deficiency and mineral toxicity. Liming is required for good yields on more acid soils. It has a high nitrogen requirement and high yields of maize make a heavy drain on soil nutrients. High yields are obtained from optimum plant population with appropriate soil fertility, and adequate soil moisture. Where possible, it's advisable to have soils routinely analyzed in order to know the characteristics of the soils and to get advice on how to improve soil fertility and/or correct soil pH for optimum maize production

## **TEMPERATURE**

The optimum temperature for plant growth and development ranges from 30°C - 34°C. The cool conditions at high altitude lengthen the cycle or growing period. Temperatures below 5°C and above 45°C result in poor growth and death of the maize plant. In general temperatures in Uganda are favourable for maize production as long as appropriate varieties are grown in areas for which they were bred. For example highland maize is suitable for highland areas.

## **FIELD PREPARATION METHODS**

### **Conventional methods**

In Uganda, the majority of maize farmers use conventional methods of land preparation.

- **Hand hoe:** This is mainly used by small scale farmers. The method is slow, labour intensive but reliable.
- **Conventional tractors:** These are mainly used by large and medium scale farmers. Due to high purchase cost, lack of spare parts and expensive fuel consequently even the cost of hiring them is not affordable by most farmers.
- **Walking tractor:** An appropriate and proven technology for small and medium scale farmers; it is fuel efficient and cost effective though they might not be efficient on heavy soil. It is multi-purpose and easy to use. However, most farmers are not aware of the benefits of the tractors, probably because they are still new on the market.

## **Conservation tillage**

This method is used by large and medium scale farmers. In this system, maize is grown with minimal cultivation of the soil. The stubble is not completely incorporated and thus contributes to run off control. It allows timely planting at a reduced. Weeds are controlled with cover crops or herbicides rather than by cultivation. Fertilizers and lime are either incorporated earlier in the production cycle or placed on top of the soil at planting, thus resulting in higher fertilizer requirement.

- **Animal traction**

This involves the use of oxen to plough the land. With this method the farmer is able to open more land and plant more maize as compared to hand hoe. It is however not appropriate where soils are heavy and terrain is steep. It also requires the acquisition and management of the oxen (Figure 1).



**Figure 1:** Using oxen to plough land

## **PLANTING**

There are three major considerations to be taken into account:

1. When to plant
2. Depth of planting
3. Plant population

### **1. When to plant**

Usually the first season rains normally start mid-February or March and end in June, while the second rains start around mid-August to December. Planting is generally recommended to be done at the onset of rain but since maize is a robust crop, dry planting can be done when rain is expected. Dry planting is advantageous because it spread out the planting duration hence enabling the farmers to open more land. Delayed planting in relation to the onset of rains will lead to reduced yield. The suitability of the varieties has been taken into account by the breeders when they categorized them as early maturity early medium and late maturity and this information should be taken into consideration by the farmer when choosing the variety. However time to plant is not such a critical factor when one is to irrigate.

### **2. Depth of planting**

Planting depth depends on the moisture level of the soil where depth for 2-3 cm is adequate for moist soil and 5-10 cm is recommended for dry planting. Deep seed placement under dry planting is recommended so that seed germinate only after adequate rains have fallen. However the depth of planting should be uniform to allow uniform plant growth.

### 3. Plant population

The recommended spacing for maize is 75 cm ( $2\frac{1}{2}$  ft) between rows and 30 cm (1 ft) between hills when planting one seed per hill. When hand planting, it is easier to plant at a spacing of 75 cm ( $2\frac{1}{2}$  ft) between rows and 60 cm (2 ft) between hills in a row allowing 2 seeds per hill. With this spacing the amount of seed required will be 25 kg per hectare or about 10 kg per acre. Plant populations that are higher than the optimum will lead to competition among the maize plant resulting into slender plants that will give low yield. Lower plant population will result into low yields (though with bigger cobs) due to reduced number of ears per unit area, it might be appropriate under intercropping but it will lead to increased weed intensity when maize is under monocropping system. It should be planted in rows. Without planting in rows, a farmer will never achieve an optimum plant population. In addition, rows ease field operations like weeding and will facilitate harvesting.



Figure 2: Well planted maize field

### METHODS OF PLANTING

Planting can be done either mechanically or by hand.

#### a) Hand planting

Hand planting is the most commonly used method in Uganda. If properly used, the method can produce excellent results because it gives a proper and uniform plant stand. The following is the general procedures:

- Mark out the field first using a string at an inter row distance of 75 cm ( $1\frac{1}{2}$  ft) apart. Mark another string at 30cm for spacing between hills.



**Figure 3:** Marking of the field using strings

- Divide the field team into three for the following activities:
  - Holing out
  - Placement of fertilizer and its covering
  - Planting and final covering.
- Make holes with 2 or 3 strokes of the hoe to a depth of at least 10 cm to allow for fertilizer, soil, seed and the final covering.
- Place the fertilizer at the bottom of the hole and make sure it does not get spread over the soil surface where it will be wasted.

If you are using corrosive fertilizer like Diammonium Phosphate (DAP) and Urea, place the fertilizer and cover lightly with soil to prevent damage to the seed. Most other fertilizers can be placed in the hole with the seed.

Place the seed and make the final covering. Make sure that the seed is well holed in to ensure good contact with moisture. All seeds must be well covered. With experience, farmers can estimate the distance without the string.

### **b) Mechanical planting**

This type of planting has the advantage of being quick, and if well supervised will give excellent results. However, if it is poorly supervised, it will give poor to disastrous results. It allows you to plant a large acreage within your pre-determined planting period. Adapt a spacing compatible with other mechanical operations like fertilizer application and weeding. Check the machine well before the anticipated planting date to make proper adjustment.

Always read the operator's manual and seek advice from the suppliers for effective usage. Every season, make sure that the planter is calibrated to avoid making costly mistakes. Below are some guidelines for calibration:

- Each planter must be tested separately.
- Select plates that will allow the largest seed of your seed sample to go through. Make sure the plate does not allow two seeds at a time.
- After determining on an optimum plant population, choose a cog set that drops 15% more than the desired seed rate.
- Make sure that the driving wheel drops seeds in the furrow opener.
- Count the number of seeds dropped by the planter over a measured length in the field at a set driving speed. The number can be multiplied to get total number dropped / ha. The correct operating speed is normally indicated in the operator's manual e.g. 5 km/h.

## **WEED CONTROL**

A weed is a plant that grows where it is not required.

### **Effects of weeds on maize**

Weeds compete with the maize plant for water, nutrients, space and light. The early stage of a maize plant (first three weeks) is very sensitive to weed competition. If maize growth is checked by weeds in its early stages of growth it never recovers fully, however well weeds are controlled subsequently. Weed infestation should be minimized for the first 10 weeks to maximize final yield. Beyond this period, well planted, and healthy growing maize would choke weeds sufficiently. Some weeds become alternative hosts of pests and diseases. They reduce profits by lowering the quality, quantity, yields and value of maize. Inefficient weed control is one of the main causes of low maize yields in Uganda. Some weeds are parasitic and poisonous to maize. A thick growth of weeds in maize makes harvesting difficult.

### **Types of weeds**

Weeds can be categorized as annual and perennial weeds.

- **Annual weeds**

These complete their life cycle within one season e.g. black jack. The seeds they produce will germinate even faster than the maize crop and are able to survive by producing a lot of seeds that will germinate next season. After planting the maize, usually annual weeds will germinate from their seed faster than the rate at which maize will be germinating. They will definitely interfere in the growth of the crop during the critical period of the first three weeks. One of the most notorious weeds in maize production is striga (figure 4). Striga spp. are parasitic weeds that attack mainly cereals like maize and other crops like sorghum, millet and upland rice. In Uganda, there are two species of economic importance; *Striga hermonthica* and *Striga asiatica*. Yield losses attributed to *Striga* in maize can go up to 100% at farm level. Striga spp. Produce numerous tiny seeds (50,000 - 500,000 seeds per

plant). The seeds are normally dispersed by wind, water, livestock, man, farm machinery and contaminated crop seeds. Once shed, the seeds can stay viable in the soil for up to 20 years. The seeds normally germinate only in response to chemical stimulants exuded by the host roots. Once germinated, the weed establishes parasitic attachments with the root of the host and starts deriving all nutrients from the host.

- **Perennial weeds**

These are weeds that are always in a maize garden all time every year. They multiply through roots and stems e.g. couch grass. Mechanical weeding only cuts off the tops but the bottom continue consuming the nutrients and water meant for the maize plants. These should be controlled early before the beginning of the season as later attempt to control them will damage the crop.



Figure 4: Striga

## METHODS OF WEED CONTROL

### Cultural methods

- **Crop rotation:** Rotate maize with leguminous crops (such as cowpea, groundnuts, pigeon pea, soya beans, kidney beans, lablab, mucuna and bambara nuts) and with other trap crops like sunflower. The striga is not adapted to the root system of the leguminous plants and will therefore die. However, this cannot completely eradicate striga because seeds can stay viable in the soil for a long time. A good crop rotation for maize should also include crops that are capable of suppressing the growth of weeds like sweet potatoes.
- **Proper spacing:** If crops are planted at recommended spacing, the plants cover the ground quickly reducing the need for weeding. In areas of reliable rainfall, weed-free conditions in properly spaced maize need to be maintained only until the crop is about 45 cm high; after which the crop itself suppresses weeds and further weed control measures are of no benefit. In areas of less reliable rainfall, weed-free conditions should be maintained until flowering to minimize the risk of moisture stress at this critical stage.

- **Timely planting:** Maize planted at the right time has vigorous growth and could be well established before the growth of weeds. The seeds should be planted at the earliest opportunity so that they can establish before weeds develop.
- **Hoeing and hand pulling:** Hoeing is the weed control method commonly used by small scale farmers. This is commonly followed by hand weeding to remove the weeds that will establish after hoeing.
- **Improving soil fertility:** Application of fertilizers or adopting any other soil fertility improvement practice will enable the maize plants to have quick and vigorous growth, which will cover the ground and suppress weeds at an early stage.
- **Good seed:** Planting must be done with improved seeds of good quality and free from weed seeds. It is always advisable to use treated seed bought from a recognized stockist.

### **Mechanical methods**

This involves the use of farm tools and implements such as hoes, cultivators, pangas, and a clean seedbed preparation help in controlling weeds. In addition to clean seedbed preparation, it is usually necessary to take other measures of weed control such as inter-row cultivation. 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.

It should start when the crop is about 7.5 cm high but once the crop is about 45 cm tall, weeding should not be necessary except in a few cases where there are favourable conditions for weed growth. At 45 cm, the leaves of vigorous maize plants will start covering the ground to suppress weeds. In addition, weeding after this stage will destroy the root system. For successful inter-row cultivation, farmers should note the following:

- Start inter-row cultivation when the weeds are still in their seedling stage.
- Do the cultivation when there is moisture in the field.
- Where possible, cultivate when the sun is hot so that weeds die in no time after cultivation.

Weed control using mechanical methods has several disadvantages such as cost and distance. In addition, hand weeding is so slow that weeds may catch up with maize crop.

### **Chemical methods**

This method of weed control makes use of herbicides. A herbicide is any chemical that has phytotoxic properties, which make it suitable for use as an agricultural chemical for the control of plant growth. There are resistant weed types for each herbicide. Therefore farmers should not expect 100% kill of all the

weeds. The most commonly used herbicide for maize is Lasso plus Atrazine applied at the rate of 5 liters per ha (2 liter per acre) at the time of planting, this will control grasses and broad leafed weeds. - 2,4- D at 1 liter/Ha can also be used for control of broad leaf weeds before maize is 45 days old, perennial weeds are controlled by application of 3 liters of glyphosate per hectare.

### **Advantages of using herbicides**

- Saves time in controlling weeds.
- Reduces the chance of damaging roots.
- Helps in controlling perennial weeds that are difficult to control by cultural and mechanical methods.
- Decreases the amount of tillage and allows a farmer to benefit from the advantages of reducing tillage operations.

### **Disadvantages of using herbicides**

- All herbicides are poisonous. If they are not handled and used carefully, they are harmful to man, non-target plants and pollute the environment.
- Some herbicides have long term residual effects. They may damage crops grown on the same field the following season.
- The use of herbicides needs technical skills acquired through training and guidance. The advantages of using herbicides out-weigh disadvantages. Thus, farmers are encouraged to use herbicides where applicable and safeguard against disadvantages of using them
- Stick to recommended herbicides for maize and recommendations for their safe use.
- Farmers must have a good understanding of the type, functioning and purpose of the different herbicides on the market. This information can be obtained from the manufacturer as per label and stockists of herbicides, National Cereals Program of NARO, Department of Crop Science at Makerere University, and agricultural extension officers. Farmers should make efforts to visit these stakeholders and talk to them; attend field days, workshops and seminars they organize for farmers and visit demonstrations that they stockists should educate farmers on proper use of herbicides as the farmers buy the herbicides from the stockist/ agri-input shops. It is highly advised to read the label on each package of herbicide and follow instructions as indicated.



**Figure 5:** A stockist shop that handles herbicides

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