



CROP MANAGEMENT

Rain fed crops

Trainer's guideline

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Objective of the training:

To provide to the farmers technical knowledge on how to plant and take care of the crops in the field.

Method of training:

A participative approach will be used for two main reasons:

- to involve more the farmers in the training: when they participate, they are more attentive and more interested
- to complete their knowledge instead of repeating what they already know, which contributes also to give more interest to the training.

How? The main idea is to always **start from the knowledge of the farmers** and then to **complete and to spend more time on the information they don't know**.

The farmers will be trained on the management of the following crops: maize, groundnuts, soya beans, pigeon peas, sunflower, rice, sorghum and cow peas.

Introduction: general information about land husbandry

About inter-cropping:

Even if inter-cropping doesn't allow to produce high yields like the pure stand allows, inter-cropping practices have some important advantages:

- the farmers don't rely on one crop only (even if they have a very small land), which reduces the risks (if one crop doesn't do well, the other crop may do better...);
- the combination of some crops can be profitable; for example, the combination of a leguminous and maize benefit to the maize because the leguminous increase the amount of nitrogen in the soil and therefore increase the soil fertility.

About crop rotation:

Crop rotation is also an important practice that should be done if the land allows it. The advantages of crop rotation are the following:

- crop rotation is a good mean of avoiding the development of pests and diseases;
- the combination of some crops can also be profitable; for example if leguminous (like groundnuts) are cultivated on a land, it will increase the amount of nitrogen in the soil, which will benefit to the following crop;
- The rotation should be well managed: if it is very interesting to cultivate maize after leguminous, the farmers should pay attention on some rotations to avoid: the crops sensitive to nematodes like sunflower or soya beans should not follow crops that are hosts for nematodes like tobacco.

About soil and water conservation:

Trying to improve soil fertility without checking loss of the top soil on which you apply the fertilizer is like trying to fill a leaking water bucket without sealing its holes. Soil erosion control is very important in maintenance of soil fertility.

Some of the ways of conserving soil and water are:

- **Contour ridging:** it consists in constructing markers ridges that follow the line level, in order to avoid the run-off of soil and water; in areas where water logging is experiences, this should not be applied; on the contrary, the ridges should be constructed off from the main contour in order to facilitate the run-off of the water.
- **Gully reclamation:** it consists in the construction of check dams or in piling stones in order to control the speed of water and to conserve the soil.
- **Planting contour tree lines or vetiver hedges.**

About compost and manure:

Most of the soils are deficient of valuable nutrients which are necessary for crops to grow well and to give optimum production. The farmers used to apply inorganic fertilizers, but now the prices have increased too much and most of the farmers can not afford it.

Compost and manure making is a way of improving soil fertility at no cost. It requires for the farmers to collect crop residues and other organic materials which can decompose easily.

There are several methods of making compost or manure: the “pit” method, the “Chinese” method, the Bangalore/Chimato and the Bokashi.

Integrated pest and disease management approach

The control of pests and diseases has to be done all along the planting season. The following practices can be done to reduce the risks of having pests and diseases:

1. **Observing the crops as often as possible**, in order to react quickly when a pest outbreak occurs (for a better control, pests should be reported to the nearest agricultural office immediately they are noticed).
2. **Observing good crop husbandry practices** such as early land preparation, early planting, burying all diseased plants and others.
3. Ensuring that **crop residues are fully decomposed** before planting.
4. **Rotating maize with non cereal crops** which are immune to maize pests (in order to stop the reproduction cycle of the pest).
5. **Inter-cropping** (combination of crops can help in controlling pests and diseases)
6. **Burning severe attack plants.**
7. **Planting resistant varieties.**
8. **Keeping the soil rich in nutrients and providing a balanced compost or manure** (too much nutrients – as it is brought by fertilizers – attract pests ; not enough nutrients make the crops more vulnerable to pests and diseases)
9. **Preserving some non-cultivated areas**, which shelter natural enemies of pests, such as birds, reptiles, insects...

Maize

1. Land preparation

When to start?

Adequate preparation should start as soon as previous crop is harvested. This facilitates complete organic decomposition and hence good aeration and high organic content in the soil for proper growth of the next crop.

What to do?

- **Clearing:** the clearing should not be done by burning the residues because it destroys the valuable microorganisms in the soils; the residues should be put in the furrows just after harvesting and covered by a little amount of soil.
- **Ridging:** the recommended ridge spacing for maize is 90cm for the local method of planting or 75cm for the Sasakawa method of planting; for both methods, the height has to be 30cm.

2. Planting

When to start?

Maize should be planted with the first good soaking rains.

Which method to use?

Two main methods can be used: the local method and the Sasakawa method.

The local method will be used by the farmers who want to intercrop. The advantages of intercropping are:

- the reduce climatic risks: if one crop doesn't do well, farmers can rely on other crops
- the combination of two crops can benefit to the maize: some crops like leguminous (soya, groundnuts, pigeon peas) have the capacity of fixing nitrogen in the soil, and therefore allow the maize to grow well

The sasakawa method will be used to get more yields. As it is a laborious method, the farmers can decide to allocate a piece of land for this method and the rest for intercropping.

	Local method	Sasakawa method
Planting station	90 cm	25 cm
Number of seeds per hole	3	1

Maize seeds should be planted to a reasonable depth: too deep planting will result into late germination while shallow will result in exposing the seeds to the sun radiation, predation by birds, rodents and insects attack. The farmers should pay attention at the first germination stage to replace the seeds where it has not germinated.

3. Fertilizers application

Farmers should be encouraged to use manure because of high cost of inorganic fertilizers.

Pratiques Network

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Manure application

When to apply manure?

Manure should be applied before planting.

How to apply manure?

- if the farmers have enough manure, they can put it in the furrows and then incorporate it in the ridges; the recommended quantity should be one 20L tin of manure applied every 8 meters.
- if the farmers have not enough manure, they can put it directly in the planting station; the recommended quantity is a double handful per planting station.

Inorganic fertilizers

- 23-21-0-4S is recommended for basal dressing and should be applied at planting time or soon after germination.
- Urea is recommended for Top Dressing. It provides Nitrogen, which facilitate vegetative growth and fruiting. It should be applied 3 weeks after germination.
- The fertilizers should be applied at 7cm away from the planting station and covered with soil.

4. Weeding

When to weed?

Maize is particularly susceptible to weed competition in the first 8 weeks of growth. Therefore weeds should be removed as soon as they appear in the field.

How to weed?

The weeding has to be done twice, to be sure that the weeds don't affect the plant during the first growing steps. It also helps to improve the circulation of the air in the soil. It is also important to note that effective weeding is achieved under dry conditions.

5. Banking

Rebuilding of the crop ridges to its original size is important to prevent run-off. The banking should be done when the soils are wet.

In termite prone area, banking close to the planting station should be avoided.

6. Removing suckers

In order to reduce competition within the plants, the farmers should remove the suckers as soon as they appear.

7. Pest and disease control

The main pests are the army worm, the stalk borer and the ear worm. The army worm has to be reported to the agriculture personnel and other stakeholders once detected; to control it, some chemicals such as Carbaryl can be used but control by natural enemies

like insects and birds which feed on the larvae is also largely encouraged, as well as the use of *Tephrosia vogelli*. For the other pests, they can be controlled through the integrated pest and disease management approach.

The main diseases are the maize streak virus and gray leaf spot. These diseases can be controlled by using resistant varieties and through an integrated pest and disease approach (see introduction).

8. Harvesting

When to harvest?

Harvesting should be done as soon as the maize is dry, when the cob has dropped down. If harvesting is delayed, there can be losses due to insects and birds attacks.

Just after harvesting, maize should be stored in a dry place. Actellic can be added for a good conservation.

In the field, the stover should not be burned but should be incorporated in the soil, to reconstitute a part of fertility to the soil and to allow a good decomposition.

9. About the OPV variety

The characteristics of the OPV varieties (as the one distributed by Inter Aide) are:

- it is an improved variety, which can give up to 100 bags of 50Kg per hectare with good management;
- it is a short maturing variety (90 – 120 days), which can give production before the local maize;
- it can be recycled 3 years with the same level of production, on the contrary to the hybrid:
 - for the hybrid: once harvested, you can not sow it a second year: you have to buy the seeds for the next season;
 - for the OPV: once harvested, you can store the seeds and sow it again the two next seasons without buying new seeds.

Groundnuts

Groundnut is a good source of protein, vitamins and vegetable oils. It is also capable of fixing nitrogen and it therefore improves soil fertility.

Groundnuts do best in most soils in Malawi provided they do not set hard at harvesting time. Groundnuts require deep soils and well-drained sandy soils (if they contain a moderate amount of organic matter).

Crop rotation is very important for groundnuts because it controls pests and diseases and at the same time it improves soil fertility for the following crop.

1.Land preparation

It should be done early enough before the onset of rains.

The recommended ridge spacing in pure stand is 90cm.

2.Planting

When to sow groundnuts?

Planting should be done with effective planting rains of 25 to 30mm.

It is important not to delay the sowing because the plant can be more sensitive to diseases and it can increase the risk of poor pod set and filling due to lack of water during critical periods (flowering). This results in poor quality seed and low yields.

How to sow groundnuts?

The groundnuts can be planted either on pure stand or on inter-cropping. On inter-cropping, groundnuts allow to improve soil fertility, which can benefit to the maize, but it gives more yields on pure stand.

On pure stand, the space between 2 planting stations should be 15cm apart, with 1 seed per planting station.

On inter-cropping, the space should be 15-20cm apart from the other crop and 15cm between 2 planting stations of groundnuts.

Note: Groundnuts can be inter-cropped with maize, but also with Soya and Beans. In this last case, groundnuts should be planted on top of the ridge while Soya and Beans are planted on the sides of the ridge.

3.Weeding

The most critical period of weed competition is from 3-6 weeks after sowing. Weeding can be done for 3 times (light weeding then banking then hand weeding which is the removal of tall weeds by pulling).

4. Pest and disease control

There are many diseases that attack groundnut crop in Malawi (such as early leaf sport, rust and rot or Groundnut Rosette). Some of them can be controlled by following the good cultural practices (rotation, early sowing, removal of crop residues, sowing at a recommended spacing, use of resistant varieties...).

The major insect pests of groundnuts are termites, white grubs, sap sucking bugs, *Hilda patuelis* and *phiob*. These can be controlled by the use of resistant varieties, by clearing grass from around the field and by avoiding growing groundnuts in fields that have a history of termites.

Aphids can also be observed. On aphids, garlic can be efficient.

Use of garlic to control aphids

Take some garlic (0.5 to 1 Kg) and pound it in a mortar (making sure that the garlic is completely crushed). Soak the pounded garlic in cold water for 24 hours. Filter the juice through a cloth and use directly in a sprayer.

5. Harvesting

Harvesting has to be at the correct time. It can be checked by lifting a few pods and examining the inside of the shell. The nuts are mature when the inside of the shell is spotted pale brown. The fall of the leaves is not necessarily a sign of maturity. Timely harvesting of groundnuts is essential to avoid discoloration of nuts, germination and pods remaining in the ground at harvesting.

Soya beans

Soya is a useful crop as it provides protein for both humans and livestock. It is also a good nitrogen fixer and it therefore improves soil fertility. Soya can be grown under a wide range of climatic conditions but it grows well in heavy soils with sufficient drainage. The average yields range from 400 to 800kgs/ha.

1. Land preparation

Field preparation should be completed before the first planting rains. Ridges should be made at a distance of 75 to 90cm apart.

2. Planting

Planting should be done with the first rains and not later than mid-December.

Soya can be grown either on pure stand or on inter-cropping. On inter-cropping, soya allows to improve soil fertility, which can benefit to the maize, but it gives more yields on pure stand.

On pure stand, there are two ways of planting:

- 2 rows spaced at 30 cm on the ridge / 1 seed per station 5cm apart
- 1 row on the ridge / 1 seed per station 2.5cm apart

On inter-cropping, Soya can be planted on 1 row / 1 seed per station / 3 to 4 planting stations between 2 plants of maize.

3. Weeding

The crop should be kept weed free especially in the initial stage of crop development. Weeding and crop rotation will assist in controlling of pests since chemical spraying is not economical in forming business.

4. Pest and disease control

The important insect pests are semiloopers, flower and pod borers and pod sucking buds. These insect pests can be controlled by using *Tephrosia vogelli* or Carbaryl 85 WP.

Use of Tephrosia vogelli as an insecticide

Harvest leaves from *Tephrosia* plants and pound it in a mortar (the crushing of the leaves doesn't need to be done perfectly). Soak the leaves in water for two hours or boil them for 30 minutes (the effective concentration is 1 Kg of leaves for 5 L of water). Filter the juice through a cloth and use directly in the sprayer. Add a bit of soap to help the spray stick to the plant. It is important that the sprays have direct contact with the pests. The treatment is effective during 7 days and must be repeated after that time.

5. Harvesting

Pods turned brown or gray in color (depending on variety) is a sign of maturity. Harvesting should be done when leaves of the crop have fallen off and pods rattle when shaken.

Pigeon peas

Pigeon pea is a valuable source of vegetable protein. It also presents the advantage of improving soil fertility through leaf litter and nitrogen fixation.

It can be grown in almost all types of free draining soils either in pure stand or mixed with other crops like maize. The average yields range from 400 to 800Kgs/ha.

1.Land preparation

Field preparation should be completed before the first planting rains.

Ridges should be made at a distance of 75 to 90cm apart.

2.Planting

Planting should be done with the first rains or soon after the main crop has emerged where inter-cropping is practiced.

On inter-cropping, pigeon peas can be planted on 1 row / 3 seeds per planting station spaced at 75 to 90cm apart in between the main component crop.

On pure stand, there are three ways of planting:

For the early maturing species:

- 2 rows spaced at 30 cm on the ridge / 1 seed per station 10cm apart
- 1 row on the ridge / 2 seeds per station 20cm apart

For the medium and late maturing species:

- 1 row on the ridge / 2 seeds per station 60cm apart

3.Weeding

The crop should be kept weed free especially in the initial stage of crop development.

4.Pest and disease control

The main pests are lepidopteran larvae (like grasshoppers), termites and leaf eaters, pod borers. The recommended control is physical destruction. For termites, dying plants should be removed.

The only major disease is the Fusarium wilt. Cultural practices such as intercropping with sorghum, rotation with tobacco or sorghum and 1-2 years fallow as well as resistant varieties can help to control the disease.

5.Harvesting

Harvesting is a continuous process. Some pods can be mature enough whereas others just start growing. The pods can be removed only when they are dry.

Sunflower

Sunflower is one of the top quality edible oils and the cake is used in the production of stock feed. Generally sunflower is not very selective to soil types provided the soils are well drained. The crop produces high yields when grown on deep and well drained sandy loam soils. Average yields are 400 to 500Kgs per hectare but the potential can increase up to 3,000 Kg per hectare with improved seeds.

1.Land preparation

Ridges should be made at a distance of 75 to 90cm apart.

2.Planting

When to sow?

Planting should be done 4 to 6 weeks after the onset of effective planting rains. In normal seasons, this would be from mid to end December. This is because the flowering and early grain filling stages coincide with the period when good rains normally occur. This also let the crop escape diseases, since maturity stage occurs under conditions of low relative humidity after the rainy season.

How to sow?

Planting stations should be 50cm apart, with 2 seeds per station for improved variety. For unimproved variety, 4 seeds can be sown per planting station and then thin to 2 seedlings 2 weeks after emergence.

3.Weeding

Weeding is crucial during the first 5 weeks. However, it is important to keep the field weed free throughout the growing season.

Sunflower is an important catch crop for witchweed (*Striga asiatica*). It should be used in rotation with maize to reduce witchweed infestation.

4.Pest and disease control

The main pests are crickets, cutting beetles such as dusty surface beetles, harpalus beetles, black maize beetles, cut worms and wire worms. They may attack sunflower mainly during the early stages of plant growth. These insect pests can be controlled by using *Tephrosia vogelli* or Carbaryl 85 WP.

Some important diseases are alternaria leaf spots, septoria leaf blotch, rust, head rot. It can be controlled by following the recommended cultural practices.

5.Harvesting

The sunflower crop is mature when the back of the head has turned from green to yellow and the bracts have turned brown. Harvesting should start as soon as the seeds are mature. The heads should be cut and dried.

Rice

Rice is one of the main cereals along the lake Chilwa, either in irrigated schemes or in rainfed lowland areas.

1. Nursery preparation and sowing

Preparation of a good seed bed for seed sowing and transplanting is important for good establishment, crop growth and weed control. It should be prepared early to enable timely sowing and transplanting. Sowing should be done between mid-December and mid-January.

2. Land preparation

Fields should be ploughed to facilitate root development and plant growth. This should be done soon after harvesting while the soil is still moist. It should be followed by breaking of clods, leveling and terracing, bunding and paddling.

3. Planting

Rice can either be directly sown or transplanted, depending on the varieties. Usually, direct sowing is recommended if it is mechanized through drilling. For smallholder farmers, transplanting is a better alternative as it ensures that vigorous seedlings are being transplanted.

Direct sowing in the field:

It can be done either by dibbling or broadcasting:

- by dibbling: the seeds should be sown with the first planting rains, 6 seeds per station at a spacing of 23cm x 23cm
- by broadcasting: the seeds are spread over the land

	Broadcasting	Dibbling
Advantages	Requires less labour Late planting is avoided	Weeding is easier. Removal of infected plants is easier. Yields are higher. Tillering is increased.
Disadvantages	Birds can pick up the seeds if not properly covered. Seeds emerge at different times. Weed control is more difficult. Tillering is reduces. Removal of infected plants is difficult.	Requires more labour when planting.

Transplanting:

Rice should be transplanted between mid-December to mid-January. Seedlings are ready to be transplanted when they are 16 to 21 days old for summer crop. Transplant should be at a spacing of 23cm x 23cm.

4. Water control

Water control and management is vital for optimum crop growth and productivity. This ensures that the required amount of water is available throughout the crop growth period. Water management practices such as leveling, bunding, making canals, siting inlets and outlets properly are vital to ensuring efficient water supply and distribution. These, however, vary between irrigated and rainfed rice.

Water availability to rainfed rice is improved by dividing the field into several small plots and making bunds around them. Bunds assist in controlling the movement and distribution of rain water.

5. Fertilizers application

Fertilizers can be applied using the broadcasting method:

- **Basal dressing:** Apply 1 kg of 23:21:0+ 4S for a 10 m x 10 m plot. This should be done 20 days after seedling emergence.
- **Top dressing:** Apply half kilogram of UREA. The fertilizer should be applied 40 days after basal dressing.

6. Weeding

Ploughing immediately after harvest helps to reduce weed population. Paddling helps further in the initial weed control operations. After broadcasting or dibbling, hand weeding is the only recommended method of weed control in rainfed rice. Weed control during the first 3 weeks is crucial

7. Pest and disease control

Birds are the most important pests of rice and substantially reduce yields. These can be controlled by scaring.

The main pests are the green grasshoppers (locally known as “Bwannoni”), the shoot fly and the army worm. They can be controlled by using *Tephrosia vogelli* or Carbaryl 85 WP. For the grasshoppers, physical picking is recommended since many people use it as relish.

8. Harvesting

Paddy is ready for harvesting when the grains on the panicles are golden brown (straw coloured) and when three quarters of the panicles in the field are at this stage. To obtain the best whole grain rice, it is recommended to harvest at 8 to 12 days after maturity date. Water should be drained 7 to 10 days before the expected date of harvesting to ensure uniformity of maturity and to enable the farmers to harvest in drier fields.

Sorghum

Sorghum is an important staple food in the Shire Valley and a food security crop in other rainfall areas. The objective is therefore to steadily increase yields in order to meet food requirements and eventually surplus for sale.

1.Land preparation

Like with any other crop, land preparation should start as soon as the previous crop is harvested. This allows in the exposing of pests which are of economical importance to sorghum production.

Where a farmer intends to grow sorghum on a land on which the same crop was planted in the previous season, a complete clearing and burning of stalks is ideal. In other ways, should the farmer decide to grow it on a different place from the previous one, then weeds and other crop residues should be put in furrows and covered by a little amount of soil. Ridges should be made at a distance of 90cm apart.

2.Planting

Sorghum should be planted at 45cm between plants and 2 plants per station. Four seeds should be planted and thinned to 2 seedlings. Fertilizer application is not recommended for local varieties. The seed rate is 4Kg per hectare.

3.Weeding

Timely weeding during the first 6 to 8 weeks of growth. Therefore, weeds should be removed as soon as they appear in the field.

4.Banking

Rebuilding of ridges to its original size is important to prevent run-off. The operation should be done while the soils are wet. In termite prone area, banking close to the planting station should be avoided.

5.Pest and disease control

The most important pests of sorghum are birds, shoot fly and stem borer. Birds can be controlled by scaring them. For the other pests, the control can be done by early planting.

The main diseases are leaf blight, Donny Mildew, sooty stripe, which can be controlled by timely sowing. Grain moulds can also be observed and can be controlled by harvesting as soon as physiological maturity occurs.

6.Harvesting

Harvesting should be done when the crop has reached physiological maturity. This prevents heavy attacks by weevils and birds. Dry the grain well and store it in dry structures. Treat the structures and the grain with *Tephrosia vogelli* or Actellic.

Cow peas

This crop is grown all over the country particularly in warm areas with low rainfall like the Shire Valley, Bwanje Valley and Phalombe plain. It tolerates heat and relatively dry weather conditions.

1.Land preparation

Land should be prepared before the first planting rains. Ridges should be made at 90cm apart both on pure and interplanted crop.

2.Planting

Plant with the first rains for the pure stand and soon after the main crop has merged for the mixed crop. Plant 3 seeds per station spaced at either 75 or 90cm apart on ridges spaced at 75 or 90cm apart in between the main crop. For pure stand, plant one seed 20cm apart on ridges 75 or 90cm apart.

3.Weeding

The crop should be free of weeds for good and early establishment..

4.Pest and disease control

The most important pests of cow peas are foliage beetles, foliage thrips, leafhoppers and aphids. They start attacking the crop at seedling stage and can cause losses of 70% to 100%. Aphids and leafhoppers can be controlled by spraying Dimethoate (Rogor)20WP or Garlic. Other pests can be controlled by using *Tephrosia vogelli* or Carbaryl 85WP.

The major diseases are Ascochyta blight, Cerpospora leaf spots and aphid borne mosaic virus, which cause losses of 40 to 100%. Intercropping cowpea with maize reduces pressure of these diseases.

5.Harvesting

Harvest the pods as soon as they are dry and continue drying to complete the process.

Reference: Inter Aide – [Agriculture training guidelines](#) – in collaboration with the Ministry of Agriculture of Malawi – March 2006

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