Introduction

It is very satisfying to pick your own vegetables, experience their intense flavour and know they have not been sprayed with poisonous pesticides. If we want to produce vegetables in our gardens that will provide us with food that is wholesome and nutritious, we need to make and maintain our gardens in the best possible way. What does this mean? The answer is that we have to use sustainable measures to prepare the garden by building the soil with organic matter, mulch and other organic methods. We need to weed, thin and support our plants and we need to control pests and diseases of our vegetables without killing our environment and ourselves. We also need to propagate plants that are inexpensive but that will provide maximum benefit.

This unit consists of the following sections:

3.1 Making your vegetable beds and building the soil
3.2 Good planting practices
3.3 Control of plant pests and diseases
3.4 Plant propagation

Specific Outcomes and learning outcomes

The specific outcomes for this unit are

- Facilitate the refinement of an annual plan for the household food production system and value-adding.

- Plan, design and implement experiments in different farming practices.

The table below shows you the **learning outcomes** that are linked to the four sections addressed in this unit and are also linked to the list of assessment activities for this unit. A time estimate is shown for the completion of each activity. This will help you to plan the use of your time. When you have completed the activities, write down the actual time you spent on them.

Learning outcomes	Assessment Activities	Actual time spent
	Workbook activities	
3.1 Making your vegetable beds and building the soil 3.2 Good planting practices	3.1. Experiment to test different bed designs (3 hours) 3.2. Experiment to test mulching (3 hours) 3.3. Experiment to test liquid manures/ teas (2 hours)	

3.3 Control of plant pests and diseases 3.4 Plant propagation	3.5. Analysis of best practices for pest control (4 hours) **Assignment** Assignment 2: Information for this assignment is contained in Tutorial Letter 101 (3hrs)	

Key Concepts

Mulch Compost Manure Soil fertility Trenches (deep and shallow) Double digging Keyhole beds Decompose Transpiration	Foliar spray Antibiotics Succession planting Germinate Cotyledon Furrows Thinning Mechanical control Chemical control Biological control	Organic remedies Predators Propagation Sexual reproduction Asexual reproduction Hardwood cuttings Soft tip cuttings Heel cuttings

Start-up activity

Dikgang's family, whom you met in Module 1, started a vegetable garden. Unfortunately they experienced a problem with aphids and other insect pests that reduced their crop yield. Dikgang's father went to a local farmers' cooperative in town and was advised to buy a chemical pesticide to kill the insect pests. Back home, he did not read the very important instructions about the proper concentration that should be used when spraying the plants. Dikgang's father mixed too much of the chemical into the water, which he then used to spray the crops. A few days later the family was shocked when they went outside. Their plants were dying. Their house cat was also dead. Dikgang was very sad, and was wondering whether the pesticide that was sprayed could have resulted in his cat's death.

Questions

1. Why do you think that the plants died after being sprayed with the pesticide?

   .....

2. Could the pesticide also be blamed for the cat's death? The cat did not eat the plants so why did he die?

   .....

3. What can one learn from this story about the use of chemical pesticides?

   .....

Comments on start-up activity

Chemical pesticides can be very harmful to the environment. One should be very careful with how they are applied and carefully follow the instructions on how they should be used. The very concentrated pesticide that was sprayed on the plants by Dikgang's father caused the plants' death by disturbing the water balance in the plant tissues. In Module 3, Unit 1 we looked at food chains. Consider the following food chain as a possible reason for the cat's death: The sprayed crops were eaten by a locust and when the cat caught the locust and ate it, the pesticide accumulated in the cat's body, and led to kidney and liver failure. One should try to avoid using chemical pesticides in the garden, since it does not only kill pests, but can also kill other animals, and can be very harmful to human health. You will learn more about this and about other more suitable methods to control unwanted organisms in your garden as you work through this unit.

3.1. Making vegetable beds and building the soil

We have seen in Module 3 that healthy soil is a key to growing healthy crops. There are a number of different ways in which soil can be improved or built up to have good depth, fertility and water holding capacity. It does not matter whether you start with a good soil, or a really bad soil – it can be managed to provide the optimal growth of your plants! We will briefly revisit composting, mulching and liquid manures/ teas as suitable methods of improving soil fertility.

Bed design is also important when we start a food garden. Organic matter included in the beds in particular ways will maximise soil fertility, depth and water holding capacity. Many different bed design techniques can be used including shallow trenches, deep trenches, double digging and keyhole beds. It is now time to get practical and lay out beds, fertilize the soil with organic matter, plant your crops and maintain your garden.

3.1.1 Laying out your vegetable beds

It is useful to lay out your garden in beds.Vegetable beds should be very well prepared before you can start planting. You can keep on improving the soil fertility in the beds with organic matter, compost, mulch and manure even after you have planted your crops.You can stop your soil from getting too hard by not walking on the beds and only walking on the pathways. The beds also make it easier to plan crop rotation and companion planting.

If the ground is sloping, make your beds along the contours of the slope and not down the slope. In this way, the paths and beds will catch run-off water when it rains, and not lead to soil erosion. Try to lay out your beds in an east-west direction. In this way the sun reaches all your plants, but it does not dry out the soil. (Remember that we talked about these concepts in Module 3).

Long narrow beds are a good idea because you can reach the middle of the bed from either side without walking on the bed. These beds are usually 1 metre or one spade length wide. You can make them as long as you want to.

Three different types of bed design

There are many ways in which vegetable beds can be designed and we will examine three of the most popular bed designs namely:

- Trenches
- Double-digging
- Keyhole beds

Trenches

Trenches are a way to increase soil fertility and water holding capacity in your beds. It is an intensive way of providing good soil for vegetable production on a small scale; especially in places where the soil is not good or deep.

You can make trenches in different ways. Here we are going to focus on deep trenches and shallow trenches. Even though making these beds is a lot of hard work, plants grow very well in them and the extra fertility lasts a long time (around 5 to 8 years).

Note: Since the organic material in the deep trench needs to decompose for about 2-3 months before planting, you need to plan this well in advance. It is possible to use this trench bed as a seedling production bed, while you wait for the organic matter to decompose. By the time the seedlings are ready to be transplanted, the bed will be ready for planting.

How to make a deep trench

1. Dig a trench 60cm or deeper. It is usually about 1m wide (to provide easy access, without having to step on the bed) and can be as long as one likes.

2. Separate the topsoil and subsoil in piles while you are digging. If your sub-soil is very infertile then do not use it in the trench. Instead, spread this infertile soil around the garden to help channel water towards your bed.

3. Place a layer of tins or branches at the bottom of the trench to help with aeration and also to supply of some nutrients. The tins need to be squashed before putting them in the hole. Make a layer of tins about 3 tins deep. If there are no tins use thin branches instead.

4. Fill the trench with a range of organic materials and top soil.
   - First add dry grass or weeds (about 10 cm deep)
   - Then add manure (about 2 cm deep)

- Add also some wood ash (a thin layer, less than 1cm deep).
- Then add a layer of top soil (about 5cm deep)
- Mix these layers with a garden fork
- Stamp them down by walking on them
- WATER the mixture well!

You can also add other organic matter like green and dry weeds and vegetable peelings, card board, paper and bones.

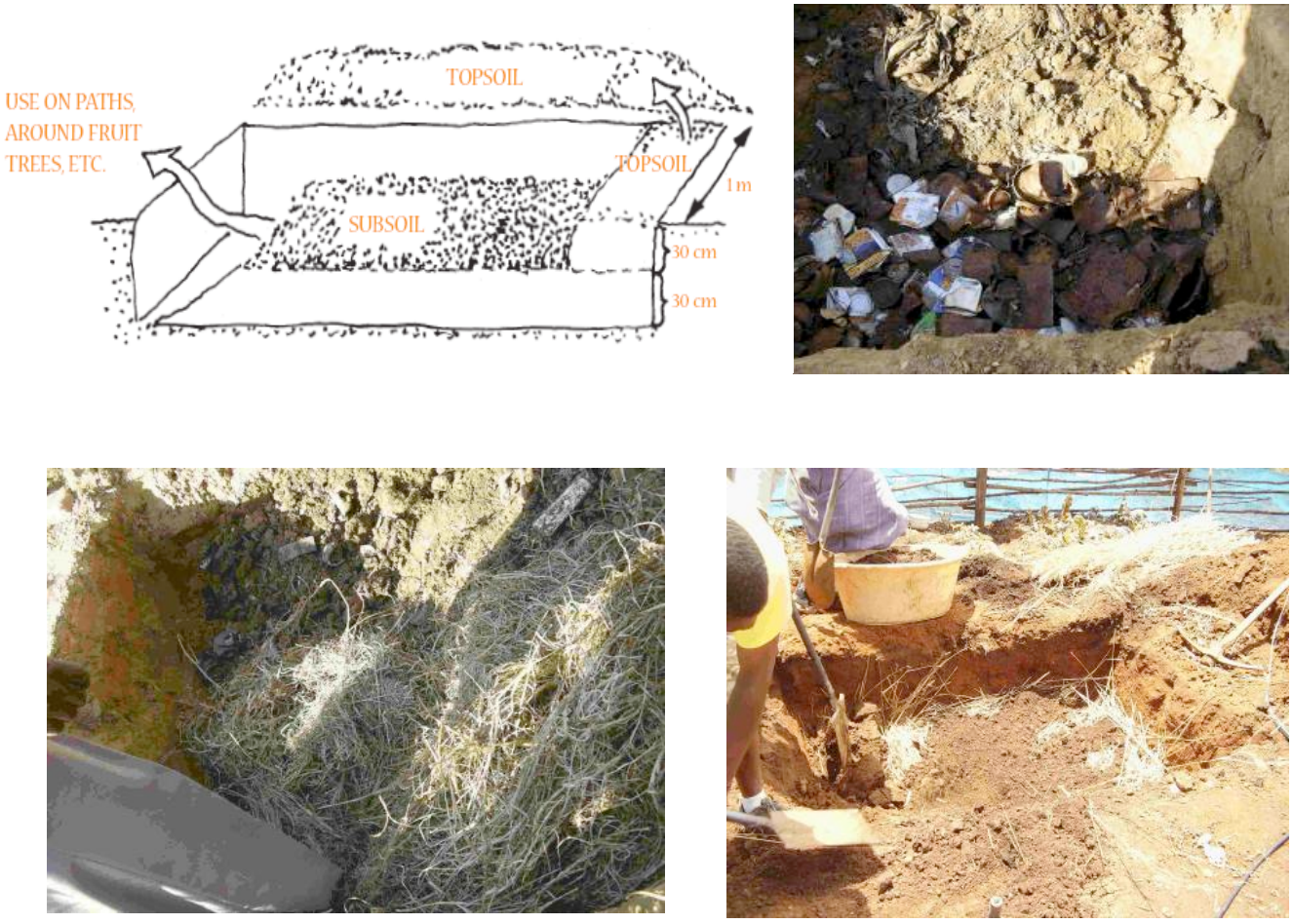


Figure 3.1 Steps in making a deep trench bed

5. Continue to place the organic materials into the trench until it has reached ground level again.

6. Now build up the trench bed to about 10-15cm above soil level. Use a good mixture of topsoil and manure and or compost.

7. It is very important that the trenches are watered well while they are being made and when they are completed. The organic material in the trench cannot decompose if it is dry.

NB: If you want you can use your trench bed as a seed bed. In this way, when your seedlings are ready to be transplanted, the trench bed will be ready to be planted. Growing seedlings from seed needs a well prepared bed. The roots of the small plants do not go down deep. The materials in the trench can decompose while the seedlings grow on top.

Different ways of watering are possible; and drip irrigation is illustrated in Figure 3.2.

Fig 3.2 Using drip irrigation to water a trench bed

How to make a shallow trench

Shallow trenches are dug to a depth of about 30cm. The bottom of the trench is filled with sticks and branches. This is covered by a layer of dead or green leaves and grass. Then the rest of the hole is filled with compost that you made in Module 3, and which should be ready for use at this stage. Finally the trench is covered with the top soil that was dug out to make the trench.

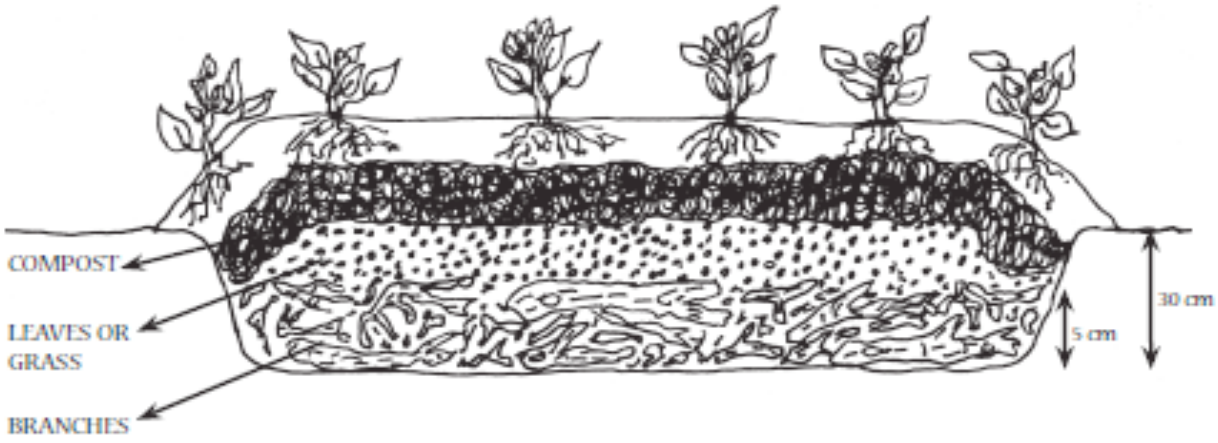


Fig 3.3 Making a shallow trench and planting your vegetables

Double digging

(Adapted from Kruger, 2008)

Another way to increase the fertility of your soil is by double digging. The advantage is that the beds are ready the moment they have been made. You do not have to wait for the organic matter to decompose first.

The method involves digging out the top soil (to 30cm deep) of a section of your bed and placing it in a pile next to the bed. The bottom of the dug-out section is loosened. Then manure or compost is mixed into this sub-soil, before the top soil from the next section is placed on top - refer to Fig 3.4 below. The sections are dug in a sequence that minimizes the amount of soil you have to move. Once completed manure or compost is dug into the top soil of the bed.

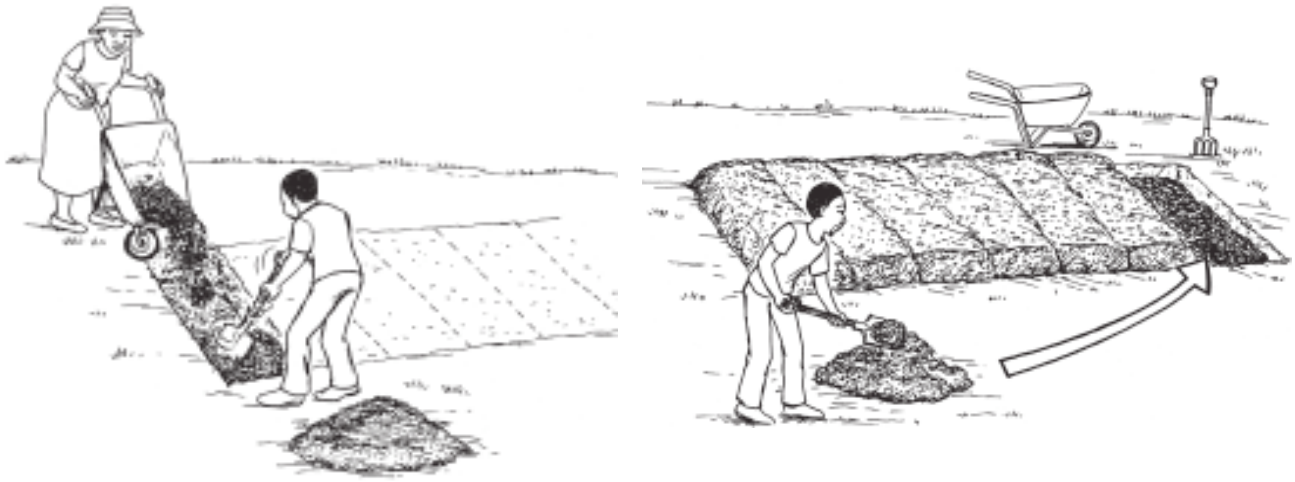


Figure 3.4 Double digging of your vegetable beds
(Adapted from Kruger, 2008)

Left: *Manure is being added to the loosened sub-soil of the first section of the bed. Note the top soil in a pile.*
Right: *The topsoil taken from the first section is now placed in the last section once the manure has been worked into the sub soil. The bed is now almost ready. Manure or compost will have to be dug into the top soil and then planting can be done.*

Key-hole beds

Key-hole beds are built up with rocks. They are suitable where there are a lot of rocks and stones and where the soil is not very good for planting.

A composting basket is built in the middle of the bed to provide extra and ongoing fertility to the bed. It is possible to water these beds with grey water and they are very good at holding water. Once they have been built they are easy to use and maintain.

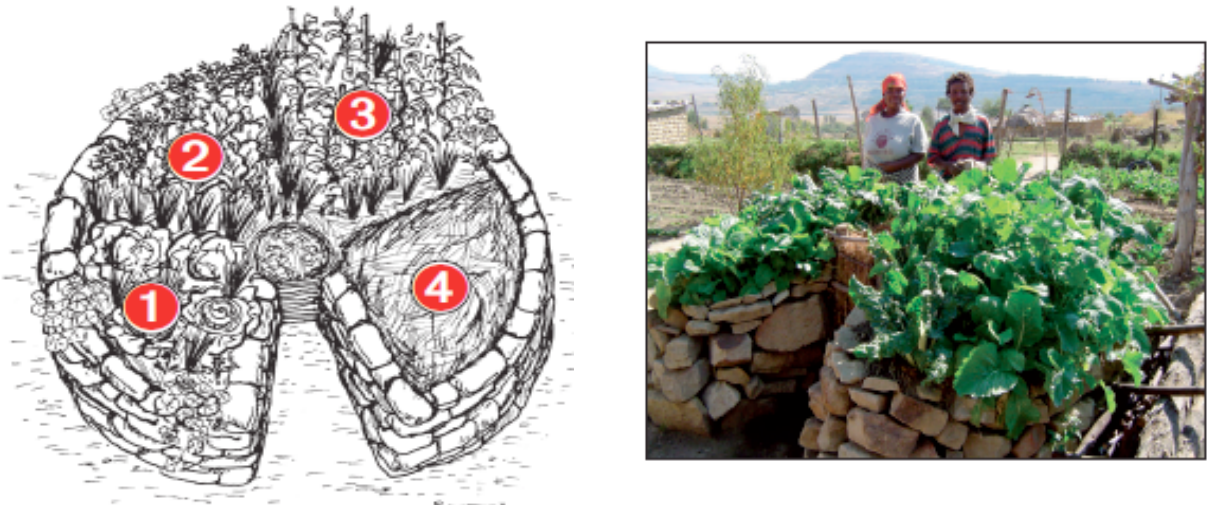


Fig 3.5 Key hole beds
(Adapted from Kruger, 2008)

Left: *This shows a keyhole bed divided into 4 sections for crop rotation purposes: 1; leaf and fruit crops, 2 root crops, 3 legumes (such as peas and beans) and 4 is being rested. Lime is dug into this section and then it is covered with a thick layer of manure and mulch*
Right: *A photograph of a keyhole bed in Lesotho. The stone walls and composting basket in the middle are clearly visible.*

It should now be possible for you to choose a method of bed design that best suits you and the household you work with.

Activity 3.1 Experiment to test different bed designs

Complete this activity on your own or in groups in the workbook

Aim: Assist a household in experimenting with different designs of garden beds.

Time: 3 hours

What you must do

The Plan
Discuss garden bed design and different ways to construct the beds with your household farmers. You can use the information provided above.

Fill in the Small Scale Experimental Plan (as we discussed in Unit 1 of Module 5) with the farmer, and observe and monitor the experiment. (There is an outline of a plan in your workbook for you to fill out).

SMALL SCALE EXPERIMENTAL PLAN

- What is the problem?
- What is the possible solution?
- Why will this solution solve the problem?
- How will I test this solution step by step?
- What will I look for and what will I measure?
- How will I measure the results or outcomes?
- How will I compare my experiment to my usual way of farming?

Monitoring

The farmer will need to monitor the experiment. Every week they will need to check the following:

- Are the plants in the new bed growing better than those planted in other ways (the way the farmer normally plants)? The usual way is the farmer's control.
- Is there a difference between the amount of water that needs to be given to the usual and the new bed designs? (How will the farmer observe or measure this?)
- Does watering need to happen more often for the usual or the new bed? (How will the farmer measure and record this?)

The soil in your vegetable beds needs to be fertile to support healthy plant growth. The beds described in the section above are one of the ways of doing this. There are a number of other ways that we will examine below.

3.1.2 Composting

You started making compost for your vegetable garden in Module 3, and now need to work it into your beds. Do you still remember why compost is necessary?

Compost is organic matter, which is necessary to maintain life in the soil. Soil life consists of the living microorganisms and small animals found in the soil. A healthy soil is alive with fungi, bacteria, earthworms, insects and other small animals. Organic matter (compost, organic mulch, manure and decomposing plant parts) is decomposed by the organisms in the soil and is recycled into humus. Humus is an important source of many nutrients. Humus (compost) also:

- Generates porous soils and stabilizes soil structure; which enables plants to grow strong roots
- Helps retain water in the soil
- Is a good source of plant food providing a wide range of nutrients
- Improves the ability of soil to store and supply plant food.
- Prevents soil loss from wind and water erosion.
- Generates high levels of beneficial soil organisms, including earthworms
- Regulates soil temperature.
- Opens up small channels for seedling roots to grow into.

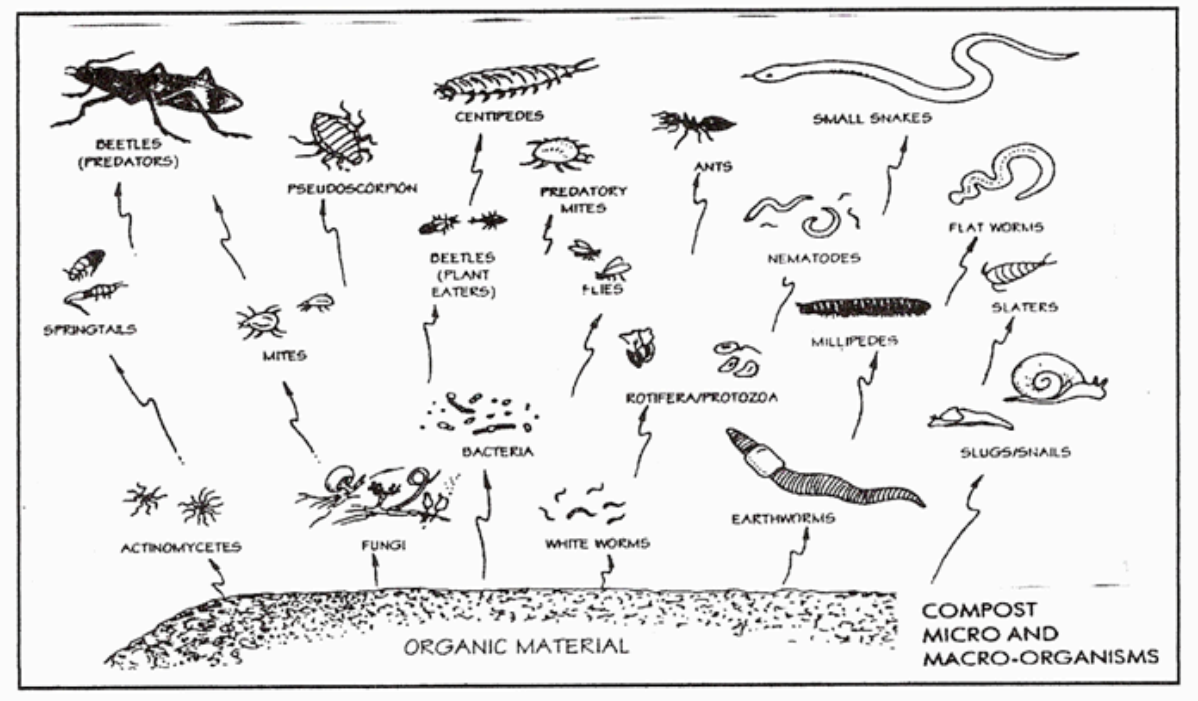


Figure 3.6 Small organisms in the soil that help to create humus
(Adapted from Vukasin *et al.)*

3.1.3 Mulching

Mulching is the spreading of a layer of material over the surface of the soil.

Why is mulching important?

Mulching has three main effects:

- It saves water, because it will stop the sun and wind from drying out the soil. That means that you will need to give less water to your plants, because it is not lost through the effects of sun and wind.
- It keeps the soil temperature more even. Mulching reduces too much heating and too much cooling of the soil. This makes it easier for plants to grow.
- Mulching increases the fertility of the soil if organic materials are used.

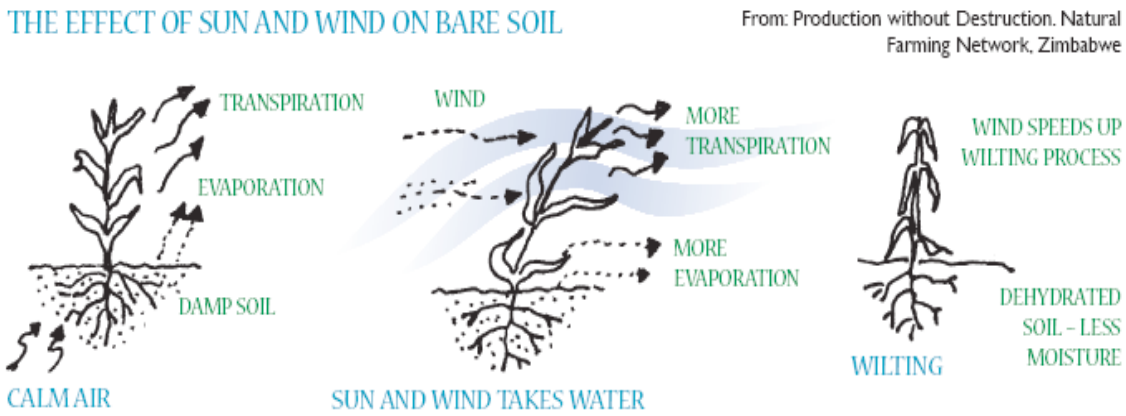


Fig 3.7 Effect of sun and wind on bare soil

Other positive effects of mulching include:

- It stops loss of minerals/nutrients from the soil
- It encourages the presence of soil organisms
- It reduces weed growth
- It prevents capping: that is the formation of a hard layer of soil on the surface
- A stronger root system develops closer to the soil surface. This makes more nutrients and air available to the roots
- Breakdown of mulch will add to soil fertility
- Breaks the impact of heavy rains and splashing of soil on plants that can spread diseases.

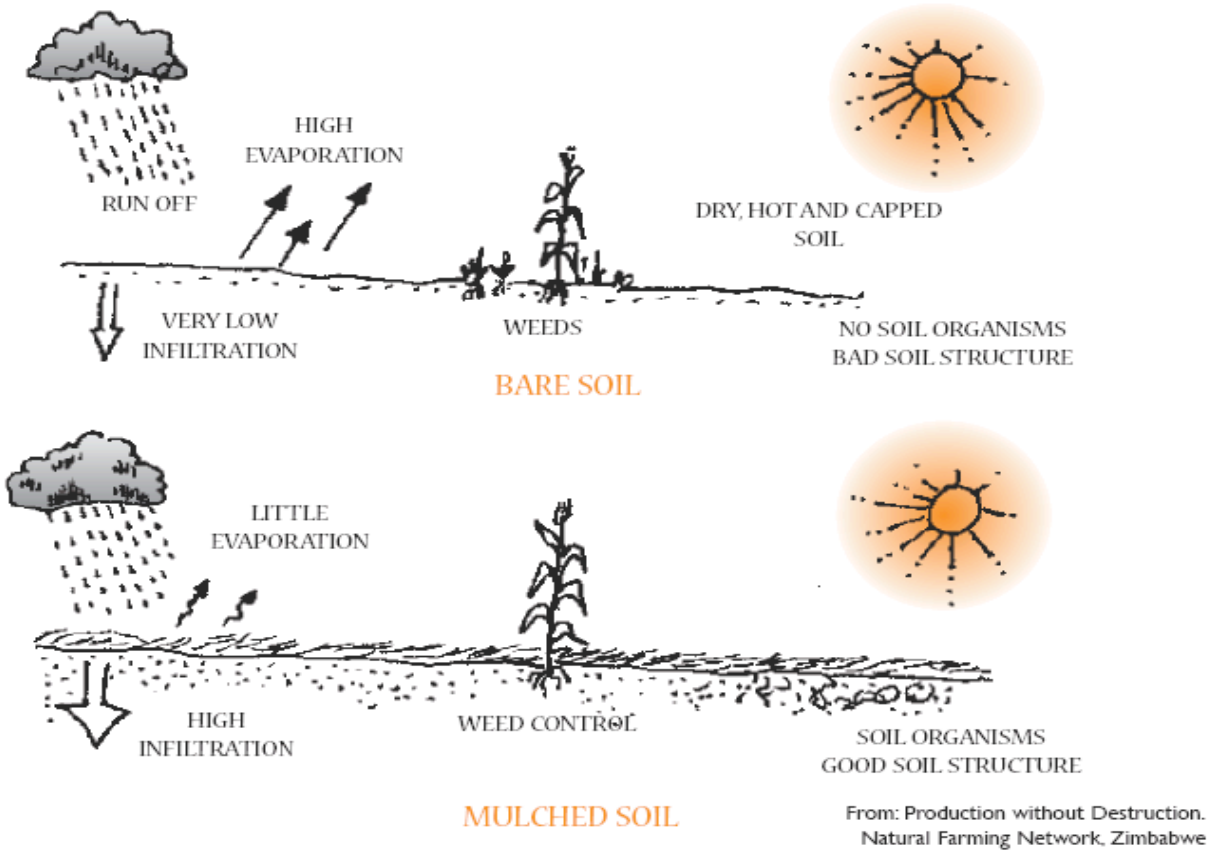


Fig 3.8 Advantages of mulching

What to use as mulch

Usually we use:

- Crop residues (stalks and leaves of harvested crops). NEVER use diseased crop residue. You will infect the soil and your new crops!
- Weeds that have been pulled out and left to dry out.
- Grasses from the veld. Make sure to use DRY grass. GREEN grass will take nutrients from your soil and your crops will have fewer nutrients available.
- Flat stones - these will cover the soil surface but will not add nutrients. They are good around larger plants and fruit trees.
- Newspaper - this will cover the soil surface and add a little bit of nutrients to the soil. Wet the newspaper when you put it on the soil, so that it does not blow away.
- Manure; use DRY or OLD manure for this.
- Leaves collected under trees.

- Old thatch grass.
- Black plastic sheeting.

How do we mulch?

1. It is best to chop up your mulching material (weeds and grass) to be about the length of your hand (10-20 centimetres).
2. Use a thin layer of mulch for seedlings and small plants – about one finger width deep (1.5 cm).
3. For larger plants use much thicker mulch – about 2-3 finger widths (3-4 cm).
4. For trees, a really thick layer, one whole hand or more (10-20 cm) can be added.

When the mulch has broken down, you need to add more! You will be amazed how quickly this happens. Usually mulch is added at least once a season, or once every 3 months. In areas with extremely cold winters, it may be an idea to make sure your mulch is compacted or squashed down firmly once the heavy frosts start. Loose mulch can make the effects of frost more severe.

Activity 3.2 Experiment to test mulching

Complete this activity on your own or in groups in the workbook

Aim:
Assist a farmer with an experiment to test the effects of mulching on their soil, water and plant growth.

Time: 3 hours

What you must do

The Plan:
Discuss mulching with your household farmers. You can use the information provided above.
Fill in the Small Scale Experimental Plan (as we discussed in Unit 1 of Module 5) with the farmer, and observe and monitor the experiment.

SMALL-SCALE EXPERIMENTAL PLAN

- What is the problem?
- What is the possible solution?
- Why will this solution solve the problem?
- How will I test this solution step by step?
- What will I look for and what will I measure?
- How will I measure the results or outcomes?
- How will I compare my experiment to my usual way of farming?

Monitoring

The farmer will need to monitor the experiment. Every week they will need to check the following:

- Did they use less water on the mulched plants, than on the plants that were not mulched? (How will they test this?)
- Were the plants that were mulched bigger and better than the ones that were not mulched? (What will they observe and/or measure here?)

3.1.4 Liquid manures/teas

Another way of improving plant nutrition is to make liquid manure teas or brews that will add fertility to the soil. This should be used as an additional soil fertility technique rather than the only one! Brews provide extra nutrients in case of small deficiencies, but can not rectify major nutrient deficiencies in the soil.

Liquid manures are a simple way of giving your plants a nutrient boost. They can be made from plant material or animal manures. The aim is to provide plants with natural plant foods quickly during their growing season. It is useful for heavy feeders like cabbages and to give seedlings a boost.

How to make liquid manures from plants

A good plant for liquid manure is comfrey. Soft green leaves and stems from any other plants can also be used and weeds are ideal. Avoid plants which are very strong smelling. Plants are made of different quantities of nutrients and take up different nutrients from the soil. It is best to use a range of plant materials to make your liquid manure/tea.

Method:

1. Make sure your container is clean before you use it.
2. Collect the plant material and fill up the container. You must keep on adding material to the container every week.
3. Place a rock on top of the plant material in the container and put the lid on. Do not add water. The plant material will make its own liquid. If the plant material does not make much liquid after a week, you can add some water – but not too much.
4. Place it in a sunny position and two weeks later check to see if the leaves have turned black. If you tilt the container you should find a black juice. This is the concentrated plant liquid manure.

5. This liquid is very strong and should be diluted.
6. Dilute the plant manure as follows: For **seedlings***:* 1 tin of liquid manure for every 4 tins of water. For **bigger plants**: 1 tin of liquid manure to 2 tins water. If you make the mixture too strong it can burn the leaves of plants. Pour the mixture on the soil around your plants every two weeks, **after** you have watered them. Note: The tin should be the size of a big jam tin (400 g).

Below are some examples of plants that are good for including in plant brews/teas.

Comfrey: This plant has large hairy leaves and grows in wet shady places. The leaves contain a lot of potassium. These can be used to mulch your vegetable beds and also to make liquid feeds for your plants. Comfrey is also a good green vegetable and a medicine. A tea made from the leaves is good for high blood pressure and arthritis.

COMFREY

From: Useful Plants for Land Design, Pelum

Stinging nettle: This is one of the best plants you can use in plant brews. It contains a wide variety of nutrients and trace elements and is a well balanced plant food. It is best to collect these plants in a sustainable way in the natural forests where they occur and plant a few in your garden. They do not survive frost, but otherwise grow almost anywhere.

Banana stems: These are chopped up and placed in the container with other plants and leaves. The stems have a high concentration of potassium and water and make a good liquid base for the brew.

Weeds: All fast growing weeds with soft dark green leaves, such as Black Jack, Amaranthus, Chickweed, Gallant Soldier, are good to use. Avoid using grasses and sedges.

Table 3.1 Advantages and disadvantages of plant brews

Advantages of plant brews	Disadvantages of plant brews
Plant brews are easy to prepare and use.	Resources such as containers with lids are required.
If diluted these brews do not harm plants.	Plant brews can burn plants if they are too strong.
Plant brews increase disease resistance in crops.	Effects of the brews on plant growth are only visible after 3-5 days.
Plant brews provide a quick and cheap plant booster food.	It is not possible to know exactly which nutrients these brews contain.
Plant brews provide mainly potassium, phosphorus and trace elements.	Some people do not like the rotten smell of these brews.
Nitrogen can be provided if the brew is used early in the fermentation cycle (after 1 week) and care is taken to avoid it's evaporation by keeping the containers closed and cool.	Nitrogen is volatile (evaporates quickly) and is lost from the brews quite early in the fermentation cycle.

How to make liquid brew/tea from animal manure

Manure from chickens, rabbits, cows, goats and sheep can be used.
A mixture of different manures is best.

1. Put your fresh manure mixture into an orange or cloth bag and tie the top of the bag.
2. Put the bag in a container and attach it to the stick or the rope. Then fill the container with water. For every 1kilogram of manure you will need 10 litres of water. This means an orange sack full of manure will fit in a large bucket, or half the bag in a normal sized household bucket. This is a way of keeping the manure and the water separate, because you should not put the wet manure on your plants.
3. Cover the container with a lid. Stir every few days.
4. After two weeks the mixture will be ready to be used. It should look like weak tea. Before using the liquid, stir the mixture well.
5. This liquid will be very strong and should be diluted.
6. Dilute the mixture as follows:

For seedlings: 1 tin of liquid to 8 tins of water.
For bigger plants: 1 tin liquid to 4 tins of water.

If you make the mixture too strong it can burn the leaves of plants. Pour the mixture on the soil around your plants every two weeks, after you have watered them. Use at least one big jam tin full for each seedling or plant. Avoid applying your mixture in the middle of the day or on very hot days.

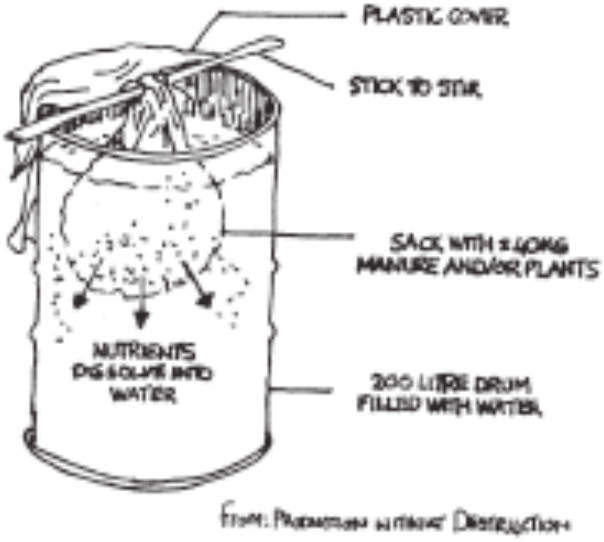


Figure 3.9 Use animal manure to prepare liquid tea

Below are some examples of different types of animal manure you can use to make liquid teas:

Kraal manure (cattle): Either use fresh manure or use manure that has been collected in a kraal. In this way you can ensure that the manure contains as many nutrients as possible and that the nutrients have not been lost into the air through baking in the sun and drying out. This is especially important if you need your liquid manure to contain some nitrogen.

Chicken manure: With chicken manure it is important to collect the droppings while they are fresh. Again this keeps the nitrogen and other plant food concentrated in the droppings. It is possible to collect the droppings daily and keep them in a sack in a cool dark place, until you have enough to make a brew.

Liquid tea made from chicken manure can burn plants, as it can contain a high level of nitrogen. It is important to dilute this brew properly before use. If you are unsure, test the brew on a few plants only and go back the next day to see what happened. If the edges of the leaves have gone brown and crinkly overnight, the brew is too strong and has "burnt" your plants.

Goat manure: This manure is very mild and is well balanced. It is unlikely to "burn" plants, but may also be a little low in phosphorus, depending on the diet of the goats.

Other manure: Manure from rabbits can also safely be used. Do not to use the manure from pigs, dogs or cats as i may carry worm eggs that can infect people.

Table 3.2 Advantages and disadvantages of animal liquid manures

Advantages of animal liquid manures (teas)	Disadvantages of animal liquid manures (teas)
Liquid manures are easy to prepare and use.	The liquid manure is only as good as the manure of origin. If the animals are suffering from deficiencies these will be transferred into the manures. As an example, there is likely to be a lack of phosphorus in cattle manure, where cattle have only been grazing on veld, and their feed has not been supplemented. This means the liquid manure made from this source will also lack phosphorus.
If diluted properly, these liquid manures do not harm plants.	Liquid manures are generally low in nitrogen. Using chicken manure drastically increases the nitrogen content.
Liquid manures increase disease resistance in crops.	The raw manure has to be handled carefully to retain its nutrients before using it as liquid manure.
Liquid manures provide a quick and cheap plant booster food.	Effects of the liquid manures on plant growth are only visible after 3-5 days.
Liquid manures provide mainly potassium, phosphorus and trace elements.	It is not possible to know exactly which nutrients these brews contain.
Nitrogen can be provided if the liquid manure is used early (after 1 week) and care is taken to avoid it's evaporation by keeping the containers closed and cool.	Some people do not like the rotten smell of these liquid manures.

How to make a foliar spray

This brew is made from a mixture of plant and animal material. It contains antibiotics, microbes and plant hormones as well as plant nutrients such as potassium, phosphate and trace elements. Spray it on the leaves of plants, as this is where it is absorbed.

Foliar sprays are made as follows:

What is an antibiotic?
It is a substance produced by micro-organisms such as fungi and bacteria, which can be used as medicines.

1. Place the ingredients below in a container with a lid:
   - 7.5 kg of fresh cow manure
   - 15 liters of water
   - 1.25 liters of milk (without salt)
   - 1.25 liters of sugar cane juice OR 4 kg of chopped sugar cane,

   OR

   0.5 kg of brown sugar (*you decide which one to use*)
   - 1 kg of wood ash (NOT coal ash!!)
   - 1 kg crushed bones or bone meal (fish bones are ideal if available. If possible do not use chicken bones. (*You can use bone meal bought from a gardening shop.)*
   - 1 x 20 litre bucket of chopped weeds
   - 0.5 kg of agricultural lime OR crushed eggshells
2. Leave this mixture for 10-15 days.
3. Dilute 0.5 liter of this mixture in 10 liters of water.

   This spray is highly effective! It is possible to keep the brew going for a period of time, by adding more weeds and manure and leaving the mixture again for about 10 days.

   (Adapted from: *EMBRAPA; Brazilian Agriculture Research Institute).*

Table 3.3 Advantages and disadvantages of foliar sprays

Advantages of foliar sprays	Disadvantages of foliar sprays
Foliar sprays are very effective and act quickly in the plants.	Some ingredients for foliar sprays need to be bought; such as agricultural lime and wood ash, sugar and milk.
If diluted properly, these foliar sprays do not harm plants.	This mixture is exceptionally smelly while it is being made.
Foliar sprays increase disease resistance in crops.	Foliar sprays can ‘burn’ plants if they are too strong.
Foliar sprays provide a quick and cheap plant booster food.	
Plant hormones and antibiotics are also included in foliar sprays.	

Activity 3.3 Experiment to test liquid manures/ teas

Complete this activity on your own or in groups in the workbook

Note: Do this activity when your seedlings have been transplanted into your vegetable beds.

Aim:
Assist a farmer with an experiment to test the effects of liquid manures/ teas

Time: 2 hours

What you must do

The Plan
Discuss the use of liquid manures with your household farmers. You can use the information provided above.

Fill in the Small Scale Experimental Plan (as we discussed in Unit 1 of Module 5) with the farmer, and observe and monitor the experiment. (There is an outline of a plan in your workbook for you to fill out).

SMALL SCALE EXPERIMENTAL PLAN

- What is the problem?
- What is the possible solution?
- Why will this solution solve the problem?
- How will I test this solution step by step?
- What will I look for and what will I measure?
- How will I measure the results or outcomes?
- How will I compare my experiment to my usual way of farming?

Monitoring
The farmer will need to monitor the experiment. Every week they will need to check the following: Were the plants that were treated with liquid manure bigger and better than the ones that weren't? (What will they observe or measure here?)

3.2. Good planting practices

To start, we will remind ourselves of the companion planting and crop rotation exercises you did in Unit 2 of this module. We will also look at the planting calendar again. You will now have to put one of those plans into practice. To add to this information we will discuss the actual sowing, planting and care practices in this section.

Activity 3.4 A farmer experiment for planting a range of crops

Complete this activity on your own or in groups in the workbook

Aim: Assist a farmer in doing an experiment to test the effects of companion planting, crop rotation and or succession planting.

Time: 4 hours

What you must do

The Plan:
Start by discussing the issues of planting a range of crops with your household farmer or farmers. You can use the information provided above to discuss including different types of crops according to the food preferences of the family. Then discuss the addition of more types of plants by including companion planting and crop rotation. Discuss the advantages and disadvantages.

Then discuss carrying out a small experiment involving the planting of a range of crops. You may end up having more than one experiment. One may involve mixed cropping of a bed or introducing the planting of herbs in the garden. Another may be a crop rotation plan. Fill in the Small Scale Experiment Plan (as we discussed towards the end of Unit 1 of Module 5) with the farmer. You will need to fill in one of these forms for each experiment that is done. You will go through the questions, work out the solutions and how you will observe and monitor the experiment.

SMALL SCALE EXPERIMENT AL PLAN

- What is the problem?
- What is the possible solution?
- Why will this solution solve the problem?
- How will I test this solution step by step?
- What will I look for and what will I measure?
- How will I measure the results or outcomes?
- How will I compare my experiment to my usual way of farming?

Monitoring:
The farmer will need to monitor their experiment. Every week they will need to check specific things such as:

- How are the new crops growing, compared to the normal or usual crops planted?
- Do the crops grown together as companions grow better than the crops planted separately? Are there fewer or different kinds of pests and diseases? Is there a difference in the amount of watering that is required?

- A crop rotation experiment will take a few years to show a difference. It is difficult thus to do a small scale experiment as the one shown here. It is possible for you/ the farmer to set aside a piece of the garden and start to practise rotation there (3-4 beds depending on the system you choose). Then it will be possible to compare the growth of crops in the rotated beds with those in normal beds. You will need to plant the same crops at the same time for this to work.

3.2.1 Sowing and watering your plants

Taking a tiny seed, putting it in damp soil and seeing a tip of green pushing through the soil two weeks later is like seeing a miracle happen! Seeds contain the tiny plant (embryo) which will grow into the mature plant. The seed contains stored food for this embryo to use until it is able to make its own food by photosynthesis.

What is germination?

It is the process in which a seed begins to grow and develop into a new plant.

Simple rules to follow when growing vegetables from seed

- Seeds need moisture to germinate (start growing). It is important to keep the soil moist but not swimming in water.
- Soil needs to be the right temperature for germination. Most seeds need warmth, which is why most sowing happens towards the end of spring and in early summer. When temperatures are too hot or too cold, seeds will not germinate.
- Seeds need air (a supply of oxygen) from the soil, so the soil must contain humus.
- Do not plant seeds too deep. Follow instructions on the packet or follow the recommendation in the next section that looks at *Methods of planting* below.
- Watch out for pests, birds and other animals.

Should you sow in trays or directly into the beds?

The soil temperatures are often still too cold in September to sow directly into the soil. Get an early start by sowing seed into containers such as seed trays and keeping them in a warm and sheltered position, but not in direct sunlight.

Transplanting the seedlings into the beds should only happen two weeks after no more frost is expected.

Sowing in containers

Most vegetable seeds can be sown in containers, but green beans, radishes or carrots should be sown directly into beds.

If we sow small quantities of seed at a time, we can sow these in containers such as shallow dishes or boxes. Make sure your container has some small holes in the bottom so that excess water cant drain out..

How to sow seed in small containers

- Take 1 part sand, 1 part sifted compost and 2 parts good sifted topsoil. Mix them together.
- Sterilize this mixture by pouring boiling water over the dry mixture before you fill your containers and sow the seeds. This will kill weed seeds and disease causing organisms in the soil.
- Sow your seeds by shaking a few seeds into the palm of your hand, using your other hand, sprinkle the seeds on the soil and push them down to the required depth (see below).
- Smooth and slightly firm the soil.
- Water the seed containers after planting. Use a watering can with a fine nozzle (top).
- Start watering away from the container so the water is sprinkled evenly over the container and not in one big spurt, because the seeds will be washed away. Finish the watering away from the bed as well. Water lightly every second day until the seeds germinate, then reduce watering to two or three times a week.

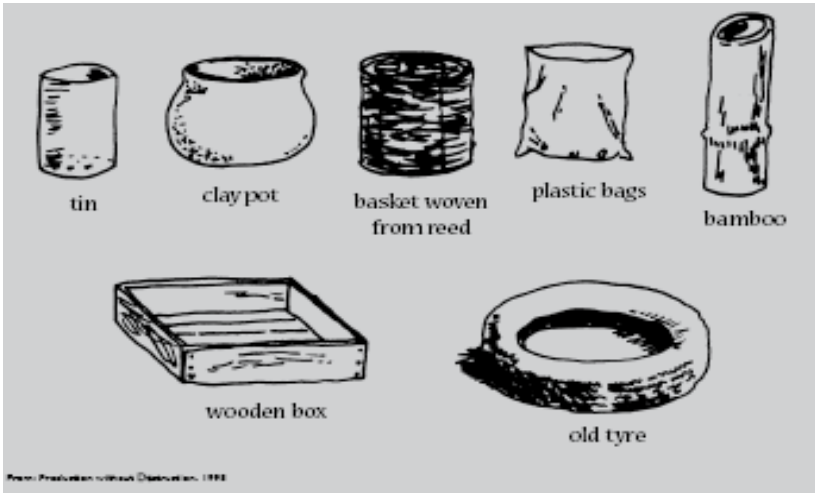


Figure 3.10 Containers for sowing vegetable seeds

Succession planting

Succession planting means that we plant a little, but often. We do this to make sure that we have some crops to harvest over a long period of time. If we plant the whole packet of seed at once we will harvest a big crop all at once. An idea is to divide a standard size packet of seeds into 4 portions. We can then plant each of these portions every 2-3 weeks.

Sowing directly into the beds

- Prepare the bed by digging over the soil, adding compost, breaking down lumps of soil and removing stones.
- The seeds for all crops (except for potatoes and sweet potato) are sown in furrows (a long hollow line) at a depth of between 2 and 7cm. Make the furrows by drawing a stick or the corner of a hoe along a straight line marked with a string. The string must be in a line parallel to the longest side of the bed. On land which is sloping very unevenly, the lines of crops should follow the contours and must not be straight.
- Sow as thinly as possible. With the back of the rake, close the soil over the seeds and firm the soil down gently.

- Water in the same way as we explained above for sowing in containers.
- Do not forget to label your seed container or the rows in your beds and add the date of sowing.
- Protect the seed bed from heat and wind.

Figure 3.11 Making furrows and planting seed
(Adapted from *Crop Production*. Unit 12.Oxford University Press, 1977)

Figure 3.12 Protecting seed bed
(Adapted from Kruger, 2008)

3.2.2 Thinning and weeding

Why must you thin out and space the plants?

In most ecosystems as well as in your containers where you sowed your seeds, life is tough! There is a fight going on - a fight for life. When resources such as food, space or water are limited in supply, organisms must compete for these. Plants also compete with other plants for light, space to grow, water and nutrients.

Thinning out and transplanting seeds

Seedlings will first develop a pair of cotyledons (rounded leaves) and after that the true leaves will form. Once the true leaves are formed transplanting may take place.
Thinning out means you provide the seedlings with enough space by transplanting them. Plant spacing refers to the correct distance between each plant growing in your food garden. If we do not keep the correct distance between plants the following can happen:

- Plants spaced too close together become overcrowded in which case they will compete for moisture, air, nutrients and light. Many of the plants will lose the fight and die.
- Plants spaced too far apart waste soil and this may lead to soil erosion when heavy rains fall.

Before sowing you therefore need to check on:

- The correct distance between lines of plants.
- The correct distance between plants in each line.
  Look at the vegetable planting guide in your resource pack for guidance in plant spacing.

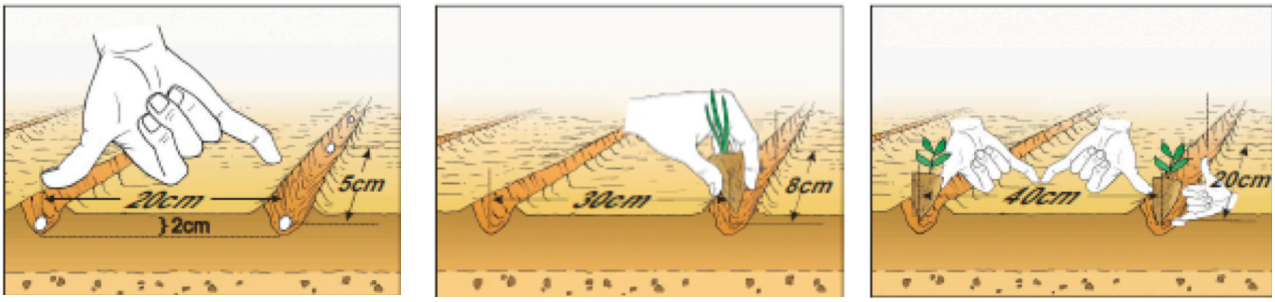


Figure 3.13 Spacing for different crops
Left: *Spacing for planting carrot seeds; 20cm between rows – thinly scattered in rows.*
Middle: *Spacing for planting out spinach seedlings: 40cm between rows and 20 cm within rows.*
Right: *Spacing for planting out onion seedlings; 30cm between rows and 8cm within rows.*
(Adapted from Dept of Agriculture and Environmental Affairs, KZN, 2009)

Weed your garden

A weed is any plant that is growing where it is not wanted. Weeds compete with food crops for water, sunlight, nutrients and space. In a vegetable garden, weeds can be controlled by:

- Pulling them out by hand or by using a hoe;
- Mulching
- Practicing crop rotation and intercropping.

3.2.3 Planting from a bag

You may have received a plant in a black plastic bag from a friend, or you may have planted a cutting in a bag and it has grown into a young tree. Plant nurseries also supply young trees and shrubs that have been propagated in plastic bags. How do you transplant plants from a bag into the soil?

How to plant a tree or shrub from a bag the water wise way

What is subsoil?
It is the soil layers lower down, where no or limited soil organisms are found.

1. Dig a hole larger than the bag. Dig a square hole, rather than a round hole, as this allows roots to find weak spots in the corners, and push out into the surrounding soil, instead of growing round and round in the hole.
2. Loosen the soil at the bottom of the hole before planting, as this will make it easier for the roots to penetrate downwards. Loosening the soil will also help with drainage and the plant roots will not 'drown'.
3. Put the 20 cm of topsoil you have dug out of the hole, to one side. Mix 2 parts of this topsoil with compost, and wet it. The remaining subsoil is nutrient poor, so mix it with your compost heap, or use it on pathways.
4. Check that the hole is deep enough for the entire plant bag to fit into the hole.
5. Remove the bag and loosen any roots that have become tangled very carefully. Do not remove the soil around the roots as you will remove the fine root hairs that the plant needs to take up water and nutrients.
6. Place the plant in the hole so that the level of the soil in the bag is the same as that of the surrounding soil.
7. Cover the roots with the soil and compost mixture up to ground level. The soil should be added in stages, and firmed down to prevent air pockets. Do not compact the soil too much as soil organisms need air in the soil.
8. Create a water bowl on the surface, which is as wide as one spade-length.
9. Water the plant, and mulch the surrounding area (the mulch must not touch the base of the plant, as this can lead to rotting).

Figure 3.14 Planting from a bag
(Adapted from: Rand Water; and Kruger, 2008)

3.3. Control of pests and diseases

What are beneficial insects?

Insects that do not harm plants but work to our advantage are beneficial, for example Bees pollinate flowers

Pests and diseases can cause great damage to crops. This does not only affect the large-scale commercial farmers, but also people who grow fruit and vegetables for household use. What is a pest? A pest is any animal (such as an insect or nematode), which causes damage to crops. What causes plant diseases? Certain microorganisms, such as viruses, bacteria and fungi cause disease in plants.

Plant pest and diseases cause various symptoms in plants. Symptoms are the signs of a disease or pest that can be seen with the unaided eye. The symptoms can either be inside the plant or on the outside of the plant.

- **Insect pests** can often be seen on plants or in or on the soil. They damage plants by feeding on the roots, shoots, leaves and fruit, or by sucking sap out of the plant.
- **Nematodes** attack roots and cause abnormal growth with knobs and galls. Plants are also stunted and grow poorly.

- **Fungi** attack all parts of a plant. You will know a plant has been attacked by fungi when the following appear; a powdery substance on and under leaves; rotten patches; spots on the leaves, fruits and stems and infected roots start wilting.

- **Viruses and bacteria** cannot be seen with the naked eye. They cause rot of roots and change of colour and distortion of stems and leaves. Some of the symptoms are similar to those caused by fungi. (Faber *et al., 2006*)

There are three ways of controlling pests and diseases: Mechanical/physical control, chemical control and biological control.

3.3.1 Mechanical/physical control

There are various mechanical/physical methods you can use to control pests. One method is to use your hands to remove the pest. *Sweeping nets* are nets that are swept from side to side to catch insects. This is another physical/mechanical method. *Light traps* that contain food and other things to attract the pest or can also be used. For example, yellow paper coated with a sticky substance will attract and trap aphids.

3.3.2 Chemical control

Chemicals to control pests and diseases can be chemicals that are commercially prepared. These chemicals are called *pesticides*. We strongly advise households not to use pesticides as they are very dangerous to the health of people, animals and the environment. Perhaps you may have heard on the news that many crocodiles in the Kruger Park are dying. Why is this happening? Scientists believe that pesticides and fertilizers are washing into rivers and polluting the water to such an extent that big animals such as crocodiles that feed at the top of the food chain are dying. Think of what these pesticides and fertilizers can do to human health! Pesticides are not only

dangerous, but also very expensive. There are many household control measures to get rid of pests and diseases which are safe to use and also effective.

3.3.3 Biological control

Have you ever watched a bird pulling a worm from the soil or seen it eating small insects from leaves? Animals that eat other animals are called *predators*. When animals are used as a method to get rid of pests this is referred to as *biological control.* We have to work with nature. We have to encourage those insects and plants that help us in the garden. Ladybirds, praying mantis, lacewings, wasps, frogs, lizards and many birds all eat the insect pests that harm our gardens. If you leave them in your garden, they will help you! So do not kill them, even if you are afraid of them.

Below is an example of the benificial predators identified in isiZulu:
Isitholambisi (praying mantis)
Unyoka abafazi (centipede)
Inle intwala (ladybird)
Umyovu (wasp)
Unwabo (chameleon)
Umbankho (lizard)
Unyoni (bird)
Uxoxo (frog)
Imvane (butterfly)

What are these predators called in your language? The picture below shows how some of these insect predators and plants are useful in our gardens and field.

Fig 3.15 Garden friends and strong smelling plants
(Adapted from Kruger, 2008)

3.3.4 Household measures to control pests and diseases

The best approach to good vegetable production is to prevent pest and disease attack rather than trying to cure it. For this you need to ensure a healthy soil and a stable environment for plants to grow in. The main way in which this is done is to promote diversity by doing the following*:*

- Use biological control methods as described above, to get rid of pests and diseases.
- Mix vegetables with other plants such as strong smelling plants tha keep pests away but attract predators.

If you do get pests and diseases in your garden do not use commercial chemicals but rather use the following:

- Herb and plant tea brews.
- Organic home remedies not made from plants.

Strong smelling plants as a control measure

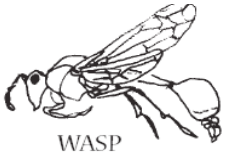
Below are more examples of strong smelling plants that you can grow with your vegetables.

Right: *Pyrethrum* and Feverfew. These plants belong to the *Chrysanthemum* family. They have small white flowers, which contain a poison for insects. They can be planted as borders along your beds, or dotted throughout your garden. You can buy seeds of these plants. Write to the following address: ***Mahlathini Organics, PO Box 807, Richmond, 3780, KZN, South Africa***.

Left: Marigolds *(Tagetes). These plants* can be used in the same way as pyrethrum and feverfew. They have the added advantage of deterring nematodes (tiny worms that attack the roots of plants in the soil).

Right: Nematodes under a microscope

Fennel: Fennel is a great plant for attracting wasps. Wasps lay their eggs in caterpillars (worms that feed on your plants) and can kill many of them in one day!



Wormwood *(Artemisia affra)* or Mhlonyane: These plants grow as large bushes and should be placed at the edges of your beds, or given their own space to grow. A tea made from the leaves is also a good medicine for fevers and colds.

Khakibos/senkhane and blackjacks: These weeds are useful to deter pests. Keep a few in the garden!

Herb and plant teas/brews as insect repellants

Many different plant mixtures can be used to control insects and diseases. These remedies should only be used if all the other methods fail. The main advantage of natural remedies is that they are cheap and can be prepared at home.

General rules to follow when making plant sprays:

- Soap (green bar soap only!) can be added to the mixture to make the spray stick to the plants and insects. Do NOT use liquid soap or soap powder.
- The mixtures can be filtered through thin cloth to remove the bits of plant material. They can be applied using a home-made brush made from grass or twigs.
- These sprays act as contact poisons so make sure you cover the insects or disease symptoms well.
- Some sprays can burn the plants if they are too strong. First test your spray on a few plants.
- The best time to spray against insects is in the late afternoon.
- The sprays are washed off in rain and have to be re-applied.

Below is a list of some of the more common herb and plant brews that can be used, what they are used for and how you would prepare them.

Aloe

Any kind of aloe can be used.

- Crush the leaves in water (1:5). This means use 5 times as much water as you use leaf material. Filter through a fine cloth and use as a spray.
- OR Dry the leaves and grind them into a powder. This can be dusted onto seeds and plants.

CONTROL:

- Insects in general; grasshoppers, aphids, caterpillars;
- Pests in stored grains such as maize, wheat and sorghum;
- Termites and ants.


APHIDS


ANTS

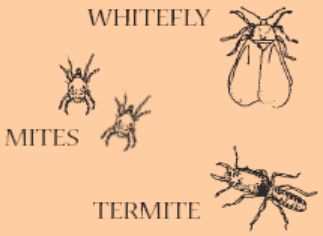

TERMITE


GRASSHOPPER

Blackjack

Cover a cupful of seeds with water and boil for 10 minutes, or let it stand overnight. Add 1 litre of soapy water and spray.

CONTROL:
Insects in general; aphids, ants, beetles, caterpillars, cutworms, mites, termites and whitefly.



Chilli

- Chop up one cupful of hot red chillies. (Be really careful not to rub your eyes!)
- Add 2 litres of water.
- Either leave this to stand in the water for 2-3 days or boil for 15minutes.
- Add half a cup of soap shavings and mix until this has dissolved.
- Filter the solution to remove the pieces of chilli.
- During dry weather, apply once a week.

CONTROL:
Caterpillars, aphids and ants.

This mixture can burn the leaves of plants if it is too strong!

Garlic and onion

Crush 3 big bulbs of garlic (or 1-2 onions) and soak them in 2 spoons of cooking oil or paraffin for 2 days. Filter and mix with 1 litre of soapy water. Dilute this mixture 1:10 with water and use as a spray.

CONTROL:
Insects in general: aphids, mites, wireworms, termites and ants. Diseases such as leafspot, blight and damping off. Examples are bean rust and tomato blight.

Marigolds

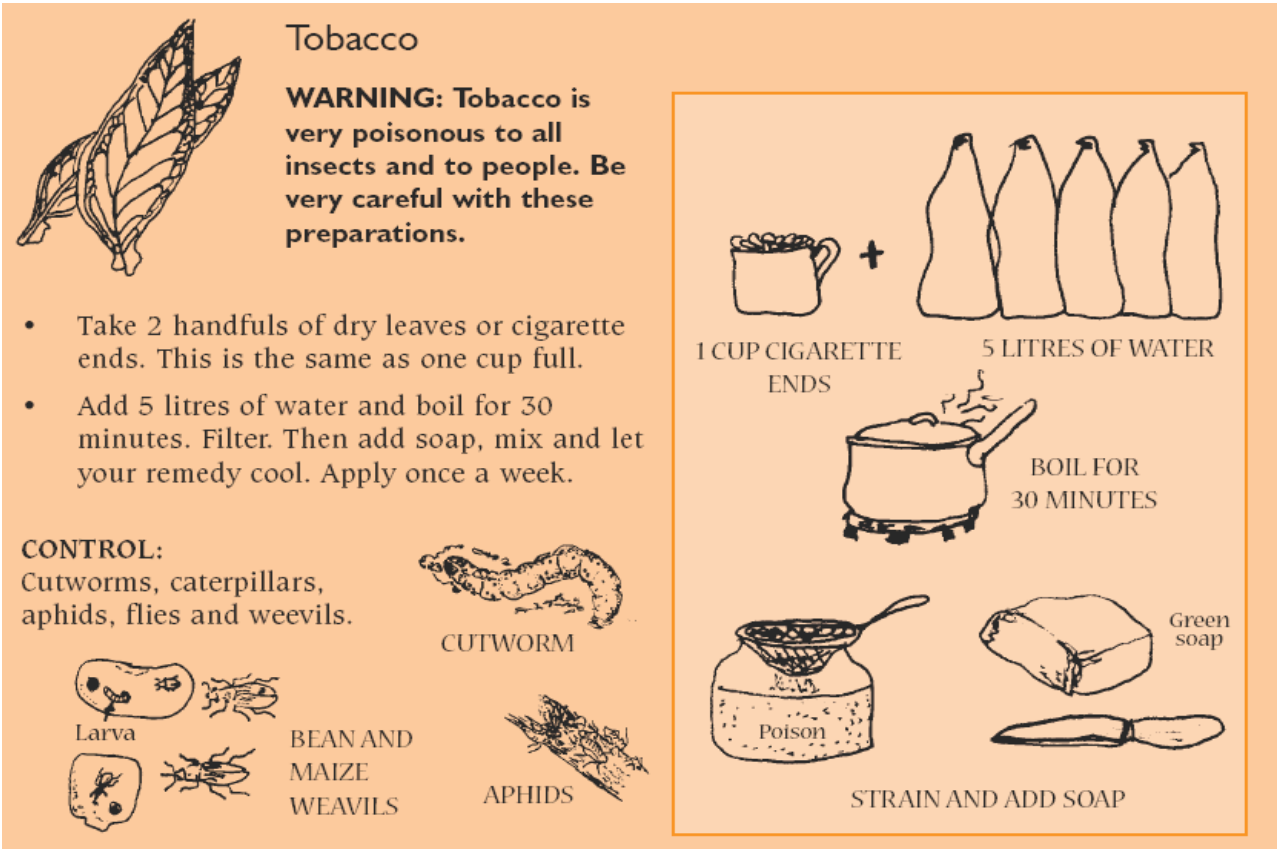
Use the whole plant. Take 2-4 plants and crush the leaves, roots and flowers. Pour on 1 litre of boiling water and soak for one day. Then add 1 litre of cold soapy water and spray this on your plants. The coarse plant materials remaining behind can be used as a mulch around your plants.

CONTROL:
Insects in general: ants, aphids, beetles, stalk borer.
Disease in general: leafspot and blight (early blight and late blight).

Note: A brew made from comfrey leaves can be diluted as mentioned above and sprayed on plant leaves to protect against downy and powdery mildew (fungi). Mildews are a problem mainly on cucurbits, pumpkins and peas.

A brew made from comfrey and stinging nettle can be sprayed on plants to protect against early and late blight, which attacks tomatoes and potatoes.
In these cases the brews are sprayed onto the leaves of the plants

Sometimes, when an infestation (large number of pests) is really bad, some of the brews discussed above do not act fast enough. As a last resort you can use tobacco. We do not recommend that you use it regularly. It is VERY poisonous, also to people. It also kills all insects, including bees and other garden friends.



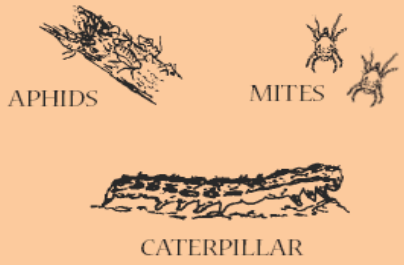
Organic remedies not made from plants

These remedies are made from organic materials, excluding plants. Some examples are given below.

Flour

Mix one big spoon of flour into 1 litre of water. Brush this on the underside of leaves where mites and aphids are. Apply in the morning of a sunny day.

CONTROL:
Spider mites, caterpillars and aphids.

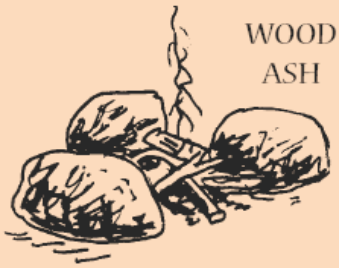


Milk

Spray a mixture of 1 litre of milk and 10 litres of water to control spider mites and diseases such as mildew on pumpkins, blight on tomatoes and potatoes and mosaic virus on peppers. Do this every 10 days.

Wood ash

- Mix one heaped spoon of wood ash in 1 litre of soapy water. Leave it overnight. Spray against insects in general
- Mix one heaped spoon of wood ash in 1 litre of soapy water. Mix in one cup of sour milk and add 3 litres of water.



CONTROL: Mildew on plants and most insects.

- Spread the wood ash in a circle around the base of your plants and water it into the soil a bit.

CONTROL: Snails, slugs and cutworms

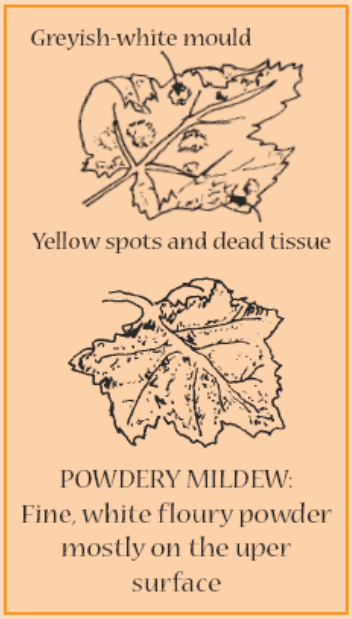


Table 3.4 Advantages and disadvantages of pest and disease control brews

Advantages of pest and disease control brews	Disadvantages of pest and disease control brews
These brews are easy to prepare at home.	These brews can be ineffective in an environment with a high pest or disease load.
They are cheap.	Tobacco brews are effective in almost all cases, but are also very toxic.
They are generally non-toxic to humans and not very toxic in the environment; as they are mostly contact poisons or anti-feedants (prevent pests from eating plant material).	You need to know which pests and diseases are attacking your plants. If you do not, we generally recommend the use of **chilli** or **garlic/onion spray** as a general initial remedy.
They can be very effective in controlling outbreaks of pest and diseases.	Preparing and applying the brews takes time.

Activity 3.5 Assess and analyse best practices for pest and disease control

Complete this activity on your own or in groups in the workbook

Note: This activity consists of Part A and Part B.

Aim:

- Solve a problem in a food garden using a pest control brew.
- Assess and analyse pests and disease problems in the community during a workshop.

Time: 4 hours

What you must do

Part A

1. Read the pest and disease control brews explained above.
2. Choose one of the brews that you think will solve a particular problem you have in your garden. Do a small-scale experiment using your brew of choice.
3. Record your experiment (using the plan and monitoring sheet provided in your workbook).
4. Take photographs if possible, (of yourself making the brew, applying the brew and monitoring your experiment in your garden).

Part B

1. The community now get together for a workshop to discuss the common pest and disease problems that they experience.
2. Community members suggest remedies they have tried, and which work well.
3. Below is an example of how you can record the discussions during the workshop. Note that the last column is for suggestions/new ideas and interventions you will offer during your workshop.

Table 3.5 Pests and disease problems, solutions and new ideas as analyzed by learning group participants in Potshini (2006).

Problem	Solutions tried and their usefulness	Other suggestions/ new ideas
Rats eating vegetables	Rattex and traps.	Rattex is extremely poisonous and should be avoided. Rather get a cat to catch the rats.
Birds eating seedlings	- Use scarecrows which are huge human figures made from straw and dressed with clothes. - Be in the garden from dawn to 8 am to chase birds away. - Plant during early winter so crops are stronger when birds come in July-August.	- Use old cassette tapes to make a barrier over the plants to keep birds out. - Use netting over the garden to keep birds out.
Mealy bug in fruit trees	- Nothing	- Planting with compost to restore balance in the soil. - Pruning parts of the plant attacked by mealie bug
Moles	Amadumbe (taro) chase them away	
Fruit fly sting on tomatoes	- Nothing	Fruit fly traps (demonstration in workshop).
Aphids and worms	Chilli and soap spray	Chilli, garlic and soap (demonstration in workshop).
Cutworms	- Eggshells around the plants - Work warm manure into the beds	- Cutworm **collars** (demonstration in workshop) - Light traps for moths.
Stalkborer	- Granules (bought from a shop)	- Napier fodder as a **trap crop** (demonstration in workshop).

Promoters will demonstrate some methods that work well during the workshop.

4. Compile a table similar to the one in the example. Record the problems and solutions tried. Include suggestions or new ideas to overcome the problem(s) in your table.

5. After analysing the present situation regarding pests and diseases with your group, you can give a talk on natural pest and disease control. We suggest that you focus on three topics (a) Using your garden friends (predators); (b) Using safe chemical sprays, and (c) Mechanical control measures.

Suggested input at your workshop:

Predators and garden friends: Use a colour picture of garden predators. Participants at the workshop identify and discuss their understanding of the roles of these animals and insects in their gardens. The basic message is: If you can, leave these animals to thrive in and around your gardens, as they are part of Nature's balance and will help you in your pest control efforts.

Using safe chemical sprays: Chilli, garlic and soap spray: This brew works well against soft-bodied pests such as aphids and worms. This spray is especially effective against cutworm.

Cutworm lifecycle: Explain this by using a life cycle drawing for a cutworm. Participants may not know that the moths and worms that appear at different times in their gardens are the same insect that has merely changed shape (metamorphosis).

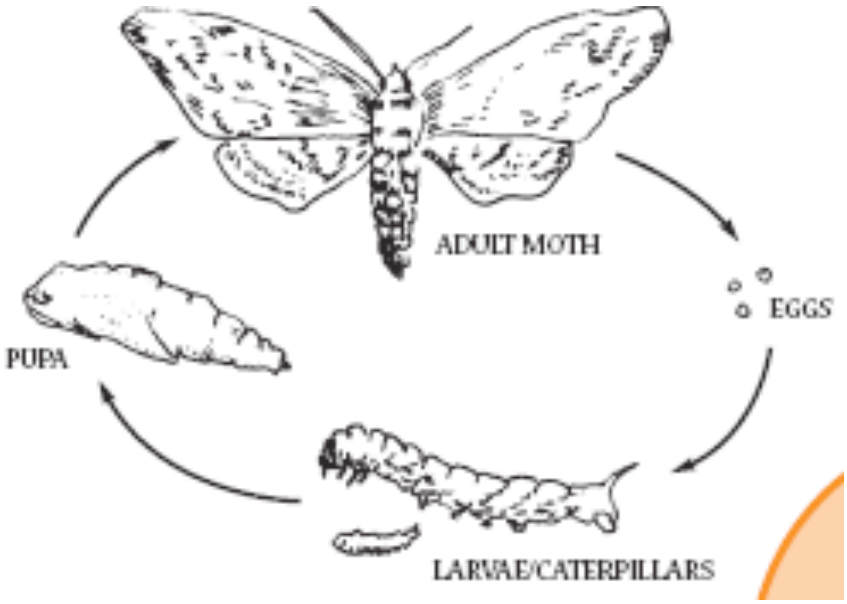


Fig 3.16 Life cycle of the cutworm

You need to explain to participants that any worm in the garden comes in three other forms. It is possible to deal with the pest at any one of these stages:

- Eggs and pupae can be mechanically removed when found.
- Worms can be sprayed with a chilli and soap mixture.
- Cutworms can be stopped by using collars.
- Moths can be caught in light traps.

Mechanical control measures: Show pictures of different ways to control pests using physical barriers. These could include: netting and ribbon structures to protect seedlings from birds, collars to protect seedlings from cutworm and light traps for moths (of all kinds).

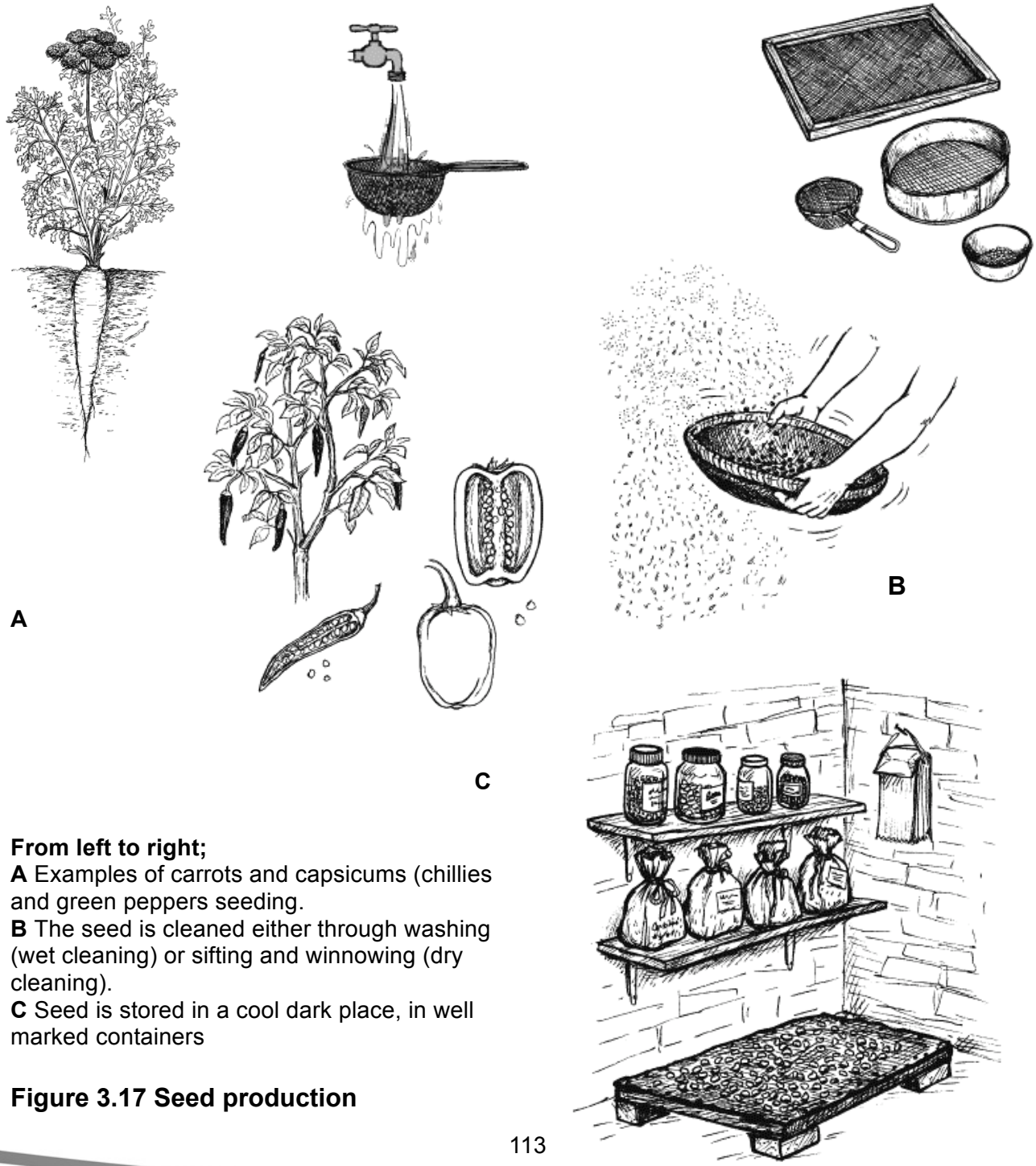
3.4 Plant propagation

Propagation is the process of reproducing or multiplying plants by natural or artificial methods. Most plants reproduce sexually by seeds, but this is not the only way. New plantlets (small plants) can develop from pieces of the parent plant, e.g. from a stem or leaf. This is called vegetative

reproduction (asexual reproduction). When plants reproduce asexually, the plants are identical to the parent plant. This method of reproduction can be very useful to farmers and gardeners because it means they can multiply a plant that has attractive flowers or tasty fruit. Each new plant will have the same features of the parent plant. Skilled gardeners use a number of propagation techniques to increase the number of plants of the same type. Let's start by looking at seeds which are the product of sexual reproduction.

3.4.1 Seeds and seed saving

In Unit 2 we examined seeds as products of sexual reproduction. Sexual reproduction means that no two plants grown from seeds of the same kind of plant will be exactly the same. The reason is that a seed has characteristics of both the mother and father plant. This is similar to brothers and brothers or sisters and sisters not being exactly the same. Except of course for identical twins!



From left to right;
A Examples of carrots and capsicums (chillies and green peppers seeding.
B The seed is cleaned either through washing (wet cleaning) or sifting and winnowing (dry cleaning).
C Seed is stored in a cool dark place, in well marked containers

Figure 3.17 Seed production

Keeping your own seed is central to your independence as a farmer. You can choose which crops and which varieties or types of crop you want to plant. You do not need to go to the shop to buy seed if you keep seed. There are still many varieties of seed that farmers keep or that you can buy from a shop that you will be able to keep for yourself once you have grown the crop.

Growing from seed to seed involves germinating seeds, transplanting seedlings and looking after selected healthy plants until they mature, so that their seeds can be collected and stored for the following year. Plants adapt to the environment they are grown in and produce seeds that carry those adaptations, producing healthier plants better able to cope with the local environment.

3.4.2. New plants from cuttings

Cuttings are pieces of plants, which are used for propagation. Most shrubs and fruit trees are propagated from cuttings. This technique involves taking small sections (called cuttings) from an adult plant, and encouraging them to grow into a whole new plant, identically to the parent plant. Cuttings are therefore an asexual means of propagating a plant. This means only one parent plant is involved and the cutting will produce a plant that is the same as the parent plant.

Cuttings can be taken from different plants of the parent plant. The base of the cutting can be dipped in a hormone, to encourage rooting, and then placed into a soil mix. However, cuttings will grow without hormone powders. Remember to keep the cuttings the right way up, as they will not form roots if you put them upside down into the soil mix.

There are three types of cuttings, as you can see in Table 3.3 below.

Table 3.6 Different types of cuttings

Hardwood cuttings	**Soft tip cuttings**	**Heel cuttings**
Bare pieces of woody stem, cut in winter, while the plant is resting and leafless. The cutting is 20 – 25 cm in length, and must be cut so that it includes a **bud** on both ends.	Soft immature shoot tips are cut from the parent plant in summer time. The cutting should be firm but not hard, with 4 to 5 pairs of leaves. The lower leaves are removed, and the remaining leaves are cut in half, to reduce water loss by transpiration.	Made by pulling off a shoot from the parent stem, so that a small part of the parent plant's stem remains attached to the cutting. This bit of stem is called a *heel*, and it promotes root growth in the cutting.

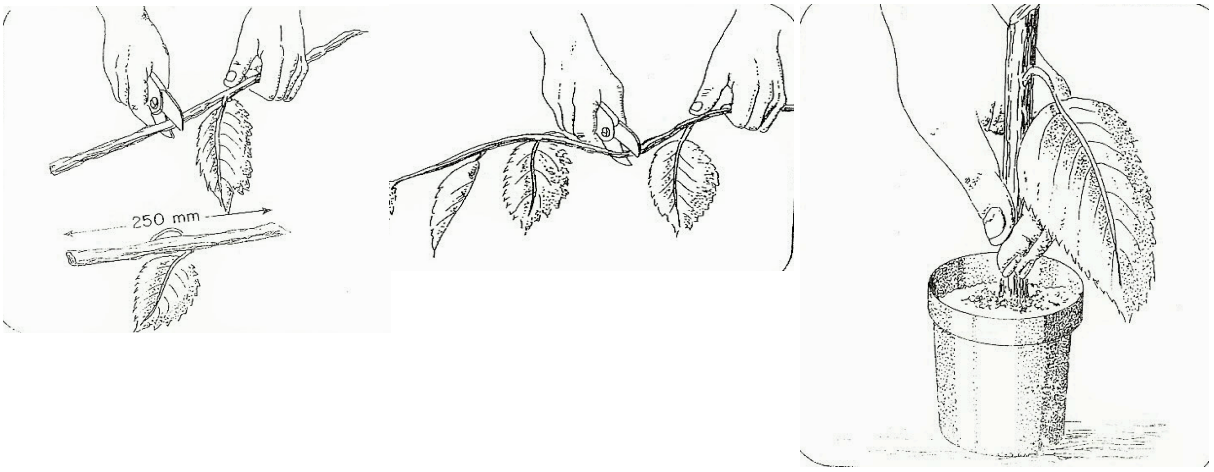


Figure 3.18 How to make a Mulberry cutting
(Kruger, *et al*., 2010)

From left to right; Cut a growing branch that is about pencil thick from the tree. Prepare a piece about 30cm long and plant in a container with sand that can be kept moist, ensuring that the cutting is upright.

Examples of vegetables and plants that can be propagated from cuttings

Sweet potatoes, amadumbe, sugar cane, imfe,

Grapes, peaches, plums, guavas, apples, pears, kiwi fruit, figs, mulberries

Rosemary, lavender, lemon verbena,

Activity 3.6 Growing a plant from a cutting

Complete this activity on your own in this study guide

1. Take a hardwood, soft tip or heel cutting from a plant as explained above. You could also take a cutting of a sweet potato stem that is between 20 and 25 cm long. Cut cleanly below a bud at the base and just above a bud at the top end.
2. Plant your cutting in a container with well-drained soil that is rich in compost. Make a small hole in the soil, more or less half the length of the cutting.
3. Place the cutting in the hole, facing up the same way as they were growing. Press the soil firmly around the cutting.
4. Keep the soil moist, but not wet.
5. After 6 – 8 weeks, the cutting should have grown roots. (This depends on the type of plant you use).
6. Gently remove the cutting from the container. If roots are 1 – 2 cm in length, transplant into your beds, using the same procedure as for seedlings.

Concluding remarks

This unit confirmed that nature is our friend when we work with nature, instead of against it. We do this by recycling organic material and mulching to enrich the soil when we farm or garden. We use recycled containers to sow our seed and water them with water that was harvested sustainably. When we use environmentally friendly ways to combat diseases and pests, not only does the environment benefit, but also our health. Starting and maintaining a garden does not have to be expensive as plants can be inexpensively propagated from cuttings. In the next unit you will finalise the work done throughout this module with households, when you complete your evidence sheets for your portfolio