INTEGRATED POST PRIMARY EDUCATION PROGRAMME

PRODUCING VEGETABLE CROPS

Institute of Adult Education
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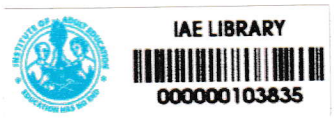

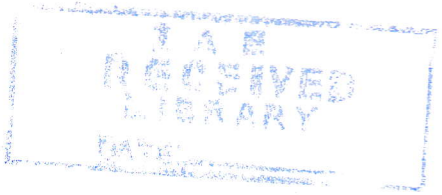

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ISBN 978-9987-11-061-2

Acknowledgements

This module **Producing Vegetable Crops** is an outcome of concerted efforts of various experts from within and outside the Institute of Adult Education (IAE). The IAE profoundly acknowledges the valuable inputs of them all for devoting their time and resources untiringly to ensure effective preparation of this module.

Special thanks are extended to the United Nations Children's Fund (UNICEF) for financial and technical support. Distinctive thanks go to the IPPE team led by Ms Leonia Kassamia (IPPE coordinator) guided by Dr. Wilberforce Meena. Much gratitude are extended to Dr. Fidelis Mafumiko (Deputy Director – Academic, Research and Consultancy) for his closer supervision to ensure that, the work is done effectively.

Sincere thanks goes to Mr. Eric Samba for guiding editorial work and Ms. Aneth Katefu who provided valuable secretarial services. Specifically, sincere appreciations and recognition for insightful and critical contributions are extended to the following writers of this module::

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Contents

About this module

This module has been produced by the Institute of Adult Education. All modules produced by the Institute of Adult Education are structured in the same way, as outlined below.

How this module is structured

The course overview

The course overview gives you a general introduction to the course. Information contained in the course overview will help you determine:

- If the course is suitable for you.
- What you can expect from the course.
- How much time you will need to invest to complete the course.

The overview also provides guidance on:

- Study skills.
- Where to get help.
- Course Unit assignments and assessments.
- Activity icons.
- Units.

We strongly recommend that you read the overview *carefully* before starting your study.

The course content

The course is broken down into units. Each unit comprises:

- An introduction to the unit content.
- Learning outcomes.
- Core content of the unit with a variety of learning activities.
- A Unit reflection.
- Unit assignments

Resources

For those interested in learning more on this subject, we provide you with a list of additional resources at the end of this module; these may be books, articles or web sites.

Your comments

After completing this module, we would appreciate if you would take a few moments to give us your feedback on any aspect of this course. Your feedback might include comments on:

- Course content and structure.
- Course reading materials and resources.
- Course Unit assignments.
- Course assessments.
- Learning hours.
- Course support (assigned tutors, technical help, etc.)

Your constructive feedback will help us to improve and enhance this module.

Course overview

Welcome to this Module: Producing Vegetable Crops

Dear leaner welcome to this module of vegetable crops, it is preparing you to undertake the production of vegetable crops. This module comprises five units which are, preparing land for various vegetable crops, planting seeds of vegetable crops and manage them, observing safety measures when handling and applying agrochemicals, conserve soil and water for sustainable agriculture, harvesting, processing and storage of vegetable crops.

Dear learner keep a portfolio to maintain the answers featured in the reflection, unit assignment and all learning activities for your references and guidance for learning improvement when you meet with your facilitator.

General competence

After completion of this module you should be able to demonstrate variety of tasks to Vegetable Crops Production.

Study skills

As an out of school learner your approach to learning will be different to that from your school days: you will choose what you want to study, you will have professional and/or personal motivation for doing so and you will most likely be fitting your study activities around other professional or domestic **responsibilities.**

Essentially you will be taking control of your learning environment. As a consequence, you will need to consider performance issues related to time management, goal setting, stress management, etc. Perhaps you will also need to reacquaint yourself in areas such as essay planning, coping with exams and using the web as a learning resource.

Your most significant considerations will be *time* and *space* i.e. the time you dedicate to your learning and the environment in which you engage in that learning.

We recommend that you take time now—before starting your self-study—to familiarize yourself with these issues. There are a number of excellent resources on the web. A few suggested links are:

http://www.how-to-study.com/

The "How to study" web site is dedicated to study skills resources. You will find links to study preparation (a list of nine essentials for a good study place), taking notes, strategies for reading text books, using reference sources, test anxiety.

http://www.ucc.vt.edu/stdysk/stdyhlp.html

This is the web site of the Virginia Tech, Division of Student Affairs. You will find links to time scheduling (including a "where does time go?" link), a study skill checklist, basic concentration techniques, control of the study environment, note taking, how to read essays for analysis, memory skills ("remembering").

http://www.howtostudy.org/resources.php

Another "How to study" web site with useful links to time management, efficient reading, questioning/listening/observing skills, getting the most out of doing ("hands-on" learning), memory building, tips for staying motivated, developing a learning plan.

The above links are our suggestions to start you on your way. At the time of writing these web links were active. If you want to look for more go to www.google.com and type "self-study basics", "self-study tips", "self-study skills" or similar.

Do you need help?

Dear learner, in the course of your study, you may need help in various issues such as the location and how to get support from resource centres, clarification of various issues pertaining to your study materials (modules) and so on. If this happens, you are advised to ask for the help from your centre coordinator or facilitator, you can also visit the website of the Institute of Adult Education which is www.iae.ac.tz or ask for help by using phone no +255 22 2150836

Unit assignments

After each unit, you will be required to attempt one unit assignment. These are not meant for submission rather for reflection on what you have learned in the whole module. You will also be given tests and assignments for submission as you will be guided by your module facilitator. You will also sit for mock examinations to accomplish your continuous assessment.

Getting around this module

Margin icons

While working through this module you will notice the frequent use of margin icons. These icons serve to "signpost" a particular piece of text, a new task or change in activity; they have been included to help you to find your way around this module.

A complete icon set is shown below. We suggest that you familiarize yourself with the icons and their meaning before starting your study.

 Activity	 Assessment	 Unit assignment	 Case study
 Discussion	 Group activity	 Help	 Note it!
 Outcomes	 Reading	 Reflection	 Study skills
 Terminology	 Time	 Tip	 Computer-Based Learning
 Audio	 Video	 Feedback	 Objectives
 Basic Competence	 Answers to Assessments		

Unit 1

Preparing Land for Various Vegetable Crops

Introduction

Many people get insufficient product from their garden because of inappropriate use of tools and ploughing techniques. The focus of this unit is to enable you to prepare land for various vegetable crops. The unit has four sections as per learning outcome.

Learning outcomes

Upon completion of this unit you will be able to:

- Identify appropriate farm tools and machinery for ploughing and harrowing.
- Clear the land using appropriate farm tools and machinery.
- Plough and harrow the land to the recommended depth

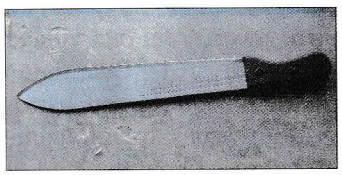
Explain the importance of ploughing and harrowing.

Farm Tools and Machinery for Ploughing and Harrowing

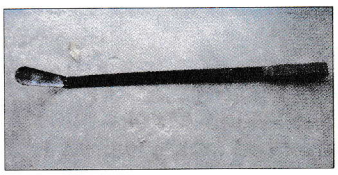
Discuss with your mate on various garden tools used at your locality and identify them. List the findings you got from your discussion and compare them with the ones' provided in the following text.

The following are farm tools commonly used:

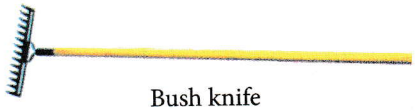
i) **Tools ;-** hand hoes for digging the land, slashes for slashing grass, axe for felling trees, bush knife for cutting shrubs, rake for collecting trash, hay fork for removing trashes.



Bush knife



Slasher



Bush knife

Figure 1: Tools

ii) **Machinery;-** tractors for cultivating land, using drawn equipments like ploughs and harrows, draught animals for cultivating land using ox- drawn equipments.

These machineries will help you to prepare big area in a short time.

Clearing land using appropriate farm tools and machinery

You have identified various tools and machinery used for ploughing and harrowing, you now need to use the appropriate tools and machinery in clearing land.

Visit farmers in your locality and inquire information on how do they use these tools especially in an area which has not been cleared before. Practice an activity of clearing the land by using the tools and follow the steps in land clearing. Below are steps for clearing land.

i) Slashing when having an area with a lot of grasses using mowers and slashes.

ii) Felling trees and distumping by using axes and heavy machinery.

iii) Uproot all roots and remove them from the ground by using heavy machinery like caterpillars.

iv) Removal of trash by using rake

Select a piece of land in your locality and clean it. Prepare a seed bed measure one metre long. Why do you think it was important for your to clean the land. In the next section you will develop you understanding on the benefits of ploughing and harrowing.

Reasons for Ploughing and Harrowing

When you travel from one village to another you can see field that have been cultivated. Take time to discuss with your friend(s) the reasons for ploughing and harrowing. Visit a nearby farmer and discuss the reasons for ploughing and harrowing. Also visit the farm and observe how the land was ploughed and harrowed. Then use the following text to enrich the findings obtained from the discussion with the farmer.

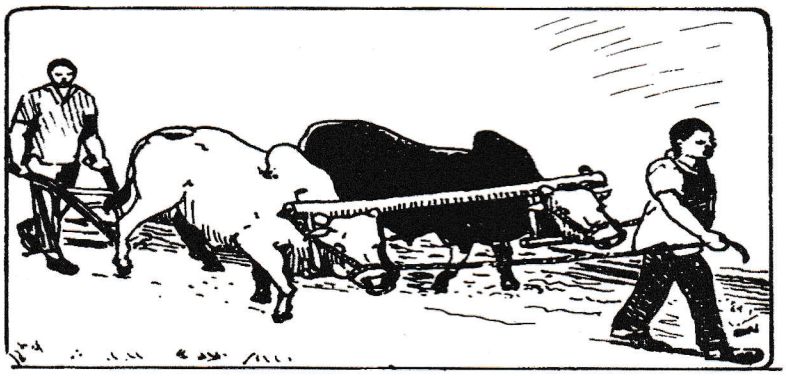
- Ploughing is the process of breaking the soil by using tractor and animal drawn ploughs.
- Harrowing is the process of breaking big clods into fine seed bed.
- This helps good penetration of roots, encourages high water holding capacity, and maximizes the uptake of nutrients from the soil.
- Also help to reduce the burden of weed attack.
- Harrowing give room to easier sowing/planting.

What depth is recommended for ploughing and harrowing?

When you cultivate/dig by using hand hoe a certain part remain above the soil surface.

Do you know what depth is recommended for ploughing? What tools should one use? Is there anybody who owns a tractor at your home area? If yes have you ever seen how it works? In this section you are now required to demonstrate ploughing and harrowing land to the recommended depth. Various crops have recommended ploughing depth which allows good penetration of roots. The ploughing depth ranges from 10cm – 15cm for vegetable.

The figure below demonstrates ploughing and harrowing by using oxen



Kulima kwa maksai

Visit different farmers in your locality and learn different practices adopted on ploughing and harrowing. Use the equipment available to perform the task as it is adopted in that particular area and learn the steps followed. You can use the following text to enrich the skills obtained from the farms you visited.

Preparing Seeds Planting

Have you ever observe any person sorting seeds ready for planting? What steps/procedures she/he was using in sorting seeds? Do you remember them? Have you attempted to sort seeds for planting? If so compare that procedure of sorting with the following principles/ procedures.

- Remove dirty by winnowing.
- Remove impurities by hand selection.
- Remove impurities by sub merging in water in such a way that floaters are poor seeds and sinkers are good seeds.
- Remove damaged seeds during processing.
- Remove insect pest infested seeds.
- Determine germination percentage (GP %) by the following formula.

GP = Geminated seeds x 100%, divide by Total sown seeds
(For simplicity, take 100 seeds and plant them on a well prepared small area of land and count how many have germinated)

Seeds required per Unit Area

Have you observed seeds of different size? Do you understand the word seed rate? Discuss with the nearby agricultural extension worker and compare the findings of the discussion with the factors that determine the amount of seed given below:

Spacing

- wider spacing requires low seed rate
- Close spacing requires high seed rate

Size of seed

- Small size requires high seed rate as seeds are small. You will need a lump-sum to end up with reasonable weight.
- Large size requires low seed rate. Being large few of them make reasonable weight.

Sowing method – if sown by broad casting, that is, an even spread of the seed on the seedbed then you will require too much seeds, while dibbling and drilling will require low/less amount of seeds as spacing will be maintained.

Germination percentage

- Above 80% you will use a reasonable seed rate.
- Less than 75% you are going to use large amount of seed so as to gap the 25% remains

Soil moisture

- Very dry and too wet use much seeds

Planting Selected Seeds on the Prepared Land

After knowing amount of seed required per unit area.

It is better to understand planting methods, spacing of various crops and proper techniques of planting.

Prepared raised seed bed

Amaranth planted by drilling method

Method of planting

There are wide range of methods, they include;-

Broadcasting – seeds are scattered evenly over the soil surface. e.g. beans.

Dibbling – holes are prepared at a recommended spacing and seeds planted. e.g. okra.

Drilling – seeds placed in prepared rows at a depth not exceeding 5 cm. e.g. amaranth.

Spacing

In order to be aware with various spacing used in different crops you are required to study the table below.

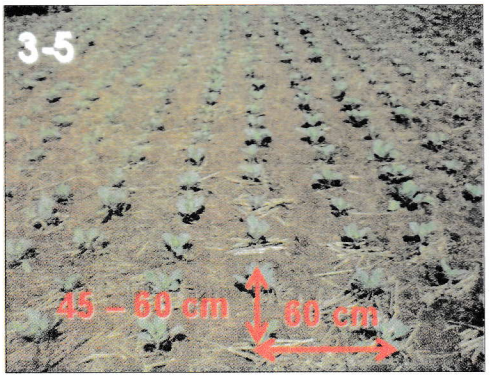
Crop type	Recommended spacing
Onions	20 cm x 20 cm or 20 com x 15 cm
Amaranths	15cm x 30cm or 30cm x 40cm
Tomatoes	60 cm x 60 cm or 75 cm x 60 cm
Cabbage	45cm - 60cm x 60cm or 50cm x 50cm
Orange	6 m x 6 m
Pawpaw	3 m x 3 m
Bananas	3 m x 3m or 2.7 m x 2.7 m

Meaning of spacing

The above table shows the spacing of different crops in the following section you will learn about seed spacing. In your own words what is the meaning of spacing. It is defined as the distance between rows and between plants within the row. Large number indicates distance between rows and small number indicates distance between plants.

Advantages of planting using recommended spacing,

- Reduce competition of nutrients, water and sunlight.
- Have vigour seedlings.
- Easier management like weeding, fertilizer application.
- Avoid easier diseases transition.



Spacing for cabbage

Steps of planting seeds/seedling are:

- Take measurement properly according to the crops.
- Make holes according to the spacing.
- Mix 2kg farmyard manure with soil per hole for vegetables and 10 – 20 kg farm yard manure for fruit trees.
- Plant seeds/seedling per hole.
- Cover with soil and firm
- Irrigate immediately if it is not raining.
- For fruit trees it is advisable to plant at onset of rains.

You are now well experienced with planting activities/practices in various vegetable crops. Consideration to other crops not in the examples provided is required.

Unit reflection

In this unit you learned on how to plant seeds of vegetable crops

Think of what you have learnt by answering the given questions.

- What was the most interesting in this unit?
- Have you found any problems in this unit?
- Do you have any questions which have raised after studying this unit?
- Which measures are you going to take so as to take of care raised questions if any?

Unit assignment

You have come to the end of this unit. Do the following questions to assess yourself before going to the next unit. If you cannot answer most of the questions, please repeat the unit.

1. Describe qualities of good seeds.
2. How do you plant amaranthus seeds in the prepared seedbed?
3. Explain the meaning of the following words
   a. Spacing
   b. Dibbling
4. Differentiate broadcasting and drilling as a method of planting seeds.

Unit 3

Managing Vegetable Crops

Introduction

In the previous unit you have learned about planting seeds correctly, the emphasis was on good quality seeds, correct amount of seeds, methods of planting as well as actual planting techniques. In this unit you are going to learn on the management practices to the planted vegetable crops.

Learning Outcomes

Upon completion of this unit you will be able to:

- Thin and gap-fill the crop to obtain optimum plant population
- Weed the crop using appropriate methods used to different crops.
- Identify different types of fertilizers.
- Apply fertilizers to the vegetable crops based on recommended rates and stage.
- Identify major types of pests/diseases and control methods.
- List and observe safety measures when handling and applying agrochemicals.

Thin and Gap Fill the Crop

Thinning is the removal of over-populated plants so as to remain with the optimum plant population.

Gap filling is the replacement of seeds to the area where germination fails.

Dear learner crops such as vegetables are like any other living things, they need to be managed very well. Imagine someone had planted amaranths spinach, tomatoes, cabbage or onions and left them unattended from the day of planting such crops will fail to grow well or die completely. It is important to follow recommended practices in the management of vegetable crops. The principles presented below outline proper management of a garden.

Thinning - for directly sown crop so as to maintain recommended number of seedlings per hill.

Gaping - if found to have some gaps i.e two weeks after Sowing/planting/transplanting.

Weed control - to avoid invasion, weed twice in a growing season.

Methods used for Weed Control

1. Hand hoe – cultivate all weeds
2. Uprooting by hand, any weeds growing very close to the plant.
3. Mulching
   Mulching is done by covering the surface of the soil with straw or grasses. You are required to spread a thick layer of grass mulch over the surface of soil in order to suppress weeds.
4. Another method is by spraying weed killers (herbicides) to established crop.

I hope now you are able to continue with management practices so as to end up with high quality vegetable crops. Figure 3 below shows the tools used for weeding.

Application of Fertilizer

Among characteristic of living things are growth and nutrition vegetable required nutrient to grow and produce. These nutrients are known as fertilizers. There are different groups of fertilizer and application method.

Groups of Fertilizers

1. **Organic fertilizers**

   This group include:

   a) Farm yard manure (droppings from different animals)
   b) Compost (composted vegetation)
   c) Green manure (from leguminous plants)

These fertilizers are used at planting time.

Rate of use

- 1 tin (of 20litre capacity per) $1m^2$ when sowing spinach.
- 2 kg per hill when transplanting tomato and cabbage.

Inorganic fertilizers

Fertilizers under this group are also called industrial fertilizers which include:

a) Phosphatic e.g. Triple Super Phosphate (TSP), Minjingu, are used as basal at planting time at a rate of 5 gm per hill or per plant measured in a soda cup, tea spoon full or pinch.

b) Nitrogenous used as topdressing (during the growing period of the crop e.g. sulphate of ammonia (S/A), Calcium Ammonium Nitrate (CAN) and Urea

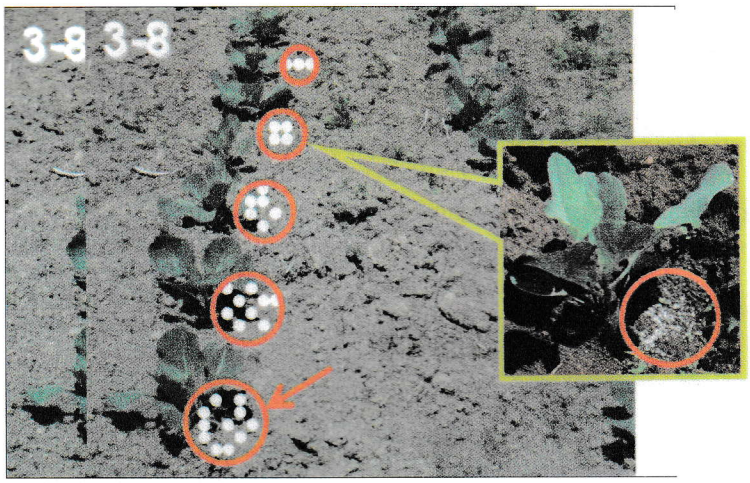
Now take time to observe the listed types of fertilizers in any fertilizer store, how many types of fertilizer have you found? Such fertilizers could be applied using the following techniques:

1. Broad casting for farm yard manure as a basal, one Tin per $1m^2$ in spinach field.
2. Spot application in tomatoes and cabbage field 2 kg per hill.
3. Drilling when using Nitrogenous fertilizers to crops like spinach. Application in this crop is every after harvest at a rate of 20 gm per row of 1m length.
4. By ring method, 5 gm per plant on tomatoes done 3 times as shown here under:

The following are steps to be followed when top dressing tomatoes.

- 2 – 4 weeks after transplanting apply 5 gm of CAN by ring at a radius of 5 cm.
- 2nd application at flowering time.
- 3rd doze at time when first fruit cluster starts to change colour from greenish to pinkish/reddish.

In cabbage top dress at an interval of 14 days twice in a season from followed by irrigation.



cabbage top dress at an interval of 14 days twice in a season from followed by irrigation.

Take a position of a farmer, what do you expect from the crops which has been dressed by fertilizers? Study the table below to know the advantage and disadvantage of organic and artificial fertilizers.

Advantages

Organic fertilizer		**Artificial fertilizer**	
1.	Wide range of nutrients including trace elements	1.	Quick to dissolve hence absorption
2.	Improve soil structure (binding soil particle together)	2.	Easy to transport

Advantages

Organic fertilizer		Artificial fertilizer	
1.	Nutrient supplied are in small quantities	1.	Has got residue effect
2.	Labour cost in terms of transportation	2.	It is expensive in terms of cash
3.	You might miss manure in some areas where animals are not available		
4.	Take time to dissolve hence being absolved very slows.		

Types of Pests/Diseases and Control Methods

Dear learner, one of the very important aspect in vegetable crop production is the problem of pest infestation the problem can end up with a zero harvest. This section you are going to learn the pest/diseases that attack common vegetable their symptoms and recommended control measures.

Before you go in details in table provided go around the field/garden and collect enough samples of different pests/diseased plants that will help you to diagnoses the disease.

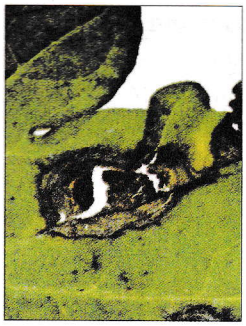
Crop	Pest, diseases and their symptom	Control
	a) Pest	
Tomatoes	1. American bollworm - Caterpillar bores into fruits and feeds on the inner parts causing fruit to root	- Destroy infested crop Spray chemical insecticide
	2. Tobacco whitefly - Suck juice on leaves	- Spray insecticide - Mottled leaves should uprooted and burnt
	3. Red spider mite - Feed on leaves	- Spray insecticide
	b) Disease	
	1. Early and late blight - Lesion on fruits - Scorched appearance on leaves and stems	- Field sanitation - Crop rotation - Fungicide spray - Burn crop residue

Crop	Pest, diseases and their symptom	Control
	2. Mosaic - Mottling - Necrosis on stem and leaves	- Up root affected plants - Crop rotation - Spray insecticide to kill vector
	3. Wilting - Sudden willing of the plant	- Crop rotation - Plant in a clean area - Add organic matter to the soil - Remove out affected plant.
	4. Nematode - Gull formation on roots	- Crop rotation - Plant on areas free from the attack.
1. Amaranthus	1. Spinach aphids - crinkling of leaves	- Irrigate by using watering can so as to remove the pests. - When endemic spray chemical
	2. Damping off - seedling get girdled at the base of the stem	- Crop rotation - Add enough O.M - Spray fungicides
2. Cabbage	a) Pest	
	1. Cutworms - The grayish black larvae that partially or completely bites out the stem at ground level causing the plant to fall over.	- Early weeding destroys sites for egg laying - Hand removal since the pest is easily found near the damaged plant - Ploughing exposes pests to its predators and desiccation - Uses insecticide
	2. Diamond back moth - Pale green larvae feed on the underside on leaves making "window" through it - Serious in drier month	- Intercropping with other crops which acts as repellents (e.g. tomatoes) or (Indian mustard)
	3. Aphids - Stunted growth of the cabbage - Staining on the cabbage (aphids suit)	- Spray with recommended insecticide e.g. Karate

Crop	Pest, diseases and their symptom	Control
	b) Diseases	
	1. Bacteria soft rot - Rooting of cabbage head	- Field sanitation - Fungicide sprays e.g. Ridomil - Crop rotation with legumes, cereals - Avoid harvesting when it is wet. - Handle produce careful and store in a cool, well ventilation area
	2. Black rot - Brownish in a v-shaped form on leaf margin	- Field sanitation - Use certified seed - Use of resistant/ tolerant varieties
	3. Black leg - Leaves develop ash grey centres with many black spots - Stem has dark canker extending below soil level that kills the roots.	- Use of certified seed - Field sanitation - Crop rotation
3. Onions	1. Purple blotch - purple centers on leaves	- Early planting on cool season. - Crop rotation
	2. Downy - mildew powder mycelium on leaves/ death from the tip	- Fungicide spray. - Crop rotation - Observe close season.

It is important for you to know what a health crop looks like, to be familiar with normal crop development and to recognize the typical damage from pests and disease. Observe the following plate showing pest and disease of tomato and cabbage.

American bollworm

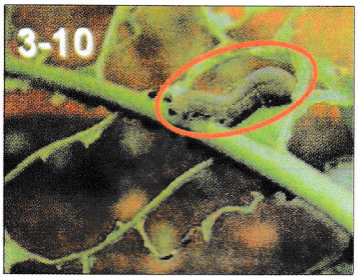


Close-up of leaf spots showing concertric ring

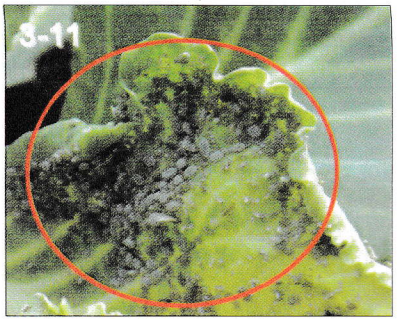
Spot on stem

Root knot

Diamond back moth

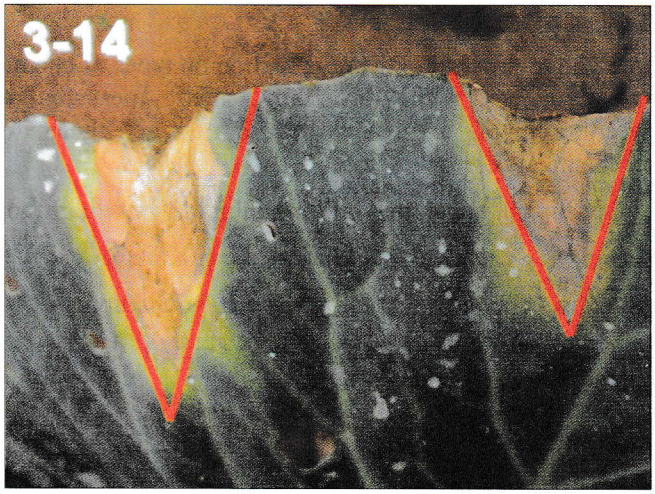


Cabbage sawfly

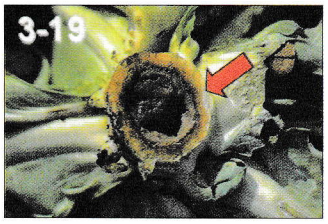


Aphids

Cutworm

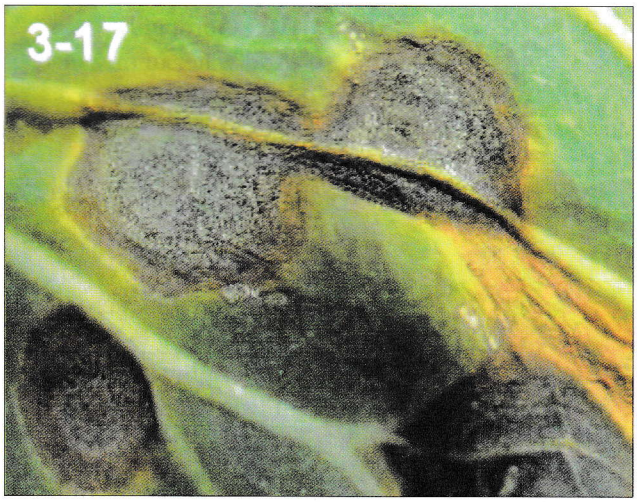


Early symptom of "stack root" on cabbage leaf



Bacterial soft rot symptom on cabbage stem

Cabbage root infected with "black leg"



Cabbage leaf infected with "ring spot"

Handling and Application of Agrochemicals

I welcome you to proceed to the next section on types of chemicals, spraying techniques while observing safety measures when handling and applying agrochemicals. As a learner, these are the common chemicals used;-

1. Fungicides - chemical, that kill or inhibit the growth of fungi
2. Insecticides – chemical that kill insect e.g. Karate.
3. Herbicides - chemical that kill weed e.g. Round up.
4. Nematicides – chemical that kill or inhibit the growth of nematodes

Spraying techniques

Mixing

- put sprayer at a level ground
- Remove the lid of the sprayer
- Fill water ¼ of the sprayer
- Measure required amount of chemical and put in the sprayer.
- Mix thoroughly
- Add water to the rim
- Put the lid/cap on

Actual spraying

- Check wind direction by using chemical driffs through the nozzle or observe vegetation movement
- Carry the sprayer
- Start spraying across the wind direction.

Do not spray crop two weeks before start harvesting. Use chemicals with less toxicity or avoid killing beneficial insects.

Have you ever heard that somebody have been affected by chemicals while spraying? If so what were the reasons for such incident?

You can compare your findings the with following precautions below:

1. Wear appropriate clothing including a face mask, gloves and boots.
2. Spray in the morning or afternoon hours when the temperature is relatively low.
3. Never work alone when handling hazardous pesticides.
4. Read the product label carefully
5. Wash off immediately splashes of concentrate on the skin or in the eyes.
6. Wash off drips of concentrated on the outside of containers for safe handling.
7. Never smoke, eat or drink until you have washed thoroughly.
8. Avoid contamination of streams, ponds, lakes or wells.

Proper dressing with protective gears

Unit reflection

You are now coming to the end of the unit, hopefully you have learned a lot especially on management practices basing on production of vegetable crops.

- What is the most important aspect you have learnt in this unit?
- What are the challenges did you face in this unit?

Unit assignment

Before you move to the next unit answer the following questions.

1. List five safety measures when spraying
2. List major problems in tomato growing
3. List the critical stages which is required is to perform top dressing in tomatoes.
4. Differentiate organic and inorganic fertilizers.

In your locality how do you control diseases affecting cabbage

Unit 4

Conservation Soil and Water for Sustainable Agriculture

Introduction

Vegetable crops are intensively cultured crops, they need intensive care through the growing period. Crops need enough water, fertile soils for nutrient supply. Therefore in this unit you are required to consider all aspects in soil and water conservation for sustainable agriculture. Soil is the store for water and nutrients required by the plants if not well conserved will lose all nutrients and water too.

Learning Outcomes

Upon completion of this unit you will be able to:

- Apply cultural measures for soil and water conservation.

Cultural Measures for Soil and Water Conservation

Dear learner, soil and water is vital to plants that is why vegetable crops require water and fertile soil all the time hence water source should be reliable and sustainable. The following are different cultural measures to be involved in conserving soil and water.

1. Plant grass and trees on open areas in order to reduce or control soil erosion which might be caused by wind and water runoff.
2. Conserve natural forest by avoiding cutting trees. Tree Leaves and twigs decompose and add organic matter when they fall to the soil.
3. At the time of land cultivating make sure that the given principles below are followed/ practiced.

Ridging/terracing construction

When you have steep slopes always such areas are prone to soil erosion. What do you think should be done in such areas? Brainstorm with your mate on the proper measures which can be taken or applied to overcome the problem.

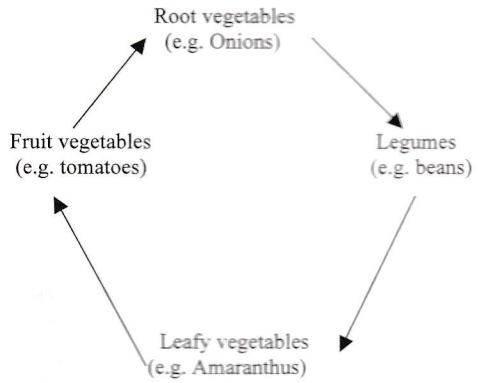
Compare your answers with these given in the following text.

Ridges/terraces are constructed in such a way that they cut across the slope hence reduce speed of water flow.

Preparation of tie ridges is also applicable prepare normal ridge across the slope and make ties to make holes as a result water flow is reduced and in the other side water infiltrate in the soil.

Crop rotation

In vegetable production the word rotation refers/meaning to changing the crop that is grown on an area of land in order to protect land. You can change crops every season to conserve nutrient supplied. Observe the diagram below which shows simple rotation in vegetable growing seasons.



You are always advised to cover the soil surface with mulch, (dry grass, crop residues etc) by spreading them on the farm. Why is it advised to do so, I hope you have enough discussion with your colleague learners, compare your answers with the following text.

Advantages of mulching

- Reduce soil erosion due to surface coverage.
- Conserve soil moisture as loss of water is limited.
- Suppresses weeds by providing shade which does not allow weed to germinate.
- Add organic matters to the soil upon decomposition.
- Improve soil structure hence leads to improve water economy through reduced evaporation from soil surface.

NB. Mulching is applicable in termite free areas.

Maintaining proper stocking rate.

Dear learner stocking rate means the recommended number of animals per unit area. Don't keep too much animals. In small area. It is recommended that in areas with high rainfall keep one cow per 1 hectares of pasture area and five hectares for areas with low rainfall.

i) It is not recommended to construct residential houses nor cultivating on top most of mountains where we expect water source.

ii) It is also recommended not to cut down trees without reason if so practice the principle of cutting one tree and plant two of them.

iii) In steep slopes and on water valleys put stones and stumps of trees to reduce the speed of water flow and construct canals to convey water ways.

iv) Plant leguminous crops which add nitrogen to the soil as they are nitrogen fixing crops. They will conserve soil as they are creeping plants will cover the soil surface hence reduce water erosion or wind erosion, that is why in rotational program of vegetable growing legume crops are included.

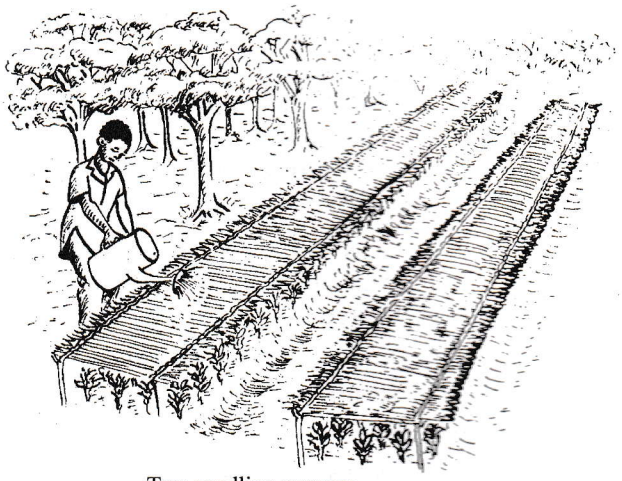
Importance of Conserving Soil

Dear learner, visit a nearby farmer who practices soil conservation measures and inquire on the advantages or importance of conserving the soil. You can use the following text to enrich the discussion with the named farmer. Compare your findings with the ones given below.

- Through soil conservation, soil erosion will be reduced or stopped and soil will remain with it's high level of nutritional status leading to production of high quality and quantity crops.
- Leaves/grass and forest is restored hence brings a reasonable rainfall.

Note: Always try to have trees planted around your area and natural forest conserved.

Find out tree seedling from government tree nurseries and plant them, or establish your own tree nursery so as to get seedling for planting.



Tree seedling nursery

Unit reflection

You have learned how soil and water can be conserved for the betterment of the production of crops. I hope you can tell which practice is the best to you.

- You can also tell areas of difficulties and how you can overcome them under field situations at your locality.
- Which practice to you is easy to follow? (Share it with your friend) after you have gone through this unit.

Unit assignment

You have come to the end of this unit. Do the following questions to assess yourself before going to the next unit. If you cannot answer most of the questions please repeat the unit.

1. List four practices used in conserving soil and water.
2. List the recommended principles which are used during land cultivation as measures for conserving soil and water.
3. After going through the unit, explains the advantages of using mulch in soil and water conservation.
4. Explain the general advantages of conserving soil and water.

Unit 5

Harvesting, Processing and Storing of Vegetable Crops

Introduction

Dear learner, on previous unit you have learned about tools used in preparing land when vegetable crops are established to the point of crop maturity. Now you are required to harvest, process and store properly the crops for future use.

Learning Outcomes

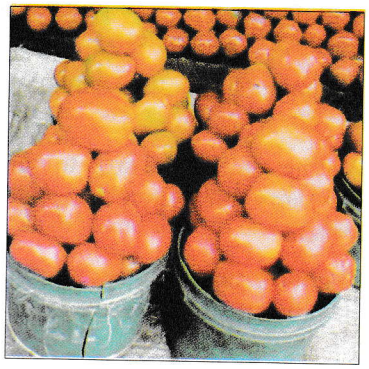
Upon completion of this unit you will be able to:

- List signs of crop maturity and materials/equipment for harvesting.
- Harvest crops using recommended techniques and tools.
- Outline various post harvest processes for different crops and their operations.

Signs of Crop Maturity

When you plant a young seeding it grows, flowers and bear fruits. It reaches a point doesn't continue. Is it maturity stage? You must ask yourself on how to recognize a mature crop. There are signs or indicators which tell if harvesting is ready. These signs include:

- Colour change from green to yellow or reddening of tomatoes.
- maintain its tenderness e.g. okra if broken at the tip
- heads become firm e.g. cabbage
- in some cases fruits taste sweet.



Therefore when a specific crop show these signs is an indication that the crop is ready for harvesting.

Materials for harvesting vegetable crops

- Sacks – as a container to hold crops from the field to respective area of destination.
- Buckets – works the same as sack and even transferring while in the field
- Knife – item specific for cutting the crop like cabbage and amaranthus during harvesting process
- Harvesting crates – container where by produce are packed from the field. Some crops like tomatoes need ventilation and packing techniques that avoid pressing.
- Garden tractor pulling a small trailer – collect to the market or homestead.

Container for harvesting produce should be kept clean and used only for this purpose.

Various Post Harvest Process

Dear learner, this section needs you to outline all the necessary post harvest operations in various vegetable crops after harvesting.

Most of the operations involved aim at improving quality of the produce to fetch high market price. If you want to use these operations you can do the following;

Sorting – after harvesting sort the product to remove un-needed debris e.g. in amaranthus.

a) Cleaning – when the produce is dirty ensure cleaning it very thoroughly using clean water.

b) Trimming of roots – applicable in onions use sharp knife to trim the roots.

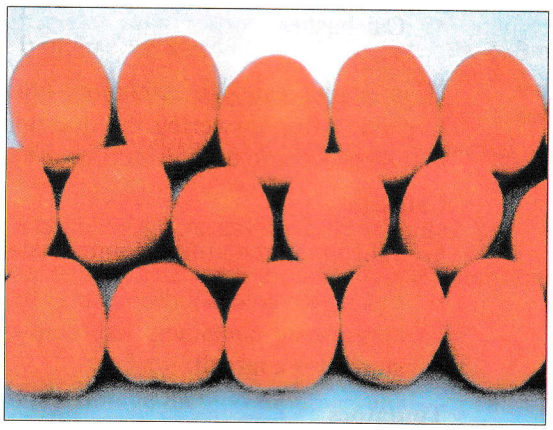
c) Wilting – allow the crop to wilt in the field for 24 hours before you carry them home. Applicable in onion to reduce water content.

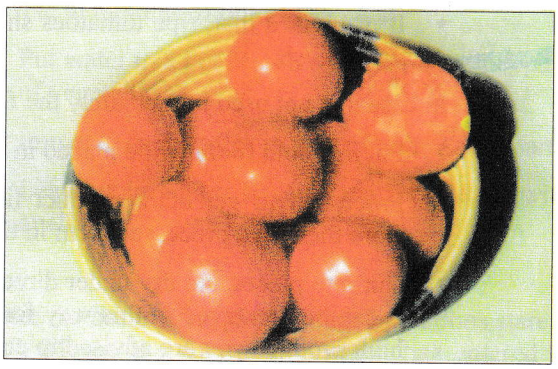
d) Grading – another step is to grade the produced so as to make the product attractive to customers.

Grading of Vegetablel Crops

Dear learner, assume you have the produce ready for use, which factors will you consider in order to come up with quality products for sale? I hope you will consider the following

- Size - product of the same size are required to be grouped together e.g. small, medium and large size.
- Colour – separate products based on uniform colours i.e. pink, red.
- Variety – differentiate varieties in the same crop should be separated differently e.g. tomato known as Tanya separated with Tengeru 2010.





- Uniform shape – avoid malformed produce, product of the same shape should be in one group e.g. round, oval.
- Healthiness – sometimes produce is infested with diseases or insect pest or sunburns pack them in their own group.

Note: Grading is done based on market requirements

The knowledge and skills you learned in the previous four sections shall help you in the next section which involve storage facilities.

Storage Facilities

The following are the common facilities used:

- Cold room – rooms which can maintain required temperature to a specific crop.
- Refrigerator
- Crates/boxes
- Dry ventilated rooms.
- Sacks/bags
- Pots
- Calabashes
- Tins

What storage facilities are you used to in your home area?

Dear learner can you remember how your parents stored crops? Explain. After answering the question, you can now proceed to outline procedure used in storing specific crop produce as follows:

Cabbage

- When matured utilize it immediately after harvesting
- Put under cold conditions e.g. in cold room while they are in appropriate containers like crates. In such a condition can be stored for a month.

Tomatoes

- It is advised that, ripe tomatoes should be utilized immediately while fresh.

In case it is not used immediately the following should be done:

- Put in a cold room while placed in ventilated containers.
- Process it to get other product like pickles, jam, source and store them in a processed form in tins.
- Cut into pieces and dry under direct sun and store in containers. It can be preserved in this way for 6 months. In case you have high produce you are advised to consult food processer through your Agriculture Extension Officers.

Onions

Sort/grade to remove those onions with thick neck to avoid sprouting in the store then store in a well ventilated and cool place. Preferable in a crib (hut), keep on turning onions weekly. This is preserved for more than 6 month waiting time of high price.

Amaranths – (green leafy vegetable)

Dear learner when you have surplus produce of this type the following steps help you to store it for long time;-

- Boil water and add salt to taste.
- Take your sorted vegetable and tie in a bag made of white cloth.
- Immerse the bag in the boiling water for 2 -3 minutes.
- Remove from the pot and drain water.
- Let the vegetable dry slowly under partial shade until it dries well.
- Put in bags, pots, calabash for storage.

It can remain safe for 6 month without deterioration (going bad or spoil).

Another storage method for amaranthus for short time.

- Tie in bundles of one (1) kg each.
- Put water in a pot, the size of the pot will depend on the amount of vegetable.
- Immerse the bundles in water by the lower part (stem side)
- Leave it in water. It can keep for 2 days without affecting it quality.

Note: the basic principle of stores operations state that "first in first out". Means the commodity which has entered first in the store must be the first to get out for use or sale to avoid deterioration.

Unit reflection

In this unit you learned about harvest, process and storage vegetable crops.

i) Which part of the unit was the best to you? Give your comments.

ii) From your learning in this unit did your face any obstacle? If any how did you solve It?

iii) Assume that, you have a lot of tomatoes in your field and you are sure that you can't sell all of them quickly as they continue ripening, how are you going to process them so as to avoid loss of the product.

Unit assignment

Dear leaner, test your understanding by answering the following questions.

1. List materials/equipments used for harvesting vegetable crops
2. Explain the procedure to process amaranthus
3. Outline the various operations involved in post harvest processes of vegetable crops
4. You are required to grade, tomatoes after harvesting, list factors to consider when doing the skill
5. You have learnt that vegetables are perishable (they deteriorate very easily).list some storage facilities recommended so as to prolong shelf life of vegetables.