RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Horticultural Crop Production

TRAINER MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

USAID FROM THE AMERICAN PEOPLE

EDC Education Development Center

2020

Acknowledgements

Rwanda Polytechnic (RP) would like to officially recognize all parties who contributed actively to the preparation of the Trainer and Trainee manuals of this module. We wish to extend our thanks to various organizations such as Workforce Development Authority (WDA), EDC through its USAID Huguka Dukore Akazi Kanoze (USAID - HDAK), TVET schools, Private Industries, GIZ Hanga Ahazaza Project and other individuals who greatly contributed from the initial concept towards publication of this training manual.

Under Rwanda Polytechnic (RP) supervision and involvement

Under Workforce Development Authority (WDA) guiding policies and directives

With funding provided by USAID through Huguka Dukore Akazi Kanoze (HDAK) project

And with technical support by Education Development Center (EDC) through local and international USAID HDAK experts

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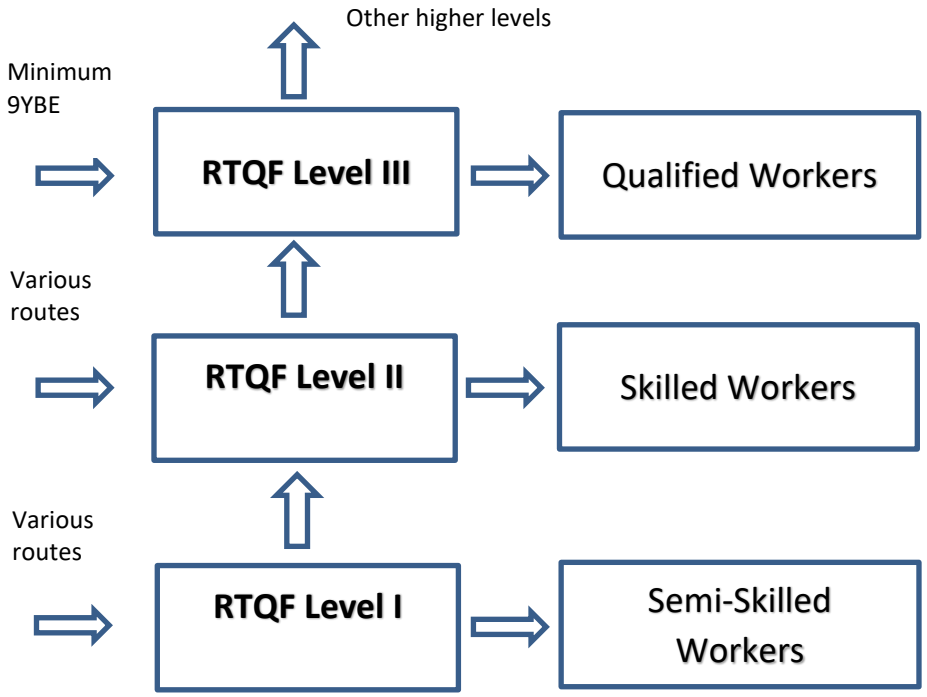
Introduction to RTQF Level II Training Modules

Background

Rwanda Polytechnic, with support of and in collaboration with USAID Huguka Dukore Akazi Kanoze, has developed RTQF TVET Level II programs that combine basic education, soft skills and vocational skills modules. Bridging the gap between Level I and Level III programmes, Level II aims to prepare learners who have a minimum education level of Primary 6 or equivalent to continue with their education or become skilled workers in the labour force.



Following the Workforce Development Authority (WDA) curriculum development process that involved experts from Rwanda Polytechnic, Rwanda Education Board, Ministry of Agriculture, technical vocational institutions, Education Development Center, Akazi Kanoze Access and other technical experts, training modules were developed in basic education, soft skills (work readiness) and, initially, agriculture. Additional vocational areas will be added over time. Trainees will be trained in all Basic Education and Soft Skills modules listed below, as well as in 6 - 8 modules that make up their chosen technical vocational programme.

Module Requirements:

Basic Education	Soft Skills	Vocational Skills
• English • Kinyarwanda • Mathematics	• Basic Entrepreneurship Skills • ICT Essentials • Communication Skills	• Vocational programmes will have a set of 6 – 8 required technical modules.

• Integrated Science (Physics, Chemistry, Biology)	• Safety, Health and Sustainable Environment • Personal Development and Career Guidance	E.g. Food Crop Production and Processing includes the following modules: 1. Food Crop Production 2. Small Scale Post-Harvest Operations 3. Growing Medium 4. Food Safety and Sanitation 5. Food Preservation and Storage 6. Flour Processing

Organization of the Training Manuals

For each module there is a Trainer Manual and a Trainee Manual. These manuals, based on the curricula for each subject, are divided into Learning Units, and each Learning Unit includes 3 – 5 Learning Outcomes. The learning outcomes make up the essential skills, knowledge and attitudes to be acquired by trainees. To make the Trainee Manual more user friendly, Unit and Topic are used respectively for Learning Unit and Learning Outcome. The number of hours per training module varies, ranging between 30 and 120 hours.

Teaching & Learning Methodology of RTQF Level II 2 TVET Materials

The teaching and learning methodology used in the materials is based in experiential and adult learning. Activities are designed to engage trainees, build upon what they know and learn and provide them with opportunities to build their skills in the classroom and in the workplace. More specifically, guiding principles in the development of the manuals include:

- Building on participants' knowledge, skills and experiences
- Facilitating a learning process through active engagement of participants rather than through lecturing
- Providing opportunities to practice – inquiry based and hands on practice, both in the classroom and workplace
- Using simple and clear language
- Connecting to the real world: use local resources and the environment for learning
- Promoting critical thinking through properly debriefing activities and asking questions that get learners to think, analyze, relate issues and topics to their own lives and come up with solutions

- Applying social inclusion principles: Finding ways to include all types of youth (and trainers) – males and females; different cultural/ethnic/religious backgrounds, people with disabilities (PWD); people with different types of health status …

- Encouraging risk taking – promote questioning and being free to explore

- Promoting habits of mind that support life-long learning: curiosity and wonder, open mindedness, creativity

These principles are reflected in the layout and flow of activities in the manuals:

1. **Key Competencies:** Table found at the beginning of each Learning Outcome that describes the main knowledge, skills and attitudes to be gained by the end of the activities.

2. **Self-Assessment:** Conducted at the beginning and end of each Learning Unit to get a sense of trainees' knowledge and skills going into it and what they have gained by the end of the Learning Unit (and steps they need to take to further their understanding and skills).

3.  **Getting Started Activity:** Typically, a quick activity or questions to 1) give the trainer a sense of trainees' existing knowledge and skills; 2) spark the interest of trainees in the topic; 3) introduce the objectives and key competencies of the topic.

4.  **Problem Solving Activity:** A challenging activity to get trainees engaged and to learn through discovery instead of memorization of facts. A variety of teaching and learning methodologies are used, including individual and group work such as reading real life work-based scenarios and answering accompanying questions to activities such as identifying proper tools and equipment from the school workshop to conduct a certain activity. Following the sharing of responses, the trainer guides trainees through the content and processes being introduced.

5.  **Guided Practice Activity:** Building on the concepts and skills gained in the Problem Solving Activity, the trainer guides trainees through practical examples.

6.  **Application Activity:** Consolidates trainees' knowledge and skills through a real-life application of the topic in the classroom, community or workplace. Trainees are given more independence in applying what they have learned.

7. **Key Facts boxes:** Throughout the Trainee Manual, one will find Key Facts boxes. These contain the main information or content for a given Learning Outcome. They are there for the trainees' reference and are used throughout the different types of activities.

8.  **Points to Remember:** List of the top key learning points or "take-aways" from the topic.

9.  **Formative Assessment:** Questions and activities to assess trainees' level of understanding of the concepts introduced.

10.  **Summative Assessment:** Based on the integrated, real life situation approach used in other TVET levels, this is done at the end of every module for agricultural modules and, with some variations, at the end of each Learning Unit for Basic Education and Soft Skills modules.

11.  **Self-Reflection:** Trainees re-take the Self-Assessment given at the beginning of the Learning Unit and identify their strengths, challenges and actions to improve their level of competence.

The Trainer and Trainee Manuals are meant to be used in conjunction with each other and are well coordinated through the headings and labelling of activities. The trainer will always be able to refer trainees to specific activities by the coordinated numbering system. For instance, a specific exercise might be labelled Topic 1.2 Task 2. The Topic is the number of the Learning Outcome and the task is the specific exercise to be done. The Key Facts are also numbered for easy reference. These nor the Self-Assessment tables are in the Trainer's Manual so the trainer should have a copy of both manuals.

The Trainer's Manual includes answers (or guidelines to the trainer as appropriate) to Formative and Summative Assessments as well as to problems given throughout the activities. Summative Assessments are not included in the Trainee's Manual. These are meant to be used as a guide for those who will be developing a context-appropriative Summative Assessment at the end of the Module or Learning Unit. Basic Education and Soft Skills modules include Summative Assessments at the end of every Learning Unit while the technical modules include it only at the end of the module.

Lastly, there is a section in the Trainer's Manual for additional information to the trainer that includes either specific information or references to information that can help them deepen their understanding of the particular content.

HORTICULTURAL CROPS PRODUCTION

Learning Units	Learning Hours	Learning Outcomes
Learning Unit 1: **Perform horticultural planting activities**	40	**1.1** Prepare planting materials
		1.2 Prepare planting operations
		1.3 Carry out planting operations
Learning Unit 2: **Assist in horticultural crops maintenance**	40	**2.1** Perform horticultural crop maintenance practices
		2.2 Assist in managing pests and diseases
		2.3 Use fertilisers on horticultural crops
		2.4 Prune horticultural crops
Learning Unit 3: **Assist in harvesting activities**	40	**3.1** Determine maturity indices of horticultural crops
		3.2 Perform harvesting operations
		3.3 Pack and transport horticultural crops produce

NOTES TO THE TRAINER ABOUT THIS MODULE:

- This module focuses exclusively with the seven most commonly found horticultural produce crops found in Rwanda: tomatoes, cabbage, egg-plant, carrots, avocado, passion fruit and pineapple. All learning activities are designed with these horticultural crops in mind.

- This module in particular represents horticultural processes, which take a significant amount of time, it is therefore important to coordinate with the training centre's on site nursery personnel or the off-site area you may plan to use. In order to ensure there are examples of plants at each stage of the growing cycle available, harmonising the schools plant growing chronogram with the demands of the course represents an important element of course planning, and should be done well in advance of the course start.

- All off-site visits should also be well coordinated with members of the community, with clear agreements and understanding on the proposed learning task. In general it can be helpful to explain what exactly you as a trainer hope the trainees will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include but are not limited to the following: setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

- The information provided at ehinga.org is available both in English and Kinyarwanda and represents a significantly valuable resource. It includes technical information for most of the crops presented in the module at each step of the production phase. See: http://www.ehinga.org/eng/categories/crops

Learning Unit 1: Perform horticultural planting activities

Learning Outcomes

By the end of the Learning Unit, trainees will be able to:

1.1 Prepare planting materials

1.2 Prepare planting operations

1.3 Carry out planting operations

Learning Unit 1: Self-Assessment

1. Ask trainees to look at the illustrations above (in their Trainee Manuals) and discuss what they see. What topics do they think this unit will include based on the illustrations? After some brainstorming, share the main topics.

2. Ask trainees if they know what the word horticulture means and then provide a definition – the cultivation of fruits, vegetables, flowers or ornamental plants.

3. Explain that this Learning Unit is going to focus on the first steps of horticulture crop production, i.e. preparing planting materials, preparing soils, and how to perform planting operation of horticulture crops.

4. Ask trainees to fill out the self-assessment at the beginning of the unit in their trainee manuals. Explain that the purpose of the self-assessment is to become familiar with the topics in the unit and for them to see what they know or do not know at the beginning. At the end of the unit, they will do a self-reflection, which includes re-taking the self-assessment and identifying their strengths, areas that need improvement and actions to take. The self-assessment is not a test!

Learning Outcome 1.1: Prepare planting materials

Objectives: At the end of the learning outcome, trainees will be able to:

a. Describe criteria for selecting horticultural planting materials
b. Describe methods of horticultural planting materials pre-treatment
c. List tools, soils, and materials that need to be collected

Time Required: 14 hours

Learning Methodology: brainstorming, small group discussion, individual work, field visits and field practical work.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper
- **Plant materials:** Seeds, vegetative propagated plants, rootstocks, and scions for grafting.
- **Seedling materials**: seed trays, pots, potting soil, planting medium, water, fertiliser.
- **Germinating materials**: tools, sandpaper for scarification, lamps for light treatment etc.

Preparation:

- ❑ Make sure you have samples of horticultural planting materials readily available in the study area.
- ❑ Make sure planting materials pre-treatment products (disinfectants) are readily available.
- ❑ Schedule a field visit and make an appointment with horticultural plant nursery operators before class.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both female and male trainees are represented. Emphasise that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasise the need to protect the environment through proper disposal of waste materials.
- ✓ **Standardisation culture:** While curing different crops, emphasise the need to follow set standards or requirements.

Prerequisites: None

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe criteria for selecting horticultural planting materials	**1.** Select good horticultural planting materials	**1.** Analytical
2. Describe methods of horticultural planting materials pre-treatment	**2.** Perform horticultural planting materials pre-treatment	**2.** Meticulous
3. List tool and soils that need to be acquired to prepare for planting	**3.** Acquire tools and soils required to prepare for planting	**3.** Careful

Steps:

Getting Started: What do we know and where are we going?

1. Ask the trainees to turn to **Topic 1.1 Task 1** in their trainee manuals and instruct them to reflect on the following:
   - **a.** Describe what you see in each image.
   - **b.** Together these images represent a process. What do you think it could be?
   - **c.** Have you ever done any of these kinds of activities? Where and how?
   - **d.** Before plants can go in the ground where might they start their life?

2. Call on a few volunteers to share their answers.

3. After the discussion, ask learners what topic this activity relates to.

4. Introduce the learning outcome and ask learners to turn to the Key Competencies table and review it together.

Possible answer: d. Just like human babies, plants need a gentle and safe place to start their lives if they are going to grow up to be big and strong one day. Therefore as careful horticulturists we start growing the small seedlings in a nursery giving the seeds plenty of water and healthy soil).

Problem Solving Activity

1. Instruct the trainees to form small groups and discuss the topics and questions in **Topic 1.1 Task 2**.

2. Read the scenario with the trainees ensuring that everyone understands the scenario and questions:

   Karissa and Alliance are farmers from your neighbourhood hoping to start a nursery to grow horticulture crops such as: cabbages, carrots, eggplant, tomatoes, avocados and passion fruits. However, before they can begin they need your help thinking about the following:

   a. What kinds of horticulture crops are typically grown in your area?
   b. Based on your answer above, what kinds should they consider growing?
   c. Where could they go to acquire things like seeds for these crops?
   d. What tools will they need?
   e. Is there anything they might need to prepare before they can plan their horticulture crops to ensure that the plants survive?

3. Call on a few volunteers to write their answers on a flip chart, or black board.

4. Review their answers together. Ask learners to compare their answers. Do they have similar information on each question?

5. Once the answers have been reviewed encourage trainees to ask questions of clarification.

6. After the presentation and sharing the answers, refer learners to **1.1 Key Facts** in the trainee manual and review them together.

Guided Practice Activity

1. Before class starts, prepare the training centre nursery with the different stations where the trainees will gain practical experience preparing seeds, propagating plants, and preparing tree and vine grafts. Trainees should have access to a minimum of one example of each plant growing type, e.g. tomato seeds, pineapple propagation, avocado tree graft. However, the more kinds of plant growing stations there are the better.

2. In small groups, inform trainees that this is where the journey begins with planting horticultural crops. They are going to do an activity, **Topic 1.1 Task 3,** which requires them to prepare for the planting of horticultural crops in the training centre's garden.

3. Provide each small group with the appropriate tools and materials at each station for preparing seeds, propagating plants, grafting.

4. Instruct each group to prepare seeds at the seeding station by having trainees treat them with the appropriate methods:
   a. Have trainees inspect the seeds to ensure quality.
   b. Have trainees perform scarification, dormancy breaking, pelleting (if equipment is available), water soaking, or a combination of these methods.

5. Help trainees to prepare to plant propagations as well as graft scions to rootstocks.
6. Instruct students to prepare the soil beds or seedling pots according to the crop and season.
   a. Provide groups with a planting medium.
   b. Inform them that each trainee in the group should get a chance to prepare the seedling bed in the seed tray or pot.

7. Once the seedbeds have been prepared go ahead and have trainees sow the seeds into the pots or trays.

8. Aide trainees as they propagate the pineapple by demonstrating how it should be cut and set in water to ensure it sprouts roots.

9. Likewise, demonstrate how to perform a plant graft taking the scion from a healthy producing plant and graft it onto the rootstock.

10. Remind trainees to be careful when handling knives.

11. Encourage other groups to ask questions for clarification. You can help all groups where they find a challenge.

12. Facilitate the trainees to perform a graft and propagation at the appropriate stations.

13. Once everyone has performed these tasks facilitate a group discussion of the trainees' experiences.

Application Activity

1. Prepare a field visit with a local famer who is going to acquire seeds and tools for a coming planting season. Your class will follow along with the farmer as they buy the materials at an agro dealer or co-op and then assist with some preparation for planting. Refer trainees to **Topic 1.1 Task 4**.

2. During this activity, you should make sure that the trainees are compiling an observation list according to the following requirements.
   a. What things do they consider when buying seeds?
   b. What kinds of tools can they buy?
   c. What kinds of pre-treatment techniques are applied to the seeds before planting?
   d. How does the farmer prepare the beds for the nursery?
   e. Which techniques do they use while planting/sowing?

3. After the field visit, facilitate a brief sharing session where trainees discuss their observations with the rest of the group.

Points to Remember

- Planting materials can be acquired through agro dealers, Aggrotech, RAB, NAEB, cooperatives and farmers in collaboration with RAB.
- Seeds must be treated before they will germinate. Most common forms of seed treatment use light, temperature, and water.
- Plant bedding should be prepared according to crop and temperature.

Formative Assessment

1. Describe the criteria to use when selecting planting materials:

   Answer: See **1.1 Key Facts** "Criteria for selecting good planting materials"

2. Describe the way a pineapple is prepared for planting versus an avocado tree.

   Answer: Pineapple is a propagated plant (cut off top of pineapple, cut back some of the small leaves at base and find small roots or soak in water until roots form, plant in soil). Whereas avocado trees are usually grafted (select and cut rootstock and fruit producing scion, cut notches and join).

3. Explain the process of seedlings beds and pots preparation.

Answer: use a bucket or tub to moisten the planting medium. The goal is to get it moist but not sopping wet. Fill the containers and pack the soil firmly to eliminate gaps. Using your finger make a small hole in the soil for the seed. Check the seed packet to see how deep you should make it.

Learning Outcome 1.2: Prepare for planting operations

Objectives: At the end of the learning outcome, trainees will be able to;

- **a.** Describe the pre-treatment techniques of planting materials
- **b.** Describe handling during transportation of seedlings
- **c.** List planting methods and patterns for horticultural crops

Time Required: 10 hrs

Learning Methodology: Brainstorming, small group discussion, field visit, demonstration and practical work in field

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- **Farm materials and tools** for preparing soil for transplant and direct planting of horticulture crops

Preparation:

- ❑ Make sure you have samples of horticultural planting materials readily available
- ❑ Make sure planting materials pre-treatment products (disinfectants), are readily available
- ❑ Make sure there is an area readily available where trainees can gain practical experience digging different planting patterns and sowing carrots.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both female and male are represented. Emphasize that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardization Culture:** While curing different crops, emphasize the need to follow set standards or requirements

Prerequisites:

- Growing medium preparation
- Basic knowledge on plant biology mainly on plant propagation and germination

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe the pre-treatment techniques of planting materials.	**1.** Apply pre-treatment techniques of planting material	**1.** Practical
2. Describe handling during transportation of seedlings	**2.** Perform handling during transportation of seedling in	**2.** Responsible
3. List planting methods and patterns for horticultural crops.	**3.** Identify planting methods and patterns for horticultural crops.	**3.** Detail oriented

Steps:

Getting Started: What do we know and where are we going?

1. Instruct the trainees to open to **Topic 1.2 Task 1** in their training manuals and ask them to reflect on the following questions:

- **a.** Describe what the illustrations show.
- **b.** Have you ever seen or participated in an activity similar to this one?
- **c.** Where do you think this is taking place?
- **d.** What do you think the man is holding in the bottom image and what are they doing it with?

Note on question d: the illustration requires some interpretation thus multiple possible answers are acceptable.

Possible answers for d: The man is holding manure to fertilize newly planted seedlings. The man is holding tilled soil and he and the women are filling in gaps for newly planted seedlings.)

2. Call on volunteers to share their answer and discuss.

3. Introduce the learning outcome and ask learners to turn back on the Key Competencies table and review it together.

Problem Solving Activity

1. Divide the trainees in small groups and have them turn to **Topic 1.2 Task 2** in their trainee manuals.

2. Read the scenario and questions below together as a class ensuring that everyone understands:

   Karissa and Alliance have several different kinds of seedlings in seed trays and pots that have now sprouted. They intend to grow tomatoes and eggplants. Additionally, they have heard from a neighbour that carrots have been selling at a very competitive rate and they would like to enter this market as well. However, this is a new crop for them and they have never planted it before."

3. Inform the trainees that they should give advice to the farmers on how to prepare their land and soil for each crop.

4. They should make a list of recommendations they should consider before they can successfully begin the planting operations. In doing so, they should consider the following questions:
   - When comparing planting seeds in seed trays to transplanting seedlings in a field what process are similar and which are different?
   - Which planting patterns or planting arrangement should be used for which horticultural crops?
   - Will soil treatment techniques apply differently for different seedlings?
   - How might the handling of seedlings during their transportation to the field be conducted?

   Answers: Tomatoes and Eggplants require 45 to 60cm of space between plants and 91 cm to 1.2 metres between rows.

5. Organize a sharing session with the groups where each one writes their list on a flip chart.

6. After every group has done this have the trainees turn to the **1.2 Key Facts** to supplement their answers.

7. After, have each group write new recommendations in another colour to their existing list.

8. Finally facilitate a group sharing session where each trainee shares their list and comments on what was unknown before consulting the key facts and one thing they learned after.

Guided Practice Activity

1. Read the instructions out loud with the entire class.

"You will now help Karissa and Alliance plan their land plot."

2. Ask them to think about the fields in their own neighbourhood and how the land was prepared and divided up for planting.

3. Inform the trainees that based on this experience and the information in **1.2 Key Facts**, their task is to draw a map to show how to divide and prepare the land for the farm's four different crops.

4. Encourage them to try their best to draw to scale how the land should be best divided up.

5. Remind them to consider the following:
- **a.** An access for transportation.
- **b.** A source for water.
- **c.** Planting pattern should be matched for the crop and terrain as well as rows divided and drawn as elevated, sunken, or flat.
- **d.** The tools that will be needed.
- **e.** Notes on how each soil should be treated.

6. Finally, highlight the fact that the design of their land plot should logically follow which methods they believe would be best for the crop's future yield.

7. After the trainees have understood the instructions, get them started on drawing.

8. Go around and help where assistance may be needed.

9. Once everyone has finished, facilitate a sharing round where trainees show their drawings.

10. Additionally you can show aerial photos or photos taken from fields which highlight different planting patterns and field layouts so that the trainees can compare the drawings with them (if available).

Note: The maps should be drawn according to the information in the **1.2 Key Facts.** So, for example, the rows of carrots should be double rows and prepared for direct seeding while the tomatoes and eggplants should be square rows with correct plant (60cm) and row spacing indicated (90cm). Likewise, the students should decide whether the rows are to be planted with an alternated pattern of trees if they imagine the farmers to be planting on a steep hill. Precipitation and soil moisture should be reflected in the choice of elevated, sunken, or flat rows. If it is the rainy season, the students should mostly likely draw elevated rows.)

Application Activity

1. Before the lesson begin to prepare the following:
   a. The day before transport, have students correctly water the plants.
   b. All of the necessary tools for handling seedlings.
   c. Tools used for direct field planting of carrots.
   d. Tools and materials for preparing the soil e.g. watering cans, fertilisers and pesticide sprayers.

2. Inform trainees that they will be performing a practical lesson found in **Topic 1.2 Task 4.**

3. Divide the trainees into small groups and tell them that they will prepare for planting operations either in the field or at the training centre's garden.

4. Review the tasks the trainees will perform:
   a. Prepare soil for transplanting the seedlings.
   b. Prepare the soil for direct transplanting and perform direct field sowing of carrot seed.
   c. Practice appropriate handling of seedlings during their transportation to the field.
   d. Explain to your trainer what patterns or planting arrangement are used in the schools garden and how they benefit the horticultural crops being grown there.
   e. Compare your drawing with the configuration of the field.

   Note: You may want to demonstrate some or all of the tasks listed above before the trainees begin in order to ensure that the operation is carried out correctly.)

5. Commence the tasks and observe the trainee groups to ensure they are carrying out the operations correctly.

6. Ask groups to explain the planting arrangements used in the garden and how they benefit the horticultural crops being grown there.

7. Conclude by facilitating a brief discussion about experience gained and lessons learned.

Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general, it can be helpful to explain what exactly you as a trainer hope the trainees will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include but not limited to the following; setting a date, duration of visit, transportation logistics, safety and precautions and any follow up items after the field visit is complete.

Points to Remember

- Carrots are sown directly into the soil/field.
- All other horticultural crops referred to in this module are generally transplanted in Rwanda.

Formative Assessment

1. Name the three steps for preparing seedling beds.
Answer: primary tillage (deep tillage, sub soiling and year round tillage); secondary tillage; soil ready for digging.

2. Name the planting methods used for carrots.
Answer: field planting or direct seeding

3. Name the planting method used for all other horticulture crops.
Answer: transplanting

4. Describe how to decide which method of field planting is appropriate for planting horticulture crops.
Answer: See **1.2 Key Facts**: "Factors which determine direct seeding or transplanting" e.g. the crop species to be grown.

5. Explain which planting arrangement could be used for an avocado tree orchard.
Answer: triangular

Learning Outcome 1.3: Carry out planting operations

Objectives: At the end of the learning outcome, trainees will be able to:

a. Describe the elements to be considered when planting horticulture crop

b. Perform horticulture planting techniques

c. Apply waste management procedures

Time Required: 16hrs

Learning Methodology: Brainstorming, small group discussion, field visit, pictures presentation, demonstration and field practical work.

Materials Needed:

- **Seedlings** of horticulture crops ready for transplant
- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- **Farm tools** and equipment needed for planting
- **Record keeping forms**
- **Farm yard manure** and compost manure
- **Measuring tape**

Preparation:

- ❑ Make sure you have samples of horticultural seedling ready to plant and related materials readily available.
- ❑ Make sure pre-treatment products (disinfectants) for planting are readily available.
- ❑ Access to a field for transplanting seedlings

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Emphasize that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardization Culture:** While curing different crops, emphasize the need to follow set standards or requirements.

Prerequisites:

- Apply basic mathematics at the workplace: basic operations and measurement
- Growing media (prepare soil for planting)

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe elements to be considered when planting horticulture crop	**1.** Respect the elements that considered in planting material	**1.** Attention to details
2. Describe the way to perform planting techniques	**2.** Apply planting techniques	**2.** Practical
3. Follow waste management procedures	**3.** Apply waste management techniques and record keeping	**3.** Careful

Steps:

Getting Started: What do we know and where are we going?

1. Have the trainees turn to **Topic 1.3 Task 1** in their trainee manuals.

2. Ask them to take a look at the illustration above discuss with a partner the following:
   a. What do you think is happening here?
   b. Have you ever seen this done or participated in this type of activity before?
   c. Where might it be happening?
   d. What steps might the people need to take after they have finished this activity?
   Possible Answer d: These farmers will need to take care of the plants immediately after transplanting them. This includes, weeding, mulching, fertilizing, waste management, watering and maintaining records.

3. Ask for volunteers to share their answer and discuss.

4. After the discussion, ask trainees what topic this activity relates to.

5. Introduce the learning outcome and have learners turn to the Key Competencies table and review it together.

6. Explain that this learning outcome/session will focus on preparing horticultural planting materials.

Problem Solving Activity

1. Group the trainees in threes or fours and have them read the scenario and instructions **Topic 1.3 Task 2**. You can read it together as a class to ensure everyone understands.

   "Rukundo and Umuhire's seeds have germinated nicely and they have successfully planted their tomatoes seedlings in the nursery. They decided to maximize space and plant the seedlings 10 cm apart. However, after a few weeks they have noticed that many of their plants show signs of disease."

2. Have them brainstorm a list of what might have caused their tomato plants to catch a disease.
   Possible Answer: Tomato seedlings were planted too close together. It is possible they were too densely planted as well for a given area.)

3. They should discuss what other problems might occur shortly after field or nursery planting for the other crops your class is producing.

4. Finally have them think about how they would design a plan for planting seedlings in a nursery or field to best prevent these problems from occurring.

5. Assign the groups a horticulture crop and ask them to pick another crop that interest them. Have them consult the two tables at the bottom of **1.3 Key Facts** to make plan for planting their seedlings. They should have two plans in total.

6. Review the plans of each group together and have them share key points for their assigned crop.

7. After the presentation and answer sharing, refer trainees to **1.3 Key Facts:** Carry out planting operations in the trainee manual and review it together.

8. Instruct the trainees to revise their plan accordingly to the feedback and ideas given during the discussion.

Guided Practice Activity

1. Before the lesson prepare nursery with all necessary tools, materials and plants required for transplanting horticulture seedlings.

2. Begin this activity by having the trainees go back to their germinated, propagated, and grafted plants that the class prepared in the first lesson and have them record how many sprouted and how many failed. Instruct them to reflect on why some may have

not sprouted. If this is this is too soon, then return to this activity at an appropriate time once the seeds have had a sufficient time to germinate (i.e. usually two weeks).

3. Inform the trainee groups that they will now perform the transplanting of their seedlings into the training centre's nursery or field that was were prepared during the previous learning unit.

4. Instruct them to turn to **Topic 1.3 Task 3**, follow their plan, and proceed in transplanting their chosen and assigned seedlings paying special attention to maintaining correct planting depth and spacing and between each plant.

5. Once all of the seedlings have been planted have student determine plant density.

6. Begin by having them measure the field in which they will plant. Then have students count each row and record the number of plants in each row.

7. Perform the calculation of density (density = total plants/area) in order to determine the density of the field.

8. Compare this to the proposed density found in the **1.3 Key Facts.**

9. Then guide the trainees to perform the necessary immediate care steps; weeding, mulching, watering, fertilizing, managing waste, and recording data. Review the information on these steps found in **1.4 Key Facts** with the trainees.

Note: This Learning Unit covers only the immediate care steps. Long term horticultural crop maintenance is covered in the next Learning Unit.

10. During the planting process they should record any challenges that they face and what ways they could improve both steps for next time.

11. Have them share their findings with the class.

12. At the end of this activity review the results of the propagated/germinated seedlings.

13. Point out any possible correlations that they or you may see, e.g. not enough water on some seeds, poor seed selection etc.

Application Activity

1. Organize a field visit to a nearby horticulture nursery.

2. Instruct groups to turn to **Topic 1.3 Task 4** and make an observation list following the questions and prompts below:
   a. Measure out the spacing and calculate the spacing density.
   b. What post planting immediate care practices that are performed?
   c. How is waste manage after planting?
   d. Did the farmer have any problems with germination/sprouting? If so, what are possible reasons?

3. Facilitate a brief discussion about the observations.

Note: This activity focuses on a field visit to an agricultural job site. Therefore, the manager of the site should be contacted and notified well in advance about the proposed activity. In general it can be helpful to explain what exactly you as a trainer hope the trainees will get out of the field visit and agree with the manager upon all of the details. Arrangements to be considered include but not limited to the following; setting a date, duration of visit, transportation logistics, safety and precautions, and any follow up items after the field visit is complete.

Points to Remember

- It is important to select crops based on the local conditions of the area and season. Failure to do so will result in little to no produce.
- Maintaining correct spacing between individual plants is a key to preventing disease.
- Following the planting of seedlings, there are several steps needed in order for the plants to thrive – weeding, mulching, watering and fertilizing. In addition, it is important to manage waste and record data to keep track of plant conditions and growth.

Formative Assessment

1. Fill in the table below with the appropriate planting dates.

Answers:

Crops	Planting dates
a. Cabbages	Beginning of Feb and Nov.
b. Carrots	Beginning of Feb and Nov.
c. Eggplant	Mid Feb - Mar.
d. Tomatoes	Begging of Nov. and April
e. Pineapples	Feb-Mar
f. Avocadoes	Mid-April
g. Passion fruits	Mid-Mar.

2. Name at least two factors to consider when planting:
Possible answers: planting season, planting spacing, planting density, planting depth

3. Name at least three things one has to do after planting seedlings to help the plants grow.
Possible answers: weed, mulch, water, apply fertiliser

Learning Unit 2: Assist in horticultural crops maintenance

Learning Outcomes

At the end of the Learning Unit, trainees will be able to:

2.1 Perform horticultural crop maintenance practices

2.2 Assist in managing pests and diseases

2.3 Use fertilisers on horticultural crops

2.4 Prune horticultural crops

Learning Unit 2: Self-Assessment

1. Ask trainees to look at the illustrations above (in their Trainee Manuals) and discuss what they see. What topics do they think this unit will include based on the illustrations? After some brainstorming, share the main topics.

2. Explain that this Learning Unit is going to focus on assisting in horticultural crop maintenance, including how care for crops, fight pests, the tools we use, and how to fertilize the crops.

3. Ask trainees to fill out the self-assessment at the beginning of the unit in their Trainee Manuals. Explain that the purpose of the self-assessment is to become familiar with the topics in the unit and for them to see what they know or do not know at the beginning. At the end of the unit, they will do a self-reflection, which includes re-taking the self-assessment and identifying their strengths, areas that need improvement and actions to take. The self-assessment is not a test!

Learning Outcome 2.1: Perform horticultural crop maintenance practices

Objectives: By the end of the learning outcomes trainees will be able to:

- **a.** Select tools, materials and equipment used in horticultural crop maintenance.
- **b.** Perform long term care practices such as mulching, weeding, hoeing, thinning and earthing up for horticultural crops.
- **c.** Describe irrigation techniques used for horticultural crops.

Time Required: 10 hours

Learning Methodology: brainstorming, oral presentation, group discussion, demonstration, projection of image and video, field visit.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- **Farm tools,** materials, and equipment. See table titled "tools" in **2.1 Key Facts**
- Materials for immediate care post planting

Preparation: Before delivery of the present outcome:

a. Prepare all materials for the application activity and ensure access to various examples of irrigation systems that are suitable for horticulture crops.

b. Ensure access to well-established horticulture crops that have been planted and now require maintenance.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Emphasise that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardisation Culture:** While curing different crops, emphasize the need to follow set standards or requirements.

Prerequisites:

- Basic understanding of using and maintaining farm tools.
- Basic knowledge on plant biology.

Key Competencies:

Knowledge	Skills	Attitudes

1. List out tools, materials and equipment used in maintenance	**1.** Select tools, materials and equipment in horticulture crop maintenance	**1.** Attention to detail
2. Describe irrigation techniques	**2.** Perform irrigation techniques in horticultural crop production.	**2.** Practical
3. Follow agriculture practices in the field of horticulture crops	**3.** Perform agriculture practices in the field of horticulture crops	**3.** Detail oriented

Steps:

Getting Started: What do we know and where are we going?

1. Ask trainees to open to **Topic 2.1 Task 1** in the trainee manuals and have a look at the three images presented in the activity.

2. Instruct them to reflect on the following:
- **a.** What do you think is happening in each image?
- **b.** Do you recognise the horticulture plants being grown in each image? If so, list them.
- **c.** Have you ever seen examples or participated in the activities shown in the images?
- **d.** Where and when?
- **e.** Think back to your experience with maintaining food crops. Do you see any similarities?

3. You may decide to supplement this activity with more images and questions that are relevant to how horticulture maintenance is performed in your area.

4. After the trainees have had some time to reflect, ask volunteers to share their answers.

5. Confirm their answers, conclude by introducing the learning outcomes in the Key Competencies table, and review it together.

Problem Solving Activity

1. Instruct the trainees to find a partner and read the scenario in **Topic 2.1 Task 2** and answer the questions that follow:

Murisa and Semana are new farmers who have successfully planted cabbage, tomatoes, and eggplant in their nursery and now the plants are becoming well established. They followed the appropriate procedures of plant spacing and density, and were attentive to all the correct procedures immediately after they had planted their crops. After a few weeks, they see that the tomatoes have started to flower while some of the eggplants are not growing as tall as they had hoped. Additionally their cabbages have been disappearing gradually every night.

2. Instruct the trainees to think back to their experiences from food crop production and how those crops were maintained.

3. Ask the trainees what they believe might be causing some these problems.

Possible Answer: The crops have not been maintained properly. Flowering tomatoes is undesirable and is a result of not thinning the plants. The eggplants could be underperforming due to a number of factors related to plant maintenance such as lack of fertiliser or water. However, since the height is mentioned here it is also most likely they are growing out instead of up, which indicates that they were not thinned properly either. Furthermore, the cabbages could be disappearing due to theft.

4. Then have them make a list of actions the farmers should take to overcome these problems and the tools that are needed.

Possible Answer: All plants should be maintained according to proper maintenance procedures. This includes thinning the tomato and eggplants as well as fertilizing, watering, and weeding them. Horticulture crops can be fenced in to protect against theft.)

5. Finally have the trainees discuss how maintenance of horticulture crops might differ from food and cash crops.

6. On the flip chart or black board, dedicate a space for each of the three questions.

7. Ask each group to select a representative to write their group's answers for each question starting with question one.

8. Review their answers in order to activate their memory of past lessons learned.

9. Move to question two. Have each group secretly write their answers.

10. Review, discuss, and repeat this step for the final and third question.

11. After the presentation and sharing the answers, refer learners to **2.1 Key Facts** in the trainee manual and review it together.

Guided Practice Activity

1. Refer the trainees to **Topic 2.1 Task 3** and instruct them to match the tools pictured in boxes A-K to the proper maintenance activity listed below. There are some tools which will be used in multiple activities.

2. Remind them to be prepared to explain their answers after they have finished.

3. Facilitate a small sharing session about their answers focusing on specific examples of when tools would or would not be used during the maintenance practices.

Possible Answers:
Weeding hoeing: B, C, E, G, K
Earthing up: B, C, D, G
Thinning: B, F
Irrigation: B
Mulching: B, L
Supporting: A, B, J, E

Application Activity

1. Divide the trainees into groups and inform them that their task is to gain practical experience by operating and maintaining different types of irrigation systems.

2. If your training centre does not provide access to other types of irrigation systems that are suitable for horticulture crop maintenance then you should arrange for a field visit with a local nursery or farm.

3. Instruct the trainees that during their practical experience they should observe the following:
- **a.** Which irrigation methods are applied?
- **b.** Which crops are being irrigated?
- **c.** What are the materials available?
- **d.** How are these systems maintained?

4. Once they have completed performing some basic operations with the different irrigation systems, proceed to performing the other maintenance related tasks listed below:
   a. weeding/hoeing
   b. earthing up
   c. thinning
   d. mulching
   e. supporting

5. Take each task one by one and have a group practice while the others observe. Point out good practices of the group and areas where they could improve then have each group try by for themselves as you observe.

6. Facilitate a brief experience sharing session where the groups are allowed to discuss their findings.

Points to Remember

- Furrows irrigation is suitable for all row crops and for crops that cannot stand in water for long periods.
- Thinning permits the remaining fruits to grow more rapidly.
- Eggplants, tomatoes, and passion fruits require support after they have become well established plants.

Formative Assessment

1. Describe two irrigation systems that are commonly used in your area and discuss the advantages and disadvantages of both.

   Answers: Hand irrigation is inexpensive but is only feasible for small areas or nurseries; furrow irrigation is suitable for row plants but is labour intensive.)

2. **What is thinning and why is it done?**
   Answer: Thinning is the process of trimming flowers from a horticulture plant to ensure its permits the remaining fruits to grow more rapidly and leave space for other plants.)

3. Answer with true or false:

a. Many of the maintenance practices of horticulture crops include the same procedures performed during the post-planting immediate care.
Answer: true

b. A technique of drawing soil up around stems to encourage blanching is called 'Earthing up'
Answer: true

Learning Outcome 2.2: Assist in managing pests and diseases

Objectives: At the end of the learning outcome, trainees will be able to:

a. Identify pests and diseases in horticulture crops
b. Describe disease symptoms in horticultural crops
c. Explain pesticide application process

Time Required: 10 hours

Learning Methodology: Brainstorming, small group discussion, individual work, field visit and field practical work.

Materials Needed:

- Standard training materials **-** flip chart, markers, tape, A4 paper, pens, paper.
- Examples of horticulture produce and plants with disease or pest damage.
- Measuring spoons, syringes for precision measurement.
- Duster, sprayer, magnifying lens, and pest trap.
- Personal Protective Equipment (PPE).
- Samples of pesticides such as; insecticides, herbicides, fungicides, nematicides and pyrethoide.
- Pictures showing at least five species of horticultural crop productions (carrots, cabbages, eggplant, avocadoes and tomatoes) in field.

Preparation:

- ❑ Make sure the training centre provide farm fruits and vegetables planted in different field's surrounding training centre.
- ❑ Samples of pesticides (insecticides, herbicides, fungicides, nematicides, and pyrethoides) with the application equipment should be available
- ❑ Conduct a field visit and make an appointment with horticultural plant nursery operators before class

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Emphasize that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardization Culture:** While curing different crops, emphasize the need to follow set standards or requirements

Prerequisites:

- Apply Safety, Health, Environment (SHE) policies and procedures and principles
- Apply basic mathematics at the workplace
- Maintain farm tools, equipment and facilities

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe symptoms of damages caused by pests and diseases	**1.** Identify symptoms of damages caused by pests and disease	**1.** Observant
2. List pests and diseases which damage horticultural crops	**2.** Identify pests and diseases of horticultural crops based on symptoms	**2.** Attentive
3. Explain pesticide application process	**3.** Match correct pesticide for managing pests or diseases	**3.** Careful

Steps:

Getting Started: What do we know and where are we going?

Ask the trainees to turn to **Topic 2.2 Task 1** reflect upon the following questions:

1. Ask them what they think is happening in the left image and what has happened in the image to the right.

Possible Answer: The image on the right is showing crops being spray for pesticide while the image on the left shows egg plants which have been damaged by either disease or pests.

2. What horticulture plants are displayed.
Answers: Bottom left- cabbage, Bottom right- Eggplants, Top- passion fruit

3. How might the image to the right be related to the previous learning unit?
Answer: Pest control is an important part of horticulture cultivation care

4. Make a prediction about what the following learning unit will be about.

5. Ask a volunteer to share his answer and discuss. Describe the source of crops observable in the field picture and how they should be raised from crop management.

6. After the discussion, ask learners what topic this activity relates to.

7. Conclude by have learners turn to the Key Competencies table and review it together. Explain that this learning outcome will focus on managing pests and diseases.

Problem Solving Activity

1. Before beginning this task, collect photographs of commonly encountered diseases and pests. Use the following resources to find images:
   - Tomato: http://www.ehinga.org/kin/articles/tomatoes/pests_and_diseaseslink
   - Eggplant: - https://afri-sol.org/field-work-disease-diagnosis-by-afrisol-staff-in-the-field/
   - Cabbage: http://www.ehinga.org/kin/articles/cabbage/pests_and_diseases
   - Passion Fruit: http://www.ehinga.org/kin/articles/passion_fruits/pests_and_diseases
   - Carrots: http://www.ehinga.org/kin/articles/carrots/pests_and_diseases
   - Avocadoes: http://www.ehinga.org/kin/articles/avocado/pests_and_diseases
   - Pineapple: http://www.ehinga.org/kin/articles/pineapple/pests_and_diseases

2. Read the following scenario in **Topic 2.2 Task 2** with the trainees together as a class and instruct them to follow the instructions individually:

   Rukundo and Uwimana are farmers that are new to your area and growing horticulture crops. They are not familiar with the local issues surrounding pest control and need your help. They have hired you to do some investigating in your local community to find out what kind of pest damage and potential diseases are common to horticulture crops in your area.

3. Inform the trainees that their task is to collect 2-3 samples of different horticulture crops that have been damaged.

4. Going around to local horticulture farmers, they should ask permission to obtain damaged leaves, fruits, stems or roots of a horticulture plant, and bring them to class.

5. Reassure them that if they cannot obtain the parts of the plant take a photograph using a smart phone, or simply take notes to describe the plant appearance.

6. After they have collected their samples, they should present them to the class.

7. Encourage the trainees to use the **2.2. Key Facts** and the following questions to guide their reasoning:
   a. What are the symptoms or signs of damage?

b. Was the damage caused by a disease or a pest?
c. What could happen if the crop goes untreated?

8. Display the samples one by one and ask students to share their thoughts about the symptoms, cause of the damage, and future predictions for the crop if gone untreated.

9. Supplement the student's samples by displaying photos of plants damaged from commonly occurring pests and diseases in the area using the images you have collected before the lesson.

10. Highlight correct answers while pinpointing misunderstandings by asking students to explain why and how they have come to the correct conclusions.

11. Keep a total on the black board or flip of all the types of crop damage, pests, diseases and symptoms.

12. Once everyone has shared, ask the trainees to the draw conclusions about the common diseases and pests found in their area.

13. Make a list of those that will be used in the next activity.

Guided Practice Activity

1. Before the lesson ensure that you have access to many examples of common pesticides.

2. Inform the trainees that the purpose of this activity, **Topic 2.2 Task 3**, is to learn how to determine which pest control methods can be used to eliminate common pests of horticulture crops.

3. Review the safe handling practices of using pesticides in **2.3 Key Facts** with the trainees.

4. Pose comprehension questions to the trainees to ensure that everyone understands. **Note:** the use of pesticide should always be handled with the utmost respect for safety procedures both for individuals and the environment.

5. Then provide various packages of many different pesticides for treating different pests of horticulture crops.

6. Refer trainee's attention back to the list of common pests and disease complied in the previous activity.

7. Assign each group several examples of pests and diseases depending on the amount of groups and pests.

8. Instruct the groups to read each label carefully and decide which pesticide could be appropriate for the damaged crop you are responsible for.
   Note: check the labels of all intended pesticides when preparing this lesson. You may need to reselect certain brands or generate your own labels for this lesson.

9. Have the trainees compile their results, while consulting the **2.3 Key Facts** in order to share with the rest of the class of possible pesticide management techniques.

10. Encourage the trainees to refer to their past experience and knowledge in how to deal with pests in food crop production and have them generate a list of feasible alternative methods for controlling these pests.

Application Activity

1. Organize the school nursery to facilitate the application of pesticides to the horticulture crops **Topic 2.2 Task 4.**

2. If the crops are healthy and no pest management is required then it may be advisable to prepare examples of plants that have been damaged by disease.

3. Put the trainees in groups and inform them that during this lesson they will apply pesticides to damaged horticulture crops.

4. Remind the students of the safety procedures required when dealing with pesticides.

5. Have students put on PPE's.

6. Perform a demonstration of how to safely apply pesticides emphasising the principals of conservative and precautionary use.

7. Provide the trainees with the check list below and guide them through this practical activity ensuring that every trainee:
   - ✓ Practice safe procedures when handling the pesticides.
   - ✓ Select the tools required for mixing and applying the pesticides.
   - ✓ Correctly measure and mix pesticides.
   - ✓ Apply pesticides to various crops using different methods appropriate for each crop.

8. Once all groups have had the chance to complete the tasks, facilitate a brief discussion for trainees to share experiences and lessons learned.

Points to Remember

- Always wear a PPE when handling pesticides.
- Look for symptoms of damage to the plant to identify which pest is the cause.
- Always take steps to reduce any potential risk to the environment when using pesticide.

Formative Assessment

1. List the pests which effect two different horticulture crops and what signs you can use to identify them.
   Answer: See 2.2 Key Facts

2. Demonstrate correct application of pesticide on tomatoes and cabbage.
   Observe the trainees.

Learning Outcome 2.3: Use fertilisers on horticultural crops

Objectives: At the end of the learning outcome, trainees will be able to:

a. Describe and choose types of fertilisers
b. Make compost
c. Apply fertilisers

Time Required: 10 hours

Learning Methodology: Oral presentation, group discussion, demonstration, audio vision presentation, field visit, brainstorming, group discussion, practical experience

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- Add also electronic balance
- Raw materials for compost making
- Field planted with different fruits and vegetables crops
- PPE

Preparation:

- ❑ Make sure the training centre provide samples of fertilisers applied in maintenance to the field
- ❑ Space, tools and waste for making a compost pile
- ❑ Make sure the required pictures are available

Cross Cutting Issues:

- ✓ **Environment and sustainability:** Emphasise principals of conservative use of artificial fertilisers.
- ✓ **Standardisation culture:** While performing application of pesticides always use the PPE; ensure the pesticides do not contaminate the environment such as water bodies
- ✓ **Gender:** While forming small group consider gender and consider inclusiveness while allocating roles for the scenarios

Prerequisites:

- Apply basic mathematics at the workplace
- Maintain farm tools, equipment and facilities
- Basic knowledge on plant biology

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe types of fertilisers	**1.** Choose fertilisers following criteria	**1.** Confident
2. Explain process to make compost	**2.** Make compost	**2.** Practical
3. Describe fertilisers application	**3.** Apply fertilisers using recommended techniques	**3.** Work-oriented

Steps:

Getting Started: What do we know and where are we going?

1. Ask the trainees to open their trainee manuals to **Topic 2.3 Task 1**, have a look at the illustration and answer the questions according the to the instructions;
   a. Have them think back to the module about food crop production and the Learning Unit that dealt with using fertilisers. What do they recall?
   b. What do they think is happening in the illustration?
   c. Have they ever had any experience in such a situation?
   d. What might the young man be thinking?

2. Ask volunteers to share their answers and discuss.

3. After the discussion, ask learners what topic they this activity relates to.

4. Conclude by referring the learning outcome and have learners turn to the Key Competencies table and review it together. Explain that this learning outcome will focus on use of fertilisers on horticultural crops.

Problem Solving Activity

1. Have the trainees turn to **Topic 2.3 Task 2** in their trainee manuals.

2. Have them partner up and read the three scenarios of different farmers who need help identifying the right fertiliser for their crops.
   a. Olivier is a horticulture farmer who also keeps five cows. He has no budget for fertilisers.

b. Haruna is a horticulture farmer with a nursery and has no budget to spend on fertilisers. However, his neighbour has recently harvested a crop of beans and tomatoes. The waste and dumped produce from this harvest is sitting in a large pile that needs to be removed soon.

c. Pascal works for a well-funded cooperative that needs to increase their yield for tomatoes.

3. Instruct them to record their recommendations below and prepare to share with the rest of the class.

4. Have them consult the **2.4 Key Facts** to strengthen their answers.

5. Once the partners have finished, count them off by 2's and have them form a sharing circle.

6. With the one's on the inside and the two's on the outside explain that they will share their recommendations for a given situation and one key fact that was most important to them.

7. Tell them which situation they should share and then on your command the one's will share and once finished say "pass" to let the two share their recommendation.

8. Once both have shared, the outside circle will take one step to the right.

9. Once the sharing has undergone several rounds conclude by reviewing the **2.4 Key Facts** together.

Guided Practice Activity

1. Refer trainees to Topic **2.3 Task 4** and divide the class into small groups of three or four.

2. Assign a crop and instruct the groups to choose one crop that interests them.

3. Reserve one crop in order to perform a group example of how to make a fertiliser calculation.

4. Demonstrate how to make the calculation for the crop asking the students for inputs on each step as best they can.

5. Review the information in **2.4 Key Facts** and the table in the **2.5 Key Facts** together to help the trainees calculate the amount of fertiliser needed for each group's two different crops.

6. Inform the trainees that they can use the area of the school's garden as the area for calculation.

7. Help trainees to calculate the amount for organic fertiliser and inorganic fertiliser needed for both crops.

8. Instruct them to fill in the table with their calculations.

Application Activity

1. Before the lesson prepare the school garden or off site facility with all of the tools and materials necessary for producing compost **(Topic 2.3 Task 4).**

2. Inform the trainees that purpose of this activity is to gain practical experience producing compost.

3. Keep the class together as one group and perform the following steps.
   a. Facilitate a brainstorm round for different sources of organic waste.
   b. Likewise, have the class discuss location best suited for compost.
   c. Have the trainees prepare the space, collect the waste and start composting process.

4. Once the compost site has been started, facilitate a planning session with the trainees for how best to maintain the compost in a sustainable way. E.g., who will monitor the compost in the future, what happens if one source of waste is exhausted?

5. Finally have the class brainstorm ways of how to make the compost project profitable, e.g. are there other farmers in the area who need to dispose of their waste and they are willing to pay for it?

Points to Remember

- Good quality compost is most readily achieved through materials such as crop waste, straw and leafy materials.
- The relative proportion of plant nutrients in mixed fertilisers is shown numerically.
- N=nitrogen P=phosphate K= potassium

Formative Assessment

Answer true or false:

1. NPK is a mixed fertiliser.
Answer: true

2. Compost is an organic fertiliser.
Answer: true

3. Name three relevant criteria for helping choose the correct fertiliser.
See **2.4 Key Facts:** "always consider the following…"

4. Describe how the three micronutrients help plants grow.
a. Nitrogen:
Answer: Promotes leafy plant growth, faster plant growth.

b. Phosphorus:
Answer: Promotes strong roots, healthy fruit, blooming

c. Potassium:
Answer: Promotes disease resistance, growth of fruit

Learning Outcome 2.4: Prune horticultural crops

Objectives: At the end of the learning outcome, trainees will be able to:

a. Describe pruning purpose

b. Select tools and equipment used to prune horticultural crops

c. Perform pruning techniques in the field

Time Required: 10 hours

Learning Methodology: brainstorming, oral presentation, group discussion, demonstration, projection of image and video, field visit.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- **Tools for pruning**: Pruning saws, sickles, pruning shears, shears, pruning knife and rasp, ladders
- **Field planted crops** which require pruning: tomato plants, eggplant bushes, and avocado trees, passion fruits vines

Preparation:

❑ Make sure the training centre provides access to garden

❑ Make sure the training centre provide tools and materials needed to prune horticultural crops.

Cross Cutting Issues:

✓ **Standardisation culture:** While performing pruning of fruit and vegetables always use the PPE; ensure the crops do not contaminate.

✓ **Gender:** While forming small groups consider gender and inclusiveness while allocating role for the scenarios

Prerequisites:

- Maintain farm tools, equipment and facilities
- Basic knowledge on plant biology

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe the purpose of pruning	**1.** Identify pruning objectives	**1.** Observant
2. Identify tools and equipment for pruning	**2.** Select tools and equipment	**2.** Attentive
3. Describe pruning process	**3.** Perform pruning technique	**3.** Work-oriented

Steps:

Getting Started: What do we know and where are we going?

1. Instruct trainees to open their trainee manuals to **Topic 2.4 Task 1**.

2. Ask them to have a look at the illustration and images and reflect upon the following:

a. Describe what the illustration and images might represent.
Possible answer: the images represent how horticulture plants are pruned and trained.

b. Why might this process be necessary for yielding good horticulture produce?
Possible answer: In general, plants need to be pruned into to ensure that they grow in a state that produces the most fruits. If the plant is not pruned or trained, it may use energy to continue growing new leaves and branches rather than concentrating it energy on growing fruits.

3. Ask volunteers to share their answers and discuss.

4. Conclude by referring the learning outcome and have learners turn to the Key Competencies table edge and review it together. Explain that this learning outcome will focus on training and pruning plants.

Problem Solving Activity

1. Together as a class read the scenario and instructions outlined in **Topic 2.4 Task 2**.

Mukamana and Uwimana are farmers who produce eggplant, passion fruits, tomatoes, avocadoes in farms within five different fields. All of their crops have gown to be well establish plants free of diseases and pests. They have followed the correct fertiliser procedures up until this point. It is now approaching the harvest season but their plants have produced very little fruits. In particular, leafy tomato plants have only small green fruits while the avocado trees have produced many hard to reach fruits at the top of their branches.

2. Instruct the trainees to partner up and brainstorm possible ideas of what could be the cause of their unproductive plants.

3. Have trainees create a list of possible recommendations and solutions to overcome these problems for each crop, i.e. eggplant, passion fruit, tomatoes, avocadoes.

4. Instruct the pairs of trainees to make a list of tools that can contribute to their list of solutions.

5. Inform them that they should be prepared to share their ideas with the large group.

6. Once each pair has had time to finish, facilitate a presentation round where each group shares their responses.

7. Review the answers together.

8. After the presentation ask trainees what pruning is and if anyone has ever had any experience doing it before.

9. Then refer learners to **2.6 Key Facts** and review it together.

Guided Practice Activity

1. Inform them that their task, described in **Topic 2.4 Task 3**, is to observe and record the shape and structure of pruned and unpruned horticulture crops in the school garden.

2. Read the following instructions with trainees so that everybody understands.
   a. Using the school's garden or a local horticulture nursery carefully observe the shape and structure of eggplant bushes, passion fruit vines, tomato plants, and the avocadoes trees.
   b. Pay attention to how the shape of these plants does or does not provide the following:

- sunlight for energy
- access to water
- keeps it strong in case of wind or other disturbances
- allows most of the plant's energy to produce fruit i.e. no excessive leaves/suckers
- how easy these fruits will be to harvest from the plant

c. Look for both examples that have been pruned well and examples of poorly or unpruned plants.

d. Using the space below, draw a before and after illustration of two different kinds of plants. In the left column draw an example of a tree or plant that needs to be pruned. In the right column, draw the same kind of plant with a correctly pruned shape.

3. After the instructions have been read, lead the group out into the school garden and have them begin their drawings.

4. Explain that after they have made their drawings, they should briefly explain how the before illustration represents a plant that needs pruning i.e. what can we see that gives us evidence that it should be pruned.

5. Explain how pruning should be done for both of your plants by consulting the **2.7 Key Facts.**

6. Demonstrate how to prune the different types of plants using the appropriate tools.

7. Allow trainees to try pruning different horticultural plants so that they will be ready to do it in the application activity.

Application Activity

1. Before the lesson, prepare the school garden or a local off-site field with several stations of tools required for each kind of crop. Make sure there are plenty of examples of different crops with plants that need pruning or training.

2. Inform the trainees that the point of this activity, **Topic 2.4 Task 4**, is to practice pruning horticulture plants.

3. Divide them into groups and assign each group a crop.

4. Instruct each group to select all the necessary tools for the job.

5. Each group member should get a chance to prune a plant.

6. When each member is finished, have the trainees ask you to inspect their work.

7. Once your inspector has approved the work of all members of the group, your group should return and sterilise the tools.

8. Once all of the tools have been sterilised, each group will switch crops and repeat the pruning process.

Points to Remember

- Diligent pruning is extremely important for growing eggplant, passion fruits, tomatoes, avocadoes.
- Always sterilise pruning tools after using them.
- Plant training is the practice of controlling the shape, size and direction of plant growth through pruning or tying the plant to a fixed location.

Formative Assessment

1. List three objectives of pruning and describe how they are achieved.
   Answer: See **2.6 Key Facts**

2. Name four horticulture crops that require pruning and list two tools that are used for pruning them.
   Answer: Passion fruit, tomato, avocados, egg plants. For tools, see **2.6 Key Facts**

3. Pick two of these crops that interest you and describe how, and when they should be pruned.

Learning Unit 3: Assist in harvesting activities

Learning Outcomes

By the end of the Learning Unit, trainees will be able to:

3.1 Determine maturity indices of horticultural crops

3.2 Perform harvesting operations

3.3 Pack and transport horticultural crops produce

Learning Unit 3: Self Assessment

1. Ask trainees to look at the illustration above (in their Trainee Manuals) and discuss what they see. What topics do they think this unit will include based on the picture? After some brainstorming, share the main topics.

2. Explain that this Learning Unit deals with how to determine when horticulture crops are ready for harvest, how to harvest them, and what to do after harvesting to minimize damage and ensure quality produce.

3. Ask trainees to fill out the self - assessment at the beginning of the unit in their Trainee Manuals. Explain that the purpose of the self-assessment is to become familiar with the topics in the unit and for them to see what they know or do not know at the beginning. At the end of the unit, they will do a self - reflection, which includes re-taking the self - assessment and identifying their strengths, areas that need improvement and actions to take. The self-Assessment is not a test!

Learning Outcome 3.1: Determine maturity indices of horticultural crops

Objectives: By the end of the learning outcome, trainees will be able to:

a. Describe maturity types

b. Determine maturity indices

c. Perform measurement of maturity indices

Time Required: 10 hours

Learning Methodology: brainstorming, oral presentation, group discussion, demonstration, projection of image and video, field visit.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- **Horticulture produce**: Various examples at different stages of maturity and ripeness

Preparation:

- ❑ Make sure there is access to the school garden.
- ❑ That there are plants available at different stages of the growth cycle in order to determine maturity.

Cross Cutting Issues:

- ✓ **Standardization culture:** While performing pruning of fruit and vegetables always use the PPE; ensure the crops do not contaminate.
- ✓ **Gender:** While forming small group consider gender and inclusiveness while allocating role for the scenarios

Prerequisites:

- None

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe types of maturity	**1.** Identify the types of maturity in horticultural crops production	**1.** Responsible
2. Describe ways to determine maturity indices	**2.** Determine maturity of horticultural crops	**2.** Methodical
3. Describe measurement parameters	**3.** Perform measurement of horticultural crops production	**3.** Practical

Steps:

Getting Started: What do we know and where are we going?

1. Have the trainers turn to **Topic 3.1 Task 1** and look at the images and illustration above.

2. Ask them to reflect upon the following:
   - **a.** What do you think might be happening in the images and how are they related?
   - **b.** Use these images to help you remember back to the food crop production module and the learning outcome that dealt with determining maturity.
   - **c.** What do you remember from that unit?
   - **d.** How might what you remember apply to horticulture crop maturity?

   Possible Answers: All plants have a life cycle that can be difficult to understand without knowing the signs. Most food crops have several signs that can help us determine when it is time to harvest. Without paying attention to these signs can result in poor yields and poor produce.)

3. Ask a volunteer to share their answers.

4. Introduce the learning outcome and have learners turn to the Key Competencies table and review it together. Conclude by explain that this learning outcome/session will focus on determine maturity indices of horticultural crops.

Problem Solving Activity

1. Ask trainees to form small groups of three or four and read the following scenario together found in **Topic 3.1 Task 2** to ensure that everyone understands:

   Rukundo and Uwimana are farmers who have grown tomatoes in a nursery and a crop of carrots in a ½ hectare field. They have recently harvested their tomatoes and plan to harvest their crop of carrots soon. They had planned to sell the tomatoes at the local market while selling the carrots to a distant buyer; however, just two days after the harvest they noticed that most of their tomatoes were already overripe and unsuitable for consumption. Therefore, they proceeded to harvest and sell the carrots in order to cover their losses. Two weeks later they discover that their neighbour who also planted the same amount of carrots received a significantly greater amount of money for their harvest.

2. After reading the scenario have trainees look at the related questions:
   a. What do you think went wrong with Rukundo and Uwimana's crop of tomatoes and why did they get less money for their carrots?
   b. What could help them to produce better crops for next season that will ultimately earn them more money?

   Possible Answer: They most likely did not harvest their produce at the correct time. They may have received less payment for their carrots because they harvested them while they were still under mature thus weighed less. At the same time while there are a few possibilities of why their tomatoes were not fit for consumption, e.g. not properly handled and cooled it is likely that their tomatoes could have been over ripe when harvested. Therefore, they should pay attention to maturity indicators when deciding to harvest for next time.)

3. Give them time to work out their responses and give help referring groups to the **3.1. Key Facts** when needed.

4. Ask groups to share their answers with the rest of the group.

5. After the presentation and sharing the answers, refer learners to **3.1 Key Facts** determine maturity indices of horticultural crops in the trainee manual and review it together.

Guided Practice Activity

1. Divide the trainees into small groups and refer them to **Topic 3.1 Task 3**.

2. Inform them that they will practice measuring and determining the maturity of different horticulture crops.

3. Provide three different examples of various produce of varying degrees of maturity.

4. Instruct them to complete the tables below answering the following questions:
   a. What is the produce?
   b. What kind of maturity type is the produce (e.g. Horticultural or Physiological) and at what stage is it (e.g. mature, immature, and overripe)?
   c. How can you tell the maturity i.e. what maturity indices are used?
   d. How long has it been since the produce was planted?

5. Encourage other groups to ask questions for clarification. You can help all groups where they find a challenge.

6. Once each group has recorded their findings, facilitate a discussion for them to share their observations while highlighting correct answers.

Application Activity

1. Before the class begins plan an appropriate date to follow up on the trainees progress of the horticulture given the current growing season phase and life cycle of the plants to be observed.

2. Ask trainees to turn to **Topic 3.1 Task 4** in their trainee manuals.

3. Explain that this activity will require that they keep a horticulture journal that will help them follow how plants develop throughout the growth cycle.

4. They should choose a crop that interests them i.e. one that they could imagine growing one day.

5. Review the instructions bellow, together as a group to ensure that everyone understands:

a. Each week measure the plants from the school garden or in cooperation with a local nursery or farm
b. Determine what indicators of maturity you will use and how you will measure these plants
c. Record all other processes related post planting maintenance
d. Include additional notes regarding the condition of the plants.
e. Follow the format of the example give below.

6. Explain that the above instruction should be recorded in a journal format as the example provides below.

E.x.

Horticulture Journal: Tomatoes 2019 (2nd growing cycle)			
Date	Maturity description:	Maintenance	Other notes
11/06	● indicator 1 Colour- dark green ● indicator 2 Size-small fruits, average circumference=2cm ● indicator 3: Firmness- very firm	● Earthing up, pruning and done today. ● Fertilisation done two days ago, June 9th.	● Plant is healthy ● Fruits are on track
18/06			
25/06			

7. Have trainees start their journal.

8. Inform the trainees when a follow up session will be to review their journals.

Points to Remember

- Physiological maturity is used to determine the level of ripeness of fruits.
- Horticultural maturity is used to determine the level of ripeness of vegetables.
- Size, shape, colour, and firmness are all good indicators to determine maturity.

Formative Assessment

1. Name the two types of maturity used in horticultural crop production and what they refer to.

Answer: Physiological maturity- The stage of development when a plant part will continue development even if detached. Usually used in reference to fruit ripening. Horticultural maturity- the stage of development when a plant possesses the necessary characteristics for use by consumers. Usually used in reference for vegetables.)

2. Describe how you would measure the maturity of two horticultural crops that interest you.
Answer: See **3.1 Key Facts**

Learning Outcome 3.2: Perform harvesting operations

Objectives: At the end of the learning outcome, trainees will be able to:

a. Select tools and equipment

b. Prepare tools and equipment

c. Perform harvesting methods in the field

Time Required: 20 hrs

Learning Methodology: Brainstorming, small group discussion, individual work, and field visit and field practical work.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- Tools and materials for horticulture operations: See **3.2 Key Facts**

Preparation: Before delivery of the present outcome:

- ❑ Make sure there is access to the garden or off-site field, garden or nursery.
- ❑ Ensure that there are plenty of examples of various horticultural plants with mature produce ready for harvest readily available in the training centre.
- ❑ Tools and materials needed for harvesting crops are readily available in the field.

Cross Cutting Issues:

- ✓ **Standardisation culture:** While performing harvesting operations of horticultural crop production , always use the PPE,
- ✓ **Gender:** While forming small group consider gender and inclusiveness while allocating role for the scenarios

Prerequisites:

- Maintain farm tools, equipment and facilities
- Basic knowledge on plant biology mainly on plant propagation and germination

Key Competencies:

Knowledge	Skills	Attitudes
1. Classify tools and equipment	**1.** Select tools and equipment	**1.** Careful
2. Describe harvest techniques	**2.** Apply harvesting techniques	**2.** Attention to detail
3. Describe post-harvest field storage operations for horticulture crops	**3.** Perform postharvest field storage for horticulture crops	**3.** Practical

Steps:

Getting Started: What do we know and where are we going?

1. Have the trainees turn to **Topic 3.2. Task 1**

2. Ask them to have a look at the illustration and images above and reflect on the following:
   a. What are the farmers wearing and holding?
   b. Do they recognize the produce?
   c. What do they think the farmers in the illustration and images are doing?

3. After giving them some time to formulate their thoughts, call on volunteers and have them share their answers.

4. Introduce the learning outcome and have learners turn to the Key Competencies table, and review it together. Conclude by explain that this learning outcome/session will focus on harvesting horticultural crops.

Problem Solving Activity

1. Have the trainees partner up and read the following scenario in **Topic 3.2 Task 2** and then answer the questions:

   The KOABIBIKA cooperative, located in Karongi district is seeking workers to assist in their harvesting operations. The cooperative's land is expansive and the produce to be harvested includes: eggplant, tomatoes and passion fruits crops within different field planted horticultural crops. You have decided to apply for this job."

a. Before you travel to the cooperative prepare for the job interview by brainstorming some questions that may arise and show you are qualified for the job:

Possible Answers: questions arise about experience, knowledge, and attitude. The trainees could show that they have previous experience with harvesting food crops, therefore have some applicable knowledge and the correct attitude.

b. How might different crops require different harvesting techniques in the field?
Possible Answers: some crops require manual techniques such as picking while other must be harvested with tools.

c. Make a list of all the different methods you can think of.
Answers: see **3.2 Key Facts**

d. Make a list of tools will you need to help harvest these crops.
Answers: see **3.2 Key Facts**

2. After reviewing the scenario and questions, ask comprehension question to ensure everyone understands the task. There may be some trainees in the group unfamiliar with what a job interview is so explain as needed.

3. Encourage them to use their previous knowledge from the module on Food Crop Production to when making their lists of tools and techniques.

4. Once each pair has completed their lists, facilitate a sharing session where trainees discuss their answers while revising their list according to any feedback and new ideas that arise. Conclude by referring to **3.2 Key Facts.**

Guided Practice Activity

1. Ask the trainees to turn to **Topic 3.2 Task 3** in their trainee manuals.

2. Inform them that this activity will focus on the tools and materials for harvesting horticulture produce.

3. Instruct them to match the harvesting tools and materials required for each crop listed below.
Answers:

- Pineapple: B, H, I
- Tomatoes: A, B, H, J

- Avocadoes: A, B, F
- Cabbage: B, C, D, H, I, J
- Passion Fruit: A, B, F, H, J
- Eggplant: A, B, C, D, H, J
- Carrots: B, E, G, H, J

Application Activity

1. Divide the trainees into groups

2. Inform that they will now perform harvesting and postharvest field operations for the horticulture crops growing in the school garden or in cooperation with a local farm or nursery **(Topic 3.2 Task 4**).

3. Guide the groups in performing the following task:
   a. Select the necessary tools and equipment
   b. Harvest different crops using the correct methods for each
   c. Perform post-harvest handling and field storage of the crops to minimize damage
   d. Clean and sterilise tools upon completion

Points to Remember

- Always make sure that harvesting tools are clean to prevent produce contamination
- The best time of day to harvest horticulture crops is early in the morning.

Formative Assessment

Choose two horticulture crops that interest you and explain to your trainer the different steps you would need take in order to harvest both correctly. Use the points below to aid in your discussion.

- Selecting tools
- Techniques and methods
- Time of day
- Field storage

Learning Outcome 3.3: Pack and transport horticultural produce

Objectives: At the end of the learning outcome, trainees will be able to:

a. Select packaging materials for horticulture produce

b. Perform packing methods

c. Perform transport

Time Required: 10hrs

Learning Methodology: Brainstorming, small group discussion, individual work, and field visit and field practical work.

Materials Needed:

- **Standard training materials -** flip chart, markers, tape, A4 paper, pens, paper
- **Various packaging materials-** suitable for horticulture produce.

Preparation: Before delivery of the present outcome:

- ❑ Make sure you have samples of harvested horticultural produce readily available in the training centre's
- ❑ Make sure, tools and materials needed for packing and transport horticultural produce are readily available
- ❑ Organize an agreement with some organization who could potentially transport produce to near or distant destinations for the final activity of the unit.

Cross Cutting Issues:

- ✓ **Gender:** While forming the groups for group discussion and practical exercise, make sure both females and males are represented. Emphasize that farming can be done by both men and women.
- ✓ **Environment and sustainability:** While curing different crops, emphasize the need to protect the environment through proper disposing of waste materials.
- ✓ **Standardisation Culture:** While curing different crops, emphasise the need to follow set standards or requirements

Prerequisites:

- Maintain farm tools, equipment and facilities
- Basic knowledge on plant biology mainly on plant propagation and germination

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe criteria for selecting packaging materials	**1.** Select packaging material for horticulture produce	**1.** Analytical
2. Describe packing methods	**2.** Select the packing methods	**2.** Precise
3. Describe the ways of transport methods of horticulture produce	**3.** Perform transport of horticulture produce	**3.** Careful

Steps:

Getting Started: What do we know and where are we going?

1. Ask the trainees to turn to **Topic 3.3 Task 1**

2. Have them look at the images and illustration above and reflect on the following:
   a. Have they ever had to package or transport horticulture crops?
   b. If so, which crops were they and how did they do it?
   c. Think back to the module that about food crop production and the learning unit that dealt with packaging and transportation. What can they recall?
   d. How might the packaging and transportation of horticulture crops be similar to that of food crops?
   Possible Answer: Careful planning must be undertaken before harvest to ensure that produce is transported and packaged effectively and efficiently.)
   e. How might it be different?
   Possible Answer: Generally, horticulture crops are more delicate and damage easier than food crops thus special attention and care must paid when handling and packaging them.)

3. After giving them some time to formulate their thoughts, call on volunteers and have them share their answers.

4. Introduce the learning outcome and have learners turn to the Key Competencies table, and review it together. Conclude by explaining that this learning outcome will focus on post-harvesting packing and transportation of horticultural crops.

Problem Solving Activity

1. Divide the trainees into groups and read the scenario questions in **Topic 3.3 Task 2** together as a class:

   Kalisa and Anet are the produce farmers who have just harvested several fields of horticulture crops. Their yields include 18 tons of carrots, 5 tons of tomatoes and 2 tons of pineapple and 3,000 heads of cabbage. However they have not planned for how to transport or package the produce.

2. Instruct them that their task is to draw up a plan for Kalisa and Anet's produce by brainstorming the following:
   a. What problems could occur to their produce if they do not arrange for transportation quickly?
   b. What problems could happen if they choose poorly suited packaging for their harvest?
   c. What would you need to know before you could decide the right packaging materials and mode of transportation?

3. Facilitate a brain storming session with all of the groups where each group presents their ideas on the flip chart or black board.

4. After the ideas have been shared and aspects of the problem has been elaborated, instruct groups to draft their plan for Kalisa and Anet's harvest.

5. Facilitate a brief sharing session of the group's plans.

6. Conclude by reviewing **3.3 Key Facts.**

Guided Practice Activity

1. Divide the trainees into groups and inform them that they will make a plan for selling the produce harvested in the school's garden by following the instructions below.

2. First have the groups choose one horticulture crop that they have harvested in the previous unit and make a list of three different places where you believe the school's horticulture crops could be sold.

3. Encourage them to think about where there would be a need for this produce (demand) and how it would require different transportation and packaging considerations depending on these different destinations.

4. Instruct them to make their plan describing how the produce should be packaged and transported following the guidelines below as well as information in **3.3 Key Facts**:
   a. How will you prevent the produce from being damaged during transport?
   b. How easy are packages to move by one person?
   c. Are they easy to fill, assemble and close?
   d. Does the package allow for enough ventilation?
   e. Are the dimensions of the storage suited for transport?
   f. Are the packages available in your area?
   g. What is the cost of each package?
   h. Are the packages suited for market sale or will the produce need to be transferred into another package?
   i. How much will transportation cost?

5. When all groups have finished their plan, facilitate a sharing round.

6. Once all of the plans have been presented, explain that the trainees will vote on which plan and location they believe to be most feasible for delivering the produce in a good state and selling it to generate a profit.

7. Record the vote.

8. Save the most popular plan since it will be used for the next activity.

Application Activity

1. Before class, be sure to have various produce and different kinds of packaging set up at different stations.

2. Divide trainees into groups, assign each group a station, and inform them that they will now prepare to package the horticulture produce that you have harvested in the school garden.

3. Instruct them to select suitable packaging for each type of fruit or vegetable and package the items at their assigned stations.

4. Once everyone in the group has had a chance to try packaging the items and done it correctly, have the trainees discuss suitable transporting methods for the packaged produce with you.

5. Then instruct the trainees to unpack the items and move to the next station.

6. Once everyone has had the chance to practice packaging at all the different stations, reconvene the trainees in a big group and refer to the plan the class voted for in the previous unit.

7. Explain that it is now time to package the selected produce according to the plan and prepare to send it to the location i.e. a local market or produce buyer.

8. Establish a plan and designate roles and action to get the packaged produce to market and generate a profit for the class.

Points to Remember

- Proper relative humidity for horticulture produce should be 85-95% for the majority of the fruits, 95-98% for vegetables

- Optimum temperature varies from 18 to 25˚C

Formative Assessment

1. Name three criteria that determine packaging selection.
   - **a.**
   - **b.**
   - **c.**

2. Choosing two horticulture crops that interest you. Demonstrate how they should be packaged according to the destination of your choice.

Summative Assessment

Integrated Situation	Resources
The trainee will complete the following summative assessment according to the following scenario: TWIZAMURE is a cooperative of farmers in Rulindo District. In 2016, it started a business of growing passion fruit and targeted the enterprise Urwibutso as a potential customer. However, they have not been able to get the targeted income because their passion fruit vines are not giving the expected yield. Urwibutso is now considering buying passion fruits from neighbouring countries. As a member of the cooperative, you are requested to demonstrate to fellow members best production practices in order to help solve the problem of low yields. You are requested to perform and demonstrate the planting, maintenance, and harvest practices on a plot of 96m^2 (8 m wide and 12 m long)." **1. At the pre-planting station the trainee must**: **a.** Explain how to select and prepare seeds for germination and how to propagate vegetative plants. **b.** Perform a tree graft. **c.** Prepare pots or seed trays with the correct amount of planting medium **d.** Plant a seed ready for germination. **e.** Explain how to prepare field soil for direct sowing. **2. In the planting field the trainee must:** **a.** Plant rows of passion fruit seedlings maintaining 2X3m of spacing. **b.** Apply correct amounts of dithane M45 at 50 gr/20L and NPK at 300kg/ha and 50 kg of urea/ha. **c.** Perform all other immediate care actions. **d.** Describe how to calculate plant density. **3. At the established plant field station the trainee must:** **a.** Perform earthing up and weeding.	**Planting materials:** ● Passion fruits seedlings ● Organic fertiliser (FYM, Compost, Green manure) ● Mineral fertiliser (NPK,DAP) ● Pesticides **Horticulture Tools:** ● Hoe, ● Panga, ● Forked hoe, ● Spade ● Watering can, ● Measuring tape, ● Pegs ● Pruning shears ● Collection bags ● Baskets ● Wires ● Timber for posts **Equipment:** ● Sprayer ● Wheelbarrow ● PPE ● Ladder **Packaging materials:** ● Boxes ● Crates ● Bins **Other kinds of horticulture crops:** ● In various stages of the growth cycle

b. Identify which irrigations systems are found at the field.
c. Discuss potential diseases and pests that could affect your crop and how to both identify them and manage them.
d. Describe the purpose of mulch.
e. Explain how to make compost
f. Perform pruning on two different crops.

4. **At the harvesting station the trainees must:**
   a. Determine the maturity of at least three different crop types.
   b. Harvest three different mature horticulture crops that use different methods.
   c. Package the harvested crops and describe how they should be transferred.

5. **The task should be performed within three hours.**

Assessment Criterion 1: Quality of Process

Checklist	Score	
	Yes	No
Indicator 1: Planting materials and supplies are properly selected following recommendations		
• Quality of planting materials		
• Absence of pest and diseases		
• Vigour		
• Health		
• Size		
• Variety characteristics		
• Certification		
• Cost		
• Distance		
Indicator 2: Planting materials pre-treatments are properly applied based on crop requirements		
• Stripping of seedlings		
• Trimming of seedlings		
• Pesticide treatments		
Indicator 3: Planting materials to the site are correctly handled and transported following instructions		

• Handling and transportation of seedlings		
• Containerized seedlings		
• Materials for packing		
• Storing seedlings		
Indicator 4: Methods of planting are properly selected depending on the crop		
• Transplanting		
• Planting pattern		
• Rectangle		
Indicator 5: The growing medium is effectively planted considering the method of planting and crop requirements		
• Planting passion fruits		
✓ Season /date planting		
✓ Planting spacing and densities		
✓ Planting depth		
✓ Planting design		
✓ Rectangle		
Indicator 6: Post planting immediate care is adequately performed depending on crop requirements and propagation techniques used		
• Post planting immediate care		
✓ Mulching		
✓ Watering		
✓ Firming soil		
Indicator 7: The collection /disposing of waste to minimize damage to the external environment is effectively done in accordance with environment laws and regulations		
• Recycling		
• Re-use		
• Safe disposal of waste		
Indicator 8: Records are accurately and promptly completed in accordance with supervisor's requirements		
• Content of recording form		
✓ Date of planting		
✓ Name of variety/clone		
✓ Location		
✓ Total area		
✓ Total number of plants		
✓ Spacing		
Indicator 9: Mulching is properly applied based on crop requirements		
• Timing		
• Types of mulch		
• Apply mulch		
Indicator 10: Weeding of the field is done properly considering following recommendations		
• Timing and frequency		
• Weeding control methods		

✓ Physical and cultural methods		
✓ Chemical methods		
✓ Biological methods		
Indicator 11: The application of supporting is done properly considering crop requirements		
• Supporting of passion fruits		
✓ Advantages		
✓ Methods of supporting		
• Trellising		
Indicator 12: The irrigation is adequately done considering crop requirements and recommendations		
• When to irrigate		
• Irrigation systems		
✓ Hand irrigation		
✓ Drip irrigation		
Indicator 13: Fencing for crop protection is properly installed following recommendations		
• Types of fencing		
✓ Live fence		
✓ Artificial/nonliving fence		
• Height of fence		
Indicator 14: Pests symptoms/damages in horticultural crops are tentatively identified following instructions		
• Pests symptoms and damages in Horticultural crops		
✓ Causes of damages		
• Biotic		
✓ Vertebrate animals		
✓ Insects and invertebrate animals		
• Common symptoms		
✓ Wilting		
✓ Dieback		
✓ Cankers		
✓ Rusts		
✓ Spots		
✓ Witches broom		
✓ Small leaves		
✓ Yellowing		
✓ Distortion		
✓ Galls		
✓ Mosaic		
Indicator 15: Disease symptoms/damages in horticultural crops are tentatively identified following instructions		
• Causes of damages		
✓ Biotic		
▸ Bacteria		
▸ Fungus		

▸ Virus		
▸ Pytoplasma		
✓ Abiotic		
▸ Adverse weather conditions		
▸ Soil conditions		
• Common symptoms		
✓ Wilting		
✓ Dieback		
✓ Cankers		
✓ Rusts		
✓ Spots		
✓ Witches broom		
✓ Small leaves		
✓ Yellowing		
✓ Distortion		
✓ Galls		
✓ Mosaic		
Indicator 16: Tools and equipment needed in pest control are properly selected following instructions		
• Tools and equipment used in Pest management		
✓ Sprayers		
✓ PPE		
Indicator 17: Pesticides are carefully applied following instructions		
• Considerations before applying pesticides		
✓ Climatic conditions		
✓ Severity of the diseases		
✓ Cost		
• Application rate		
• Application interval		
• Pesticide mixture		
• Pre-harvest interval		
Indicator 18: Fertilisers are correctly identified and acquired following recommendations		
• Identification of fertilisers		
✓ Types of fertilisers		
• Organic fertilisers		
✓ Compost		
✓ Farmyard manure		
✓ Green manure		
• Commercial fertilisers		
✓ Simple fertilisers		
✓ Compound fertilisers		
• Source of fertilisers		
✓ Making compost pit		
✓ Growing green manure plants		
✓ Agriculture inputs shops		

Indicator 20: Fertiliser rates are correctly calculated considering the plot size and recommendations		
• Calculation of fertiliser rates		
Indicator 21: Fertilisers are properly applied following recommended techniques and the crop		
• Application of fertilisers		
✓ Timing		
✓ Method of application		
▸ Row or band placement		
▸ Top dressing and side dressing		
▸ Fertigation		
Indicator 22: The pruning stage is properly determined considering the crop and instructions		
• When to prune		
Indicator 23: Pruning techniques to be used are properly selected considering crop requirements and instructions		
• Pruning techniques		
✓ Timing		
✓ Pruning rules and guidelines		
✓ Pruning cuts		
✓ Training of passion fruit		
Indicator 24: Tools and equipment are properly selected considering the selected pruning techniques and instructions		
• Pruning tools		
✓ Shears		
✓ Pruning knife and rasp		
✓ Ladders		
Indicator 25: Pruning is properly executed following instructions		
• Disinfection/ sterilisation of tools		
• Pruning cuts		
✓ Pinching		
✓ Training		
• Horizontal T leader		
✓ Caring the wound		
Indicator 26: Crop growth stages is correctly determined in reference with the crop development		
• Computation from date of planting		
Indicator 27: The timeline from planting or flowering to maturing stage is correctly determined in reference with the crop vegetative cycle		
• Time (computation)		
Indicator 28: Physical features (size, shape, colour, surface characteristics, abscission) are correctly identified in reference with crop maturity and market requirements		
• Measurement		
✓ Visual indices and quantitative		
✓ Colour		

✓ Size and shape		
✓ Firmness of flesh		
• Chemical characteristics		
Indicator 29: Proper selection and acquisition of materials, tools and equipment for harvesting according to the crop requirements		
Criteria of selection		
• Harvesting methods		
✓ Hand		
• Passion fruit		
Materials used in harvesting		
• Pruning shear		
• Picking containers		
• Harvesting Knives		
• Nets		
• PPE		
• Bulk Bins and Picking Trailers		
Indicator 30: Tools, materials and equipment for harvesting are properly prepared following instructions		
• Preparation of tools, materials and equipment for harvesting		
✓ Cleaning		
✓ Disinfection		
✓ Check conditions of tools, materials, and equipment for harvesting		
Indicator 31: Harvesting methods are appropriately identified according to the crop harvesting requirements		
• Harvesting methods		
✓ Hand harvesting		
Indicator 32: Harvesting of horticulture crops is correctly executed following guidelines		
• Field-postharvest handling operations		
✓ Avoiding dumping		
✓ Pre-Sorting		
✓ Grading		
✓ Shading		
✓ Pre-cooling		
✓ Cleaning/washing		
Indicator 33: Packaging methods for horticulture produce are correctly selected according to the recommended crop packing conditions		
• Selection of packaging methods for horticulture produce		
✓ Functions of packaging		
✓ Packaging materials		
• Criteria for selecting packaging materials		
• Easy transport		
• Easy to fill, assemble and close		
• Ventilation		
• Dimension suited for transport		
• Availability		

• Cost		
• Suited for market demands		
Indicator 34: Packing methods are suitably performed considering horticulture produce requirements		
• Packing methods		
✓ Guidelines for packing horticulture crops		
Indicator 35: Transport methods of horticulture produce are properly identified according to produce requirements		
Transport methods of horticulture produce		
• Transport systems		
• Short distance transport		
Observation		

Assessment Criterion 2: Quality of product

Checklist	Score	
	Yes	No
Indicator 1: Passion fruit field is properly maintained		
Weed free plot		
Mulched plot		
Trained passion fruits		
Healthy and vigorous passion fruit plants		
Indicator 2: Passion fruit are harvested appropriately		
Mature passion fruits		
Passion fruits cut with their stalk		
The number of harvested passion fruits which are damaged is minimal		
Observation		

Assessment Criterion 3: Relevance

Checklist	Score	
	Yes	No
Indicator 1: Time is effectively managed		
Duration (3 hours)		
Indicator 2: **Plot dimensions are accurately respected**		
Area of the plot (96 m^2)		
Length (12m)		
Width (8 m)		
Indicator 3: Spacing is accurately respected		
Between rows (2 m)		
Within rows (3 m)		
Indicator 4: Fertiliser and pesticides rates respected		
Application of NPK at 300kg/ha in 3 equal splits		
Application of Urea at 50kg/ha in 3 equal splits		
Application of Dithane at 50g/20L of water		
Observation		

REFERENCES

Adjei, L. (2017, September 25). *How to: Transplant vegetable seedlings from nursery to the farm*. MyFarm Blog. https://blog.agrihomegh.com/transplanting-vegetable-seedlings/

Avocado tree pruning basics. (2013, April 22). California Avocado Commission. https://www.californiaavocadogrowers.com/cultural-management-library/avocado-tree-pruning-basics

Bareja, B. G. (2019, May 7). *Methods of planting crops: What is direct seeding and what is transplanting?*. CropsReview. https://www.cropsreview.com/methods-of-planting.html#:~:text=In%20general%2C%20a%20farmer%20who,planting%3A%20direct%20seeding%20and%20transplanting

Bayer Group. (2015, October 6). *Figure 2. A twin row planting with a 38-inch row center* [Photograph]. https://www.dekalbasgrowdeltapine.com/en-us/agronomy/pros-and-cons-of-different-corn-row-spacing.html

Bazodo Enterprises. (n.d.). *Germination guaranteed: Veg, spinach and fruits*. https://bazodo.com/seeds/90-bazodo-all-variety-seeds-28-types-germination-guaranteed-veg-and-spinach-and-fruits.html

Boyette, M., Sanders, D. C., & Rutledge, G. A. (1996, September 1). *Packaging requirements for fresh fruits and vegetables*. NC State Extension Publications. https://content.ces.ncsu.edu/packaging-requirements-for-fresh-fruits-and-vegetables

Brouwer, C., Prins, K., Kay, M., & Heibloem, M. (n.d.). *Irrigation water management: Irrigation methods: Chapter 5 Sprinkler irrigation*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/s8684e/s8684e06.htm

Cantwell, M. (2014, June). *Maturation and maturity ondices: When to harvest?*. UC Davis Postharvest Technology. https://ucanr.edu/datastoreFiles/234-2711.pdf

Cutrer, J. (2018, September 10). *Orange clay pots* [Photograph]. Flickr. https://www.flickr.com/photos/joncutrer/49280193866 License: https://creativecommons.org/licenses/by/2.0/legalcode

Dicalite Management Group, Inc. (n.d.). *Perlite and vermiculite in a soilless mix*. Dicalite Management Group. https://www.dicalite.com/2018/05/perlite-and-vermiculite-in-a-soilless-mix/

Dixie, G. (2005). *Horticultural marketing: Chapter 8: Post-harvest handling*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/a0185e/a0185e0a.htm

Encyclopedia Britannica. (n.d.). *Fruit farming: Soil management, irrigation, and fertilization*. https://www.britannica.com/topic/fruit-farming/Soil-management-irrigation-and-fertilization

Energypedia. (2020, July 14). *Surface irrigation*. https://energypedia.info/wiki/Surface_Irrigation

Friedman, L. (2017, August 8). *Seedling trays* [Photograph]. Flickr. https://www.flickr.com/photos/lynnfriedman/36244873994/ License: https://creativecommons.org/licenses/by-nc-nd/2.0/legalcode

Hessong, A. (n.d.). *How to prune passion fruit*. SF Gate. https://homeguides.sfgate.com/prune-passion-fruit-37928.html

Klein, P., & Date, A. Z. (n.d.). *Chapter VI: Land preparation, planting operation and fertilisation requirements*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/Y4360E/y4360e0a.htm

Lutts, S., Benincasa, P., Wojtyla, L., Kubala, S. S., Pace, R., Lechowska, K., Quinet, M., & Garnczarska, M. (2016, October 12). *Seed priming: New comprehensive approaches for an old empirical technique*. IntechOpen. https://www.intechopen.com/books/new-challenges-in-seed-biology-basic-and-translational-research-driving-seed-technology/seed-priming-new-comprehensive-approaches-for-an-old-empirical-technique

Miss May Rivers, & Rawpixel.com. (2017, December 12). *The fruit grower's guide: Vintage illustration of equilateral triangle* [Enhanced photo]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Vintage_illustrations_by_Miss_May_Rivers_digitally_enhanced_by_rawpixel_111.jpg License: https://creativecommons.org/licenses/by-sa/4.0/legalcode

The New Zealand Digital Library. (n.d.). *Making the right seedbed for the crop, soil, and climate*. http://www.nzdl.org/gsdlmod?e=d-00000-00---off-0hdl--00-0----0-10-0---0---0direct-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0--4----0-0-11-10-0utfZz-8-00&a=d&cl=CL1.16&d=HASH412cd503b5262205ac14c6.6.4

Paulin, B., & O'Malley, P. (2008, July). *Compost production and use in horticulture*. Department of Agriculture and Food, Western Australia. https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1197&context=bulletins

Peace Corps. (1990). *Alternate row planting*. New Zealand Digital Library. https://www.nzdl.org/gsdlmod?e=d-00000-00---off-0envl--00-0----0-10-0---0---0direct-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0--4----0-0-11-10-0utfZz-8-00&cl=CL1.6&d=HASHb1669db516271d3af777f8.8.3.3>=1#:~:text=Alternate%20rows%20or%20strips%20(alley,contours%20to%20minimize%20soil%20loss

Plant Health Engineering Division, NIPHM. (n.d.). *Introduction*. https://niphm.gov.in/Recruitments/PHE-ASO-Manual-22042013.pdf

Popenoe, J. (2018, November). *Pesticide application methods*. Citrus Research and Education Center (CREC) - University of Florida, Institute of Food and Agricultural Sciences. https://crec.ifas.ufl.edu/media/crecifasufledu/extension/extension-publications/2018/2018_november_pesticide.pdf

Pxfuel. (n.d.). *Cucumber, bud, potted plant, support, nature, leaf, plant part, growth, green color, close-up* [Photograph]. https://www.pxfuel.com/en/free-photo-jxcvf

Free for commercial use, DMCA

Republic of South Africa National Department of Agriculture, & AgriSETA. (2006, July). *Learner guide: Primary agriculture: Plant crops under supervision*.

AgriSETA. https://www.agriseta.co.za/downloads/LearningMaterial/116200_LG.pdf

Seed Dynamics. (n.d.). *Pelleting: Improving a seed's size and weight for precise metering*. https://seeddynamics.com/technology/techniques/pelleting/

SNV Netherlands Development Organisation. (n.d.). *Smallholder horticultural production and business: Trainer's manual*. https://snv.org/cms/sites/default/files/explore/download/rarp_2016-horticulture-trainers-manual.pdf

Stauffer, B. (n.d.). *Fact sheet: Drip irrigation*. Seecon International. https://sswm.info/sswm-solutions-bop-markets/affordable-wash-services-and-products/affordable-technologies-and/drip-irrigation

Tewari, D. (2009, August 29). *Nursery management in vegetables*.

Agropedia. https://agropedia.iitk.ac.in/content/nursery-management-vegetables

United States Agency for International Development (USAID). (2012, August 23). *Producing high quality seeds* [Photograph].

Flickr. https://www.flickr.com/photos/usaid_images/8405116827

License: https://creativecommons.org/licenses/by-nc/2.0/legalcode

Wikipedia. (n.d.). *Postharvest*. Retrieved 2019, from https://en.wikipedia.org/wiki/Postharvest

This publication is made possible by the support of the American People through the United States Agency for International Development (USAID). The contents of this are the sole responsibility of Education Development Center (EDC) and do not necessarily reflect the views of USAID or the United States Government.

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