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COURSE OVERVIEW

Training curriculum

This course on good agricultural practices for ware potato production in Cameroon comprises four modules and 18 themes, as outlined below:

Module 1: Introduction to the potato crop

  Figure 1. Importance of the potato crop
  Figure 2. Understanding the potato’s crop cycle

Module 2: Soil, crop and water management

  Figure 3. Land selection and preparation
  Figure 4. Application of manure and fertilisers
  Figure 5. Planting techniques
  Figure 6. Weeding and hilling-up
  Figure 7. Irrigation

Module 3: Pest and disease management

  Figure 8. The disease triangle
  Figure 9. Control of late blight
  Figure 10. Control of bacterial wilt
  Figure 11. Control of soft rot (or blackleg)
  Figure 12. Control of viral diseases
  Figure 13. Control of potato tuber moth
  Figure 14. Control of nematodes
  Figure 15. Safe use of chemicals

Module 4: Post-maturity practices

  Figure 16. Harvesting
  Figure 17. Sorting and grading
  Figure 18. Storage

The sequence of modules and themes follows a certain logic as per the growth and development cycle of the potato crop. Therefore, it is strictly recommended to follow the same sequence during
training sessions. For each theme, the trainer-of-trainers\(^1\) or the trainer\(^2\) should allocate a minimum of 15 minutes for the presentation and 10 minutes for questions and answers. In total, the course requires a minimum of 8 hours to be completed, equivalent to a 2-day training workshop for the trainers or 4 training sessions of 2 hours for the producers. For future trainers, a third day training is required on the pedagogy. In a bid to gauge the impact made in training at any level, trainers are encouraged to assess participants’ knowledge through a written test before and after the training using the same questionnaire. A test sample is provided in appendices.

It is recommended that the trainers to attend the second workshop titled “Trainer Instructions” pass an evaluation test organized right after the first training of trainers workshop titled “Good Agricultural Practices for ware potato production in Cameroon” with a score of at least 12/20.

**Training materials**

This course is designed to be a complete set of training materials for easy scale up or scale out. Five types of tools are proposed to facilitate the training of trainers and then cascade down the training to producers. Those materials are the following:

1. Trainer Guide,
2. Trainer Visual Aid,
3. Producer Manual,
4. PowerPoint presentations, and
5. Demo Guide.

**Trainer Guide**

The Trainer Guide is the master document printed in A4 format. It comprises three major parts: (i) the course overview, (ii) the four training modules also found in the Producer Manual, and (iii) the appendices. The course overview presents the training curriculum and all materials to be used. The second part of the guide consists of the training modules, alongside with trainer’s notes and instructions. In the last part (appendices), the Guide provides suggested questions and take home messages per theme as outlined in the Trainer Visual Aid.

**Visual Aid**

The Trainer Visual Aid is a didactic tool which helps the trainer to train participants. The front page contains an image which depicts the topic. That is the image participants see. The rear page is reserved for the trainer, and it includes four components for each of the 18 modules (figures): (i) a small format of the front page image; (ii) a brief summary of the theory in bullet points in which keywords are provided in bold, (iii) three guiding questions, and (iv) a take home message. The small image helps the trainers remain focused on the topic. It is worth mentioning that any brainstorming on the image should be done using the front page one. In his/her introduction to the topic, the trainer may ask participants to critically look at the image and describe what they understand from it. For each figure, three questions are suggested to recap and confirm whether the participants understood the topic or not. The trainer closes the topic with a take home message.

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1. Trainer-of-trainers means the trainer who trains potential trainers.
2. Trainer means the person who trains others for direct use of the knowledge acquired.
**Producer Manual**
This is a pocket-size handbook that the trained participants/producers use. It is recommended to distribute the manual after completion of the training. Acquisition of the manual before the training takes place provides participants with an excuse to skip training sessions or for them to lose focus during training. In this regard, the Producer Manual could be considered as one of possible incentives for completion of the training by producers.

**PowerPoint Presentations**
Two different but complementary presentations are provided in the training package. The first presentation titled “Good Agricultural Practices for ware potato production in Cameroon” is designed to be used by the trainer-of-trainers. It contains information from the Producer Manual presented in slides and is designed to be used during training workshops of potential trainers. It can also be used to train model ware potato producers. The objective of the second presentation titled “Trainer Instructions” is to train trainers in how to train (i.e., pedagogy). This presentation is made in the morning of a one-day training workshop for lead trainers. In the afternoon, participating trainers conduct a simulation exercise (teach back practicum). In principle, the pedagogy workshop comes after the training of trainers on “Good Agricultural Practices for ware potato production in Cameroon” and not the other way around.

**Demo Guide**
This guide is a complementary support tool to the ware potato and seed potato training materials. Therefore, it is not meant to be used alone. It helps the trainer to organize and facilitate hands-on training in the field. It comprises three demonstration protocols: (i) crop husbandry, (ii) positive selection and (iii) small plot technique. For each demo, the guide provides responses to the following questions: What, Why, When, For how long, With what and How. The How includes both a text and images in a bid to clarify the different steps required in each training session. When planning a demo training session, the trainer should consider four successive steps: (i) Introduction to (or brief refresher explanation on) the topic; (ii) the practice of the demo as per the current guide; (iii) a session of questions and answers among participants; and then (iv) the way forward for the next training session.
COURSE CONTENTS

Module 1 Introduction to the potato crop

Figure 1. Importance of the potato crop

The potato crop comes from South America from where it was spread all over the world, including Africa. The crop is currently the third food crop in the world, after wheat and rice. Besides having a high nutritional value, potato is one of the best cash crops in many countries, including Cameroon.

Potato can, thus by generating important income, enable farmers to upgrade their living conditions, e.g., by obtaining better houses, better schools for their children, and better healthcare.

Before venturing into potato agri-business, the following conditions must be fulfilled:

1) Have minimum access to knowledge or technical backstopping on Good Agricultural Practices for ware potato production.
2) Land free of potato diseases is available.
3) Resources to purchase inputs and pay labour before planting (e.g., seed, fertilisers and pesticides) are available.
4) Good quality seed of desired varieties is available and accessible.
5) Production plan for the next three or more seasons (indicating hectarage to be grown each season and the sources of seed) is prepared.
6) Target market for the produce is identified before planting.
7) Have a storage facility or post-harvest handling plan of the produce.

Ask participants to list the major food crops grown in their area. Then, ask them to rank those crops in relation to income generation. This helps to find out the comparative importance of potato.
Understanding the different growth and development stages of the potato crop will help growers to know the right time to perform agronomic practices in the field to increase yields.

The national average tuber yield in Cameroon is around 3 t/ha whereas yields of over 30 t/ha can be obtained with Good Agricultural Practices.

The growth cycle of the crop can be divided into four stages which require timely and specific farming operations.

**Growth stage 1 – Planting to plant emergence**

This stage begins when sprouted tubers are planted and ends when plants emerge from the soil (emergence). In normal conditions, this stage lasts 2 to 4 weeks, but it can also be longer depending on planting conditions such as soil type and moisture, seed physiological age, planting depth, ambient temperature, etc. It is highly recommended to plant well sprouted tubers with multiple (minimum 3) and strong sprouts to ensure uniform emergence of multi-stem plants in the field. This stage is very critical in the crop growth cycle as it drives the crop to success or failure, because the harvest is strongly related to the seed quality used and number of stems per seed.
Growth stage 2 – Emergence to tuber initiation
This stage starts from plant emergence to tuber initiation. It lasts 2 to 4 weeks after emergence, but this period is strongly related to the variety used. Some varieties start forming tubers much earlier than others.

Growth stage 3 – Tuber initiation to end of leaf growth
This is the flowering stage of the crop which marks the end of leaf growth. This means that all leaves are formed and fully grown. The crop reaches its maximum coverage of the soil.

Growth stage 4 – End of leaf growth to plant death
This is the maturity stage of the crop. At this stage, crop growth stops and tubers become bigger. The leaves eventually turn yellow and die. It is important to wait with the harvest until total death of the foliage has occurred because yield increases significantly at this stage. This means that foliage should remain protected against pests and diseases till natural death occurs. However, chemical applications (fungicides and insecticides) must stop at 2 – 3 weeks before harvest.
Module 2  Soil, crop and water management

Figure 3. Land selection and preparation

Land selection.

Potatoes like a cool environment (16 - 20°C). Therefore, plant potatoes in an area that is not too hot (i.e., beyond 28°C), and select an open site, without shades. In Cameroon, potatoes are grown in highlands (above 1,800 masl) and at mid-elevation (800 – 1,800 masl). The soil should be deep, well drained and loose for proper development of roots, stolons and tubers. The site should be free of soil borne pests and diseases, such as nematodes and bacterial wilt. To reduce the risk of pests and diseases, select a site where potato has not been grown for more than two consecutive years. Also plan for a 2-3 year rotation scheme (i.e., 5 cycles or seasons) as potatoes should not follow potatoes or other crops of the same family (e.g., eggplant, pepper, tomato or tobacco) on the same field. During rotation, ensure that all potato plants from left-over tubers are removed in the following crops.

Land preparation.

It is essential to prepare soil early in the season when the soil is partially dry to prevent soil compaction. Prepare land until the ground becomes soft, free from clods and dug to a depth of over 30 cm. Land preparation normally begins at least two weeks before planting and consists of:

- Clearing (manually or with herbicides)
- Raking and stumping (removal of weeds and stones)
- Tilling (hoe, tractor)
- Harrowing
- Ridging (50 to 70 cm height)

Emphasize the need to use the mechanization (motocultivators, tractors) being promoted by ProCISA. Engage them in the discussion on the advantages and disadvantages of the tools.
Like any other crop, potato requires adequate nutrients from manure and chemical fertilisers to grow well. The manure collected with the two hands of an adult can be applied to feed 2-3 seed tubers. This is equivalent to 15-20 t of well decomposed manure per ha. This is very useful on poor soils. It is not recommended for rich soils such as forest soils. Manure (e.g. 1-5 t/ha of chicken manure) may be combined with chemical fertiliser. Manure and chemical fertiliser must be mixed well with soil to avoid direct contact with planted tubers.

For chemical fertilisers, various compound NPK fertilisers are available on the market in Cameroon. The most commonly used fertilisers have a composition of NPK of 12-11-18 (e.g. YaraMila) or NPK 11-11-22 and they are mixed with a second N-rich fertiliser (e.g., YaraLiva 15-0-0) at a ratio of 4/1, respectively. Avoid any NPK fertilisers that have proportions between major nutrients (N, P and K) very different from the ones proposed here (e.g., 20-10-10). If the plant spacing is for example 80 cm x 30 cm, 600 kg/ha of mixed fertilisers will be required, i.e., 480 kg/ha for the NPK-based fertiliser and 120 kg/ha for the N-based fertiliser. In practical terms, apply the content of two Fanta or beer bottle caps for each seed tuber or plant. Apply one cap of mixed fertilisers at planting and reserve the second one of same fertilisers for top-dressing, 1-2 weeks after plant emergence. But for those who may not be able to fertilise after emergence, they can apply the two caps at planting. Also, if you fail to apply fertilisers at planting, you may apply the two caps after emergence. To fertilise the crop after emergence, dig one small hole at around 10-15 cm from the plant base using a stick. Put fertilisers and fill in using hands or the stick.

Inform participants that listed fertilisers’ brands (YaraMila and YaraLiva) are just examples among others. Those are the most commonly used in Cameroon for potato cultivation.
Plant good quality seed of market-preferred varieties. Currently, the most grown varieties are Cipira, Dosa, Panamera, Mondial, Spunta and Désirée.

Use certified seed if available or quality seed from known seed producers or sources. Ensure the seed tubers are well sprouted and avoid old and dried out tubers with long sprouts which can break off. Short and strong sprouts will ensure that once planted growth will be faster, uniform and the crop will be more vigorous. Ensure that seed tubers of the same size (category) are planted together in one area. This results in uniform crop vegetation which will facilitate better management.

Two ways of planting potatoes are possible: planting into furrows or on flat (holes). The two methods can produce the same results. Therefore, it is up to the farmer to choose the easiest method. Planting on ridges should be avoided because plants may not have enough soil for hilling-up at later stages of development. Prepare furrows or holes at a spacing of 75 - 80 cm. But if your variety produces abundant foliage and/or the slope is steep, go up to 90 cm. Within rows, use a plant spacing of 25 - 40 cm depending on seed size, 25 cm when tubers are small (around 30 mm of diameter) and 40 cm for large size (like 55 mm of diameter). Note that on a sloping terrain, furrows or holes should run across the slope to reduce soil erosion and maintain runoff within plant rows. Tubers should be covered by enough soil (10 - 15 cm). Do not waste your time arranging tubers in a way so that sprouts are placed in upright position. They naturally get their way out without any noticeable delay regardless of their position.
The potato crop should be weeded early to reduce competition for light, nutrients and water from weeds, and to prevent weeds from harbouring pests and diseases. First weeding normally occurs right after plant emergence. The field should remain free of weeds until the foliage dies naturally.

Avoid planting potatoes in a field where there is a weed which is difficult to control or eradicate.

Hilling-up potatoes for the first time is always done with the first weeding, especially when plants grow fast. It increases and loosens the soil around the stems, allowing plants to produce many tubers. The second and important hilling-up occurs 2 – 3 weeks later, depending on the growth of the vegetation. A third and last hilling-up may occur 2 - 3 weeks later, especially when the slope and/or the rainfall are high. Ensure that tubers are not uncovered at any time. Also, use a smaller (thinner) hoe than the one used for other field activities.

Benefits of hilling-up potatoes include the following:

1) Facilitating nutrient assimilation while reducing risks of flooding conditions.
2) Maintaining soft ground for smooth root, stolon and tuber development.
3) Ensuring that stolons produce tubers and preventing that stolons become above-ground stems when exposed to light.
4) Reducing tuber exposure to sunlight which turns the tubers green. Green tubers are NOT meant to be eaten because they are poisonous.
5) Reducing exposure of tubers to pests and diseases such as potato tuber moth that can cause huge losses in field and storage.

Weeding is not a big issue to farmers. Enhance discussions around hilling up which is one of the best agricultural practices for better potato yields. The hilling-up topic requires hands-on demo in the field.
It is important to ensure that the crop will get enough water throughout the crop growth cycle. Potato water needs are critical at tuber initiation. When drought occurs at that stage, the duration of tuber formation increases which results in big yield reductions. Half of expected yield can be lost.

Since it is possible to grow potatoes in Cameroon during the dry season (from October to February), farmers who can access water are encouraged to invest in irrigation systems. It is one of the best adaptation strategies that can reduce the impact of climate change. Irrigation by gravity whenever possible is a reliable and cost-effective method.
Like any other crop, it is important to protect potatoes against pests and diseases because they reduce tuber quality and yield. The loss can be total (100%).

For pests and diseases to occur either in field or storage, three conditions that form a triangle known as THE DISEASE TRIANGLE must simultaneously be met. Those conditions are the following:

a) The potato crop, which is attacked (by pests and diseases);

b) The pathogen or pest (organism causing disease or damage, also known as causal agent);

c) The environment (conditions that favour the pathogen or pest).

This triangle constitutes the base for the control of pests and diseases. Therefore, any initiatives or strategies to control pests and diseases should aim at breaking this harmful interaction.

Please note that the pathogen can stay in the plant or tuber for a long time without symptoms as long as the environmental conditions are not conducive to the disease outbreak. This phenomenon is known as latent infection which is very frequent for a disease called bacterial wilt.

In the following paragraphs, the manual provides insights on some of the most common and harmful pests and diseases found in sub-Saharan Africa in general, and Cameroon in particular.
Late blight causes crop failure by damaging the leaves, stems and tubers. Infected leaves or stems present brown spots as if they were burned. Fortunately, it can be controlled by spraying chemicals. Severe infections occur at times of high relative humidity (over 90%) and cool temperatures (less than 22°C). The disease spreads very quickly in the field and, if it is not controlled, infected plants die within a week.

Late blight can be managed through:

i. Timely sprays to prevent infection and even kill the pathogen after infection to avert spread. Several chemicals are well known to control late blight when used as prescribed. Two major groups of chemicals are normally used to control this disease. The first group contains chemicals that kill by contact at the plant surface (contact fungicides). The most used by potato growers are the following: Mancozeb, Pencozeb, Balear (Tropic), Plantineb, Manesan, Mancobex and Mancozan. The second group comprises chemicals known as systemic fungicides because they enter the plant and move inside the plant and kill the pathogen. The most known potato fungicides in the country are the following: Ridomil (Gold and Plus), Fungi-Pro, Fungicur, Monchamp, Metalm 75 WP, Metrostar and Parastr. Pesticides on the market have varying quality. It is recommended to test different products and alternate the use of the best products.

ii. Planting clean seed of less susceptible varieties;
iii. Collect and burn potato foliage after harvest.

Even though late blight is controlled by spraying, it is important to know what and when to spray because chemicals do have side effects on applicator health and the environment, in addition they are costly. Therefore, use first a contact fungicide just after plant emergence and then spray a systemic fungicide two weeks later, i.e., around 40 - 45 days after planting, using recommended doses. Please note that exceeding the prescribed dose does not provide any additional benefit but rather side effects. For subsequent sprays, use contact fungicides at 2-week intervals until the canopy turns yellow due to maturity, except when disease symptoms are visible in the field. In that case, spray a systemic fungicide. In principle, less susceptible varieties do not require spraying more than twice in a season with systemic chemicals because of their cost and potential to induce pathogen resistance and cause harm to the environment.
Bacterial wilt causes plant to wilt even if there is enough water in the soil. When a tuber is cut in half, black or brown rings can be seen. Sometimes, a milk like fluid may come out of tuber eyes signified by soil sticking to tuber eyes at harvest.

Bacterial wilt can infect the crop at all crop stages and can cause total failure of the crop. It is both a soil and seed borne disease. It also affects plants such as chili, tomato, tobacco, black nightshade and eggplant, as well as several weed species. It can be detected in the plant by immersing a small piece of stem base in a glass of water. Bacterial wilt has the exclusive property of oozing from the stem and moving downward in the water.

The disease can spread from field to field or from plant to plant within a field via infected seed, irrigation water, soil, farming tools, livestock and people.

There is no commercial chemical for controlling bacterial wilt. Therefore, the only way is to manage the disease through cultural practices which include the following:

i. Planting clean seed in fields free from bacterial wilt;
ii. Rotating potato crops with other crops not belonging to the potato family, such as cereals. Maize is the most recommended crop after potato);
iii. Uprooting wilting plants together with soil around roots;
iv. Cleaning tools before and after use.

**Emphasize that bacterial wilt has more impact in seed systems than in ware potato production. It is advised to conduct the glass test in the field. Also, it is worth mentioning that every wilt in the field is not caused by bacterial wilt.**

There are other causes of wilting plants.
Soft rot also known as blackleg is caused by a bacterium which has the exclusive characteristic of altering tuber tissue into liquid or soft rot and black lesions at the base of the stem. Infected tubers rot either in field or in storage and produce a bad smell characteristic of this disease. In line with the disease triangle, high soil moisture favours the pathogen to attack tubers and stems, causing significant crop losses. Manage this disease by applying control measures recommended for bacterial wilt.

*It is important to mention that even though soft rot is a bad disease, it is not widely spread like bacterial wilt. Emphasize the difference between the two diseases.*
Viral diseases are difficult to recognize in the field. In mild infections, the plants can show no signs of disease at all. One of the potato viral diseases that can be easily detected is potato leafroll virus. Plants infected by this virus show leaflets curling upward and turning pale yellow and when pressed they feel brittle and fragile.

There are many types of viruses and in most cases the field or the plant is infected by more than one virus causing compound effects. Since there are no specific control strategies for each virus, do not blame yourself for not knowing the different viruses. What is important is to be able to differentiate a normal plant (healthy looking) from a diseased one.

What these viruses have in common is that they all lead to smaller potato tubers which farmers unknowingly select for seed, leading to further reduced yields during subsequent seasons.

Viruses are controlled by the combination of the following practices:

v. Using clean/certified seed. It is very risky to select seed potatoes based on tuber size alone, as plants infected with viral diseases generally produce smaller tubers.

vi. Controlling insects that can spread viral diseases. Sucking insects such as aphids, thrips, mites, leafminers and whiteflies are carriers of viruses. Therefore, management of these insects by spraying chemicals, and/or trapping them reduces the spread of viral diseases.

vii. Planting potato varieties that are less susceptible to viral diseases.
Potato tuber moths (PTM) also called potato tuberworms infest the crop in the field and move with tubers to the store. They form mines in leaves and stems. They reproduce continuously in stored potatoes causing huge losses.

Potato tuber moth can be controlled by:

viii. Spraying the field with appropriate insecticides at 2 – 3 week interval. The first treatment starts right after plant emergence. Note that it is cost effective to mix fungicides and insecticides when spraying. The following are the most commonly used insecticides on potato in the country: Cypercal, Cygogne, Decis, Kumfu, Timol and Pyrifos.

ix. Avoiding planting in too light and loose soil, as this facilitates exposure of tubers on which the female moths can deposit their eggs.

x. Deep planting or high hilling-up to protect tubers.

xi. Avoid storing tubers showing openings/galleries and/or excreta. Moths in storage can cause huge damage to neighbouring fields.

xii. Using natural repellent plants such as Lantana that cause moths to fly away from storage place.
Figure 14. Control of nematodes

Two types of nematodes are known in potato production: the potato cyst nematodes and the root-knot nematodes. Infested potato plants may show varying degrees of stunting, yellowing of leaves and a tendency to wilt under moisture stress.

Root-knot nematodes are the most widely spread across the globe. They attack tubers and cause blemishes making tubers unmarketable. Infested potatoes can become more susceptible to bacterial wilt.

Damage from cyst nematodes shows expanding patches of poor growth. The plants are stunted, yellow or yellow-white and wilting. Over time, yields are reduced and tubers become small. Twenty years may elapse from the nematode introduction until field symptoms become obvious. Note that it is safe to eat potatoes containing nematodes. Do not keep them for seed but you can eat them.

Management of nematodes should focus on reducing the population to levels below the damaging threshold. Control of nematodes is primarily preventive because they are difficult to eradicate when they are present in the field. Management practices should include:

i. Selecting non-infested fields for production.

ii. Using healthy seed potatoes.

iii. Increasing crop rotation between potato crops to 5 years while avoiding any other crops belonging to the potato family, e.g., tomato, eggplant. Some forage species significantly reduce the quantity of nematodes found in the soil;

iv. Cultivating potato varieties that are less susceptible to nematodes.

The topic of nematodes is not easy to explain unless you have some samples for illustration.
Chemicals should be used carefully to ensure protection of the user, neighbours and the environment. All chemicals are harmful and should be handled with much care. The user should dress in recommended protective gears and follow instructions of safe spraying. Many cases of pesticide poisoning occur in farming communities.

Chemicals should thus be the last resort once the farmer has exhausted other cultural or biological control mechanisms such as varieties with pest/disease resistance, healthy seed potatoes, rotation with other crops, organic pesticides (e.g., Neem) and integrated soil management. When chemicals are mandatory like in case of late blight, the farmer should not spray more than the dose required, nor exceed the treatment frequency recommended by the manufacturer. When spraying, avoid time of strong wind and do not spray against wind direction.

The aim is to maintain pest populations and disease severity at acceptable levels while keeping pesticides and related interventions to levels that are economically justified and safe for human health and the environment.

Some farmers have a bad habit of spraying crops just before harvest. This is strictly forbidden. No fungicides or insecticides should be applied during the last 2-3 weeks of the crop. Disposal of chemical containers is also another societal issue that needs to be addressed at scale.
Module 4  Post-maturity practices

Figure 16. Harvesting

Harvest should be done when the crop is well mature, at complete death of the vegetation. Harvesting should be done in dry weather and not when it is raining. Harvest methods can affect tuber quality. Potatoes can be harvested either manually or using machinery. When harvesting manually, there are also two ways, directly by hand or by using a hoe. Harvesting by hand takes longer and is more labour intensive, but produces good quality and undamaged tubers. Using a hoe is less time-consuming and labour intensive, but some tubers can be damaged in the process. Use of a motocultivator or tractor is by far less labour intensive and faster method than harvesting manually, especially when the field is relatively big (over 1 ha).

Tubers should be left on the ground for a while to allow any soil caked on them to dry out and fall off. After harvest, you should sanitize the field by gathering and destroying harvest remnants such as foliage residues, rotten tubers, etc.

A farmer does not wake up and start harvesting a potato field. There is a whole planning process to make as to get ready for the logistics and the market. Huge losses can occur between harvest and sale.
Figure 17. Sorting and grading tubers for the market

Tubers from diseased plants must be collected last. Healthy looking tubers should then be graded, separating big tubers from small ones (depending on what the market demands). All tubers are not appropriate for processing. Only large tubers (over 60 mm) are normally used for making chips. In principle, the farmer should take into account the different tuber classes when establishing prices. The cheating practice of displaying large tubers at the top of the bags while hiding small ones at bottom and/or stuffing bags should be discouraged. Also, the use of bucket as a metric for transactions hides malpractices. Use of scales is the method that instils trust between seller and buyer.
Oftentimes, farmers do not care much about storing ware potato like they do for seed. Tubers for consumption or the market provide long storability while maintaining good tuber quality when the following three major conditions are met: cool temperatures (below 20°C), darkness and ventilation. Tubers exposed to direct sunlight become green and poisonous. Lack of aeration causes tubers to rot. There is no harm to pour ware potatoes on the floor provided that there is a minimum of hygiene.

Engage participants in the discussion to find out the different modes of conservation of potatoes, for both home consumption and sale.
### APPENDICES

**Appendix 1. Guiding questions and take-home messages per figure**

<table>
<thead>
<tr>
<th>Figure number</th>
<th>Topic</th>
<th>Guiding questions</th>
<th>Take home message</th>
</tr>
</thead>
</table>
| 1             | Importance of the potato crop  | • Where does the potato crop come from?  
• Name the only two crops that are produced more than potato for food production in the world?  
• Why is the potato considered to be an important crop?                                                                                                                                                                           | The income generated by growing potatoes is normally higher compared to the ones obtained from any other food crop.                                                                                                                      |
| 2             | Understanding the potato’s crop cycle | • What are the four stages of the potato crop cycle?  
• Why is it important to have maximum ground coverage by foliage until the end of the season?  
• When is it appropriate to harvest the potato field?                                                                                                                                                                         | The more the ground is covered by potato foliage the more yield can be expected. It is important to preserve foliage throughout the cycle.                                                                                           |
| 3             | Land selection and preparation | What are the suitable climatic conditions for growing potatoes?  
• Is it advisable to plant potatoes where you have harvested potatoes or crops of the same family during the previous season? Why?  
• What are the sister crops grown in your area?                                                                                                                                                                                | It is highly recommended to wait at least 2 to 3 years before you plant again potatoes or alike in the same field.                                                                                                                   |
| 4             | Application of manure and chemical fertilisers | • What is the quantity of organic manure required to fertilise potatoes on an area of 1 ha?  
• What are the chemical fertilisers that are recommended for the potato crop in your area? At which dose?  
• When can you apply organic manure and chemical fertilisers if you wish to get better yields?                                                                                                                          | Unlike other crops, planting potatoes on a poor soil without manure and chemical fertilisers is a waste of time and resources.                                                                                                         |
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| 5            | Planting techniques            | • What are the names of the potato varieties that you grow in your areas? Are they local or improved varieties?  
• How would you arrange plant rows on a sloping terrain?  
• What is the optimal plant spacing density for a maximum yield in ware potatoes? | Potato variety, seed tuber size, seed quality and soil quality are important factors to take into consideration when spacing seed at planting. |
| 6            | Weeding and hilling-up         | • Why must a potato field remain clean, without weeds, until the harvest?  
• Why is it important to hill up potatoes?  
• When should potatoes be hilled up? | Unlike other crops such as cereals, potato yield is underground. If you are unable to hill up, please refrain yourself from planting potatoes. |
| 7            | Irrigation                     | • At what stage of potato plant growth and development are water needs most critical?  
• What can you do if you wish to plant potatoes in a dry season?  
• What would you do if you have to use a pump to irrigate your field in an area where the fuel is not available? | Please ensure that there will be enough rain or irrigation water until the end of the season prior to planting. |
| 8            | The disease triangle           | • Why is it important to control pests and diseases?  
• What are the three components of a disease triangle?  
• How do you call an infection of the potato plant or tubers that does not show symptoms? | Being able to differentiate diseased plants and tubers from healthy-looking ones (in field and storage) is an important step towards controlling pests and diseases. |
| 9            | Control of late blight         | • What are the key symptoms of late blight in the field? And what are the key factors for its outbreak?  
• What are the most effective measures to control late blight in the field?  
• What is the difference between a contact and a systemic fungicide? | Late blight is the most damaging foliage disease. Ensure that you have access to appropriate fungicides prior to planting. |
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<tr>
<td>10</td>
<td>Control of bacterial wilt</td>
<td>• What are the symptoms of bacterial wilt on the plant and the tubers? • How can you detect bacterial wilt in the field? • What are the most effective measures to control bacterial wilt?</td>
<td>There is no commercial chemical to control bacterial wilt. It is difficult to eradicate the disease once present in the soil.</td>
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<td>11</td>
<td>Control of soft rot (blackleg)</td>
<td>• What is potato soft rot (blackleg) and what are the symptoms? • How would you differentiate soft rot (blackleg) from bacterial wilt on tubers and plants? • What are the most effective measures to control soft rot (Blackleg)?</td>
<td>There is no commercial chemical to control soft rot (blackleg). It is difficult to eradicate the disease once present in the soil.</td>
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<tr>
<td>12</td>
<td>Control of viral diseases</td>
<td>• Why does the negative impact of viral diseases go beyond the first season symptoms are observed in the field? • What are the most effective measures to control viral diseases? • Why is it important to use clean/certified seed?</td>
<td>No need to know the names of viruses. What is important is to be able to differentiate a normal plant (healthy looking) from a diseased one.</td>
</tr>
<tr>
<td>13</td>
<td>Control of potato tuber moth</td>
<td>• What is potato tuber moth (PTM)? • What are the symptoms of PTM on tubers in storage? • What are the most effective measures to control PTM in storage?</td>
<td>Planting a repellent plant around the diffused light store (DLS) such as Lantana can help to reduce the impact of potato tuber moth.</td>
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<tr>
<td>14</td>
<td>Control of nematodes</td>
<td>• What is potato nematode? • What are the symptoms of nematodes on tubers? • What are the most effective measures to control nematodes?</td>
<td>Nematodes are hard to eradicate once introduced in the soil. Preventive measures are always the most effective approach.</td>
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| 15            | Safe use of chemicals             | • Why is it so important to be careful when using chemicals in general, and pesticides in particular?  
• Where can you get specific indications on how to use a pesticide?  
• When is the use of pesticides strictly forbidden in a potato field, and why? | Please ONLY spray when necessary without exceeding the recommended dose and frequency. |
| 16            | Harvesting                        | • When is it appropriate to harvest a potato field for maximum tuber yield?  
• What are the different techniques used to harvest potatoes in the field?  
• Does the potato field require any care after harvest? Why? | Never harvest before complete death of shoots if you wish to have a maximum yield. |
| 17            | Sorting tubers for the market     | • Why is it important to sort potatoes after harvest?  
• Why is it important to grade tubers after harvest?  
• What are the possible consequences of using buckets instead of a scale while selling potatoes? | All potato tubers harvested in the field do not have the same uses, and thus the same value. Please grade your tubers and price them differently, whenever possible. |
| 18            | Storage of ware potatoes          | • Does it make any sense to care about storage of ware potatoes? Why?  
• What are the best conditions for a longer shelf-life of ware potatoes?  
• Why is it recommended not to expose ware potatoes to sunlight for too long? | Never eat or sell for consumption green tubers or tubers presenting green spots. They are poisonous. |
Appendix 2. Test sample for pre and post training knowledge assessment

Assessment on ware potato production

Name: .................................................................................. Date: .... /.... /....

Note: Each good response equals 1 point out of 20.

Module 1: Introduction to the potato crop
1. Why is the potato considered to be an important crop?

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2. What are the four stages of the potato’s crop cycle?

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Module 2: Soil, crop and water management
3. What are the suitable climatic conditions for growing potatoes?

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4. What is one of the best adaptation strategies that can reduce the impact of climate change?

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5. What are the mineral fertilisers that are recommended for potato crop in your area? At which dose?

6. What is the optimal plant spacing for a maximum yield in ware potatoes?

7. Why is it important to hill up potatoes?

8. At what stage of plant growth and development are water needs most critical?

Module 3: Pest and disease management

9. What are the three components of a disease triangle?

10. What is the difference between a contact and a systemic fungicide?
11. What are the most effective measures to control bacterial wilt?

12. How would you differentiate soft rot (blackleg) from bacterial wilt on tubers and plants?

13. What are the most effective measures to control viral diseases?

14. What are the symptoms of potato tuber moth on tubers in storage?

15. What are the symptoms of nematodes on tubers?

16. When is the use of pesticides strictly forbidden in a potato field, and why?
Module 4: Post-maturity practices

17. When is it appropriate to harvest a potato field for maximum tuber yield?

18. Why is it important to grade tubers after harvest?

19. What are the best conditions for a longer shelf life of ware potatoes?

20. Why is it recommended not to expose ware potatoes to the sunlight for a long time?