

Training Manual for Potato Production in Nigeria



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HOW TO USE THIS MANUAL

This training guide is written for extension workers at different levels of experience. They can use it to train the community knowledge workers/ community-based facilitators, lead farmers, and farmers.

Before the session

Be well organised and read through the training guide before starting a session. It will help you to feel confident. Check that you understand what to do. Organise all the necessary materials for the session like the hand-outs, flipcharts, charts, chairs, and training venue.

Beginning the Session

Greet and welcome the participants. Ask questions about the last session. For example, you can ask:

- What did we learn in the last session?
- What did you apply in your farm that you learned from previous sessions?
- What did you tell your family or community members about the session?

During the Session

Remember to speak audibly and be clear. Pause to allow time for the group to ask you questions. If farmers cannot see the board or picture during an activity, explain what is shown.

During group work, provide the farmers with flipcharts and markers. Write the participants' suggestions, answers and ideas on a flipchart and supplement with the content provided in the guide. Remind your audience that they can ask you questions if they do not understand something.

Ending the Session

1. Check what your audience learned using the questions in the question and answer activity.
2. Thank your audience for participating.
3. After each module, ask yourself the following questions and write down your answers:
 - What went well in the session and why?
 - What would I do differently next time?
 - Which part of the session did the learners seem most interested in and why?
 - Which part of the session did the learners seem least interested in and why?
 - Did you manage time well? If not, why?

Reflect on each session in order to find out where you can make changes to improve later sessions.

This manual has been designed to allow readers to select and review specific sections that are relevant to their interests. Therefore, each module and sub-module are self-contained and can be read on its own. Because the focus of the guide is on how to successfully cultivate rice in the field. The manual is divided into the following modules:

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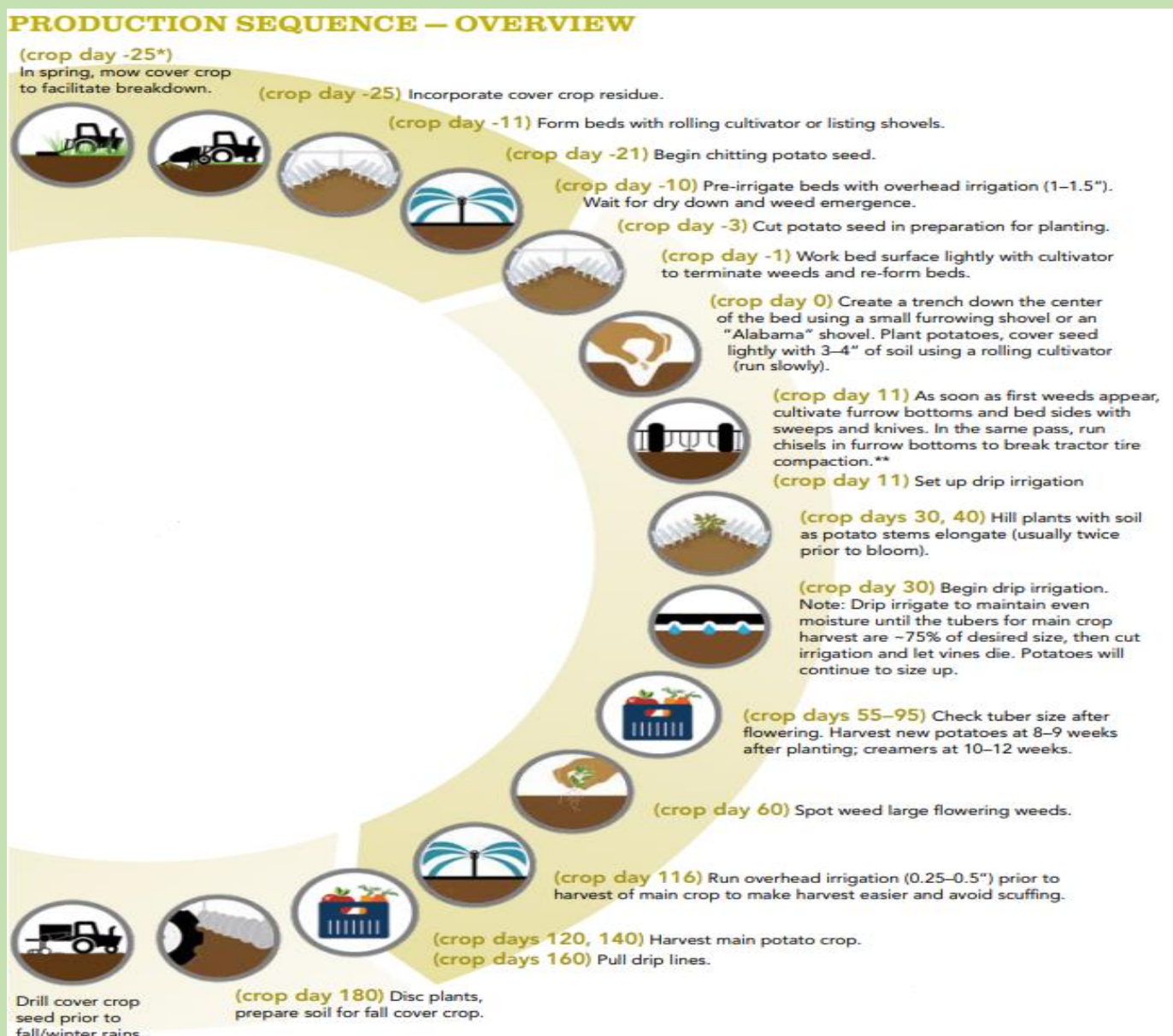
Module 1

Overview

Potato (*Solanum tuberosum* L) originated in the area of present-day southern Peru and extreme north-western Bolivia; it was believed to have been domesticated 7,000 – 10,000 years ago. They were introduced into Nigeria by the European Tin Miners on the Jos Plateau and the Germans living in Southern Cameroons in the First half of the 20th Century. It is the most widely cultivated root and tuber crop in the world and the fourth most cultivated crop after Maize, rice, and wheat.

The nutritional value of Potato is more than those of other root and tuber crops grown in Nigeria. It contains thiamin, riboflavin, vitamin C., protein, fat, fiber, carbohydrate, potassium, phosphorus, iron, and niacin.

About 95% of potatoes in Nigeria are cultivated on the Jos Plateau on both irrigated and rain-fed agriculture. Some minor production is recorded at Obudu highlands in Cross river state, Mambila Plateau in Taraba State, and in Kano, Kaduna, Yobe and Sokoto States.



Module 2

Site Selection and Land Preparation

Key points in this module:

1. site selection
2. Land preparation

Site selection

Potato requires a fertile, well-drained sandy loam soil for optimal growth. The site selection should not have been cropped during the three preceding years with solanaceous crops such as Potato, Pepper, Garden egg, and Tomato prior to the potato production because these crops can harbour pests and diseases that may affect potato. Climate conditions with annual rainfall between 900-1200mm with an attitude between 100m -1760m above sea level. These areas can be found in the Jos Plateau, the Obudu highlands in Cross River State and the Mambila Mountain range traversing Adamawa and Taraba States.

- Potatoes can be grown in well-drained, loose soil with plenty of organic matters of all kinds of soil.
- Light to medium soils that warm up easily, are not too stony, and are deep with even water supply
- It has been recommended to grow potatoes in slightly acidic soils with pH between 4.8-5.5 (for scab control), however, given the newer cultivars, it is better to keep soil pH between 5.5-6.0 and use scab resistant cultivars which allows better potato yields during that growing season.
- When grown in soils with higher pH, tuber yield and quality could be compromised due to potato scab, a disease caused by bacterium *Streptomyces scabies*.
- Avoid compaction and poorly drained soils.
- During flowering and formation of tubers, potatoes are sensitive to long wet or dry periods.
- Irrigation systems is beneficial in dry season.

Field and laboratory soil testing are also essential to determine fertilizer requirements.

Important Things to Note

- Select an area that receives full sunlight
- Sandy, quick-drying soils lead to rougher skins and russeting as well as raised scab infection.
- Avoid clayed soils and waterlogged areas
- Moist soil conditions during formation of tubers lead to netted scab.
- Acidic soils, soils heavy in clay or contaminated with spores can lead to powdery scab.
- Avoid land with very deep ditches.
- Select soils rich in organic matter

Land Preparation

It is important work to select appropriate plot in the potato tuber production method. The following things need to be considered while selecting plot for production:

- Prepare land one month before planting during the dry season period so that weed can dry.
- Loosen the soil down to 8 to 12 inches deep by digging and turning the soil several times.

- The site for producing potato should be in sunny area with fertile soil,
- select the plot where the aphid and other insect cannot easily come out from other solanum field for controlling disease.
- Take time when preparing the land to get healthy plants without disease or insects damage.
- Make furrows in your properly prepared land two feet apart,
- mix organic fertilizers (compost manure, etc.) properly with soil during the Ploughing or harrowing operations.



*Well prepared field for potato production.
Photo Credit: Suleiman*

Land preparation method

- Clear debris, then make ridges using traditional hoes.
- Ensure that big lumps/clods of soil are broken into fine pieces to ease root and tuber penetration.
- Ridges are raised 40 – 45cm high
- Raised beds can be used during the dry season to improve the retention of irrigated water.
- The method of land preparation for dry season cropping depends on the type of irrigation. Ridges 75cm apart are prepared if sprinkler or furrow irrigation is being used.
- If flood irrigation is to be used; seed beds are made with bond round the edges of the bed to hold water.

Mechanized:

- Plough, harrow and ridge.
- The ridges should be 1 meter apart for rainy season production. 75cm apart for dry season production planting.

Things to note

- The height of the ridges should be 25cm to allow for tuber expansion and easy harvesting.

Summary

A fertile soil is good for potato cultivation.

Field can be prepared with hoes or by machines.

Question and Answer Session

1. What are the important things to take into consideration in siting a potato farm?
2. How do you prepare the field?

Module 3

Selection of variety

Key points in this module

1. Choice of variety
2. Seed selection and preparation
3. Seed treatment

Choice of variety

The choice of variety to be planted depends on end-use.

1. High yield and large tubers: Connect, Marabel, Nicola and Kondor
2. Processing/High dry matter: Diamant.
3. Dry season Production: Bertita, Nicola.
4. All Season Production: Nicola, Marabel, Diamant, Caruso, Connect and Lady christyl.
5. Early maturing varieties: Marabel, Caruso and Lady christyl

Seed selection and preparation

- Potato Crop is Ecology Specific
- Select Potato varieties that have high market value.
- Select improved Potato varieties that have disease resistance.
- Soak the Potato seed from 1½ or 2 hours in either formaldehyde solution, and then allowed it to dry.
- Treat seed with fungicide, and or insecticides (e.g. Pestox) and rodenticide if rodents' damage of sown seed is envisaged.
- Use potato seed that has broken dormancy (good sprouting)
- Use disease-free seeds only for planting.



Pre-sprouted seed Ideal for planting



Poor quality potato seed tuber with weak and long sprouts.

Photo credits: Pixabay.com

The variety of potato should be selected according to the climate, resistance to diseases and the market demand

Dormancy period

- The newly harvested seed tuber will not sprout up to certain period, which is known as dormancy period.
- The dormancy period may be range about 30 to 60 days.

Seed tuber size selection

Tuber size (weight)

- It is better to select medium sized single potatoes for seeds than the chopped ones.
- Single potato tuber should be used as seed, which can avoid spread of diseases from the tools used for cutting the seed tubers.

Number of sprouts

- Each selected seed tuber should have about 4-8 sprouts so that, we can harvest more tubers as well as more medium sized tubers.

Treatment of seed tuber before planting

- To control the fungal diseases on seed tuber, the tuber should be treated in the following ways:
- Seed tuber should be dipped in the solution of 2 -3-gram fungicides in one litre of water before sun-light treatment.
 - Sun-light treatment is the process of exposing the seed tubers on the sunlight for 20-30 days under the condition of 10- 20 degree Celsius before the plantation for getting the healthy, strong and uniform 4-8 sprouts from each of all potato.

Summary

Potato varieties are adapted to season
It is ecology specific
Break dormancy of the seed
Avoid spread of disease during seed preparation
Treat seeds before planting



Potato seed piece sizes

Question and Answer Session

1. What are the available potato choices for your region?
2. What are the good ways to prepare the planting seeds?
3. What is the better type of seed for planting?
4. How do you treat seeds?

Module 4

Planting of Potato

Key points in this module:

1. Planting
2. Hilling
3. Irrigation

Planting

- Planting materials is usually seed tubers 40-50mm in size.
- Early planting makes the plants escape the vagaries of Potato blight which reach epidemic levels in the middle of the rainy seasons.
- The seed is placed on ridges at a depth of 3 to 4 inches, at a spacing of 30cm within rows and 100cm between rows (This gives the recommended population density of 33,333 plants/hectare).
- Pre-sprouted seeds are recommended
- Tiny and old seed tubers should not be used for Planting
- Time of Planting: Last week of October to early November for dry season production and the onset of rains for rainy season production.

Things to Note

- The best emergence and early vigour are from well-sprouted seeds
- Use a clean, sharp paring knife to cut large Potatoes into medium-sized pieces, making sure that there are at least 2 eyes on each piece.
- Potatoes that are smaller than a hen's egg should be planted whole.
- If cutting up Potato pieces for planting, do so 1 to 2 days ahead of planting, this will give them the chance to "heal" and form a protective layer over the cut surface, improving both moisture retention and rot resistance.



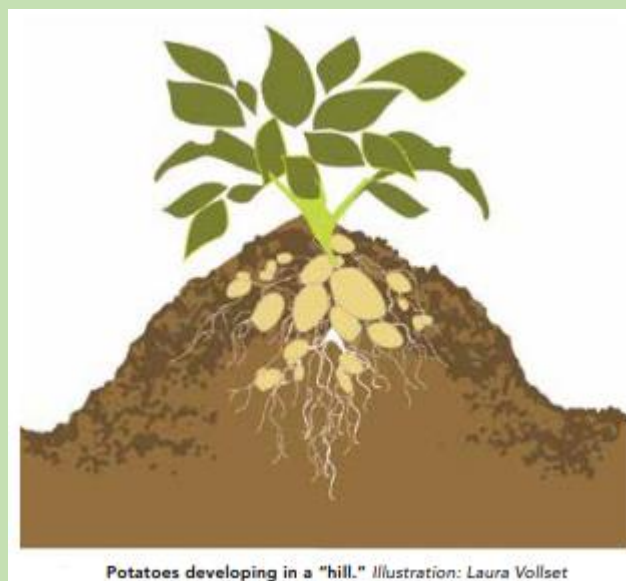
Potato planted at 20cm in-row and 120 cm between-row

Hilling Potatoes

Re-form the beds after planting deep, then again after the plants emerge, building the beds higher to keep potatoes covered with soil as the stems elongate. This re-forming of the bed, or "hilling," is essential for potato

production because it blocks sunlight from the tubers as they form. Any light contact causes “greening”; the presence of chlorophyll and potential for accumulation of toxins, render any green tuber unmarketable.

Hilling also facilitates weed management and boosts yields. Potatoes grow remarkably fast once they emerge (usually about 14 days after planting). Do the first mechanical hilling once plants reach a height of 20 cm –25 cm (within 30–33 days after planting). Use a rolling cultivator during this time of initial growth to smother any weeds germinating in the bed, and to keep furrows clean of annual weeds. Do the second hilling 5–7 days after the first. On small plots, hilling can be done by hand with a shovel.



Ridging a potato field. Credits: CU_CASCADE

Irrigation

Potato can grow under rainfed condition, under rainfed supplemented with irrigation or under full irrigation. When growing under full irrigation, drip irrigation is the best option for potatoes, allowing you to control irrigation rate and timing, and apply water directly to the growing plants. At planting, set the drip lines in the center of the bed on top of the seed pieces; cover it as you close the furrow and bury it further as you hill the potatoes (note that you can also lay drip tape after the plants have emerged). Potatoes can be irrigated overhead, but this method favours development of late blight due to prolonged periods of leaf wetting. If overhead sprinklers are used, irrigate mid-day following dry-down of foliage from morning dew, and shut down the sprinklers early enough for leaves to dry prior to sunset.

The irrigation water requirement can be distributed:

- 20 % during the development of the plants (first month)
- 70 % during tuber development, and
- 10 % during crop senescence

Summary

Early planting helps to control spread of diseases

Tiny seeds should not be used for planting

Hilling helps to protect the potato tubers from sunlight and helps in weed control

Potato performs well under irrigation

Question and Answer Session

1. What is the recommended spacing for potatoes?
2. When is the best time to plant?
3. What are the advantages of hilling in potato field?
4. How should you distribute water for irrigation?

Module 5

Fertilizer application and weeding

Key points in this module:

1. Fertilizer management
2. Weeding
3. Growth phases

Fertilizer management

- Fertilizer rate (compound) N. P. K. (15:15:15) 400kg or 8 bags/ha.
- Fertilizer rate (single fertilizer): 109kg N, 132kg P and 263kg of K (recommended for Jos –Plateau).
- Recent findings revealed that 180kg/ha of OCP N.P.K 15:15:15 fertilizer should be recommended.
- 7 bags of NPK 15:15:15, 2.5 bags of MOP and half bag of TSP (At 50kg per bag).
- 4 bags of NPK and all TSP and MOP should be bulked and applied at 10.5g per stand (2 coca cola caps). fertilizers should be applied within first 4 weeks after planting. 3 bags of NPK which should be applied 15-20 days after 1st application at 4.5g per stand or 1 cap of coca cola.
- Spot, band or ring application is recommended.
- The blanket application rate is not recommended because of the following reasons: potato is a heavy feeder of K which DAP does not have because it contains only nitrogen and phosphorus; DAP has too much P which could cause long term acidity if used for a long time; and lastly it is advisable to split N applications during the lifetime of a crop because loses of N occur much faster and cannot survive until crop maturity.
- Where Organic manures are used, apply 5-10 tonnes per hectare.



Sprouting potato seed with applied fertilizer

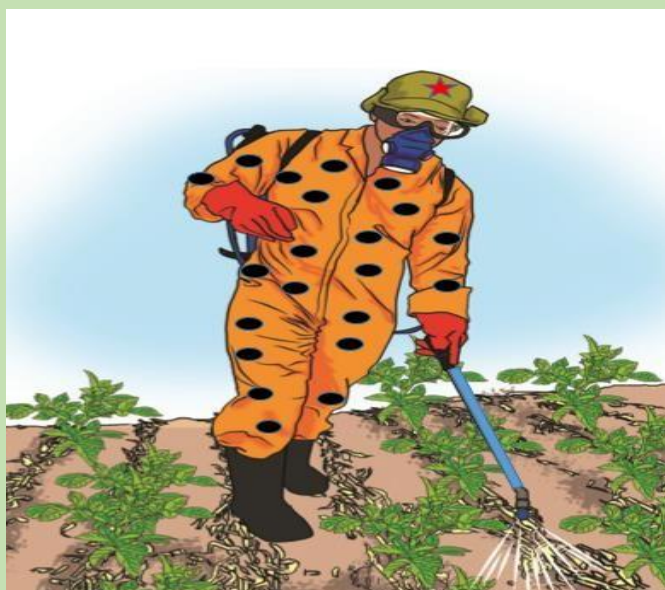
Things to note

- A soil tests should be carried out to determine the right amount of fertilizer needed for any particular farm.
- Do not let the applied fertilizer to touch the plants directly as this may lead to dehydration of the plants which may kill them
- Properly decomposed manure is preferable to a fresh one
- Cover the fertilizer or manure with soil after application to reduce the evaporation of their active ingredients and washing away by rain.

Weed management and growth phases

The weed situation in the field is an important determinant of when weeding should be done. Weeds are removed to prevent them from competing with the potato for moisture, light, nutrient, and space thereby reducing yield. Manual Weeding should be carried out at about 4 weeks and 8 weeks after planting. Chemical weeding with herbicides can also be used for weed control.

- Pre-emergence: Use of **Alachlor** @ 1.0 kg ha⁻¹ or **Pendimethalin** @ 1.8 kg ha⁻¹ or **Metribuzin** @ 1.0 kg ha⁻¹ or **Methabenzthiazuron** 1.0-1.5 kg ha⁻¹ or **Oxifluorfen** @ 0.1-0.2 kg ha⁻¹ or **Oxidiazon** @ 0.75 kg ha⁻¹.
- Early postemergence: Use of **Paraquat and Diquat** @ 0.36-1.0 kg ha⁻¹ or **Metribuzin** @ 0.35-1.0 kg ha⁻¹. Apply when no more than 5-10% potato plants have just emerged from the soil. It is the most commonly in use for the treatment of potato weeds.



Herbicides application

Precautions while spraying in the field

- Read the label on the package before using.
- Only apply chemicals obtained from recognized sources.
- Adhere to manufacturer's instructions and recommendations on the label.
- Use correct kind, dosage and application technique and appropriate safety precautions.
- Determine calibration rate and go by it.
- Seek technical advice when in doubt.
- Do not use expired agrochemicals.
- Wash your hands thoroughly with soap and water after using agro-chemicals.
- Do not eat while applying agro-chemicals.
- Dispose agrochemicals containers in a secure place.
- Wear protective equipment while you apply to ensure safety. You must wear goggles, nose mask, overalls, gloves and closed gumboots.
- If the herbicide accidentally touches the skin and sensitive organs such as the eyes, wash the affected part with soap and clean water. If you feel some pain seek medical attention.

Growth Phases

Phase 1: Vegetative establishment, 0–30 days

Most vegetative growth occurs during this phase.

Adequate pre-plant nitrogen (in the nitrite form) ensures a large, effective plant that can support tuber development through sugar and starch translocation.

Phase 2: Stolon and tuber initiation, 30–60 days

Flowering begins at approximately 40–50 days.

Phase 3: Tuber enlargement, 60–90 days

It is critical to provide adequate irrigation during this phase. Dry down should be less pronounced than in phases 1 and 2; never let the plants get to less than 60–65% field capacity.

Phase 4: Tuber enlargement, skin set and curing, 90–120 days

Tubers enlarge, increase in starch content and individual varietal characteristics. Skins set and thicken, allowing for long-term storage.



Potatoes begin to flower at approximately 40–50 days post planting. Photo: Elizabeth Birnbaum

Summary

Fertilizer should be applied in two doses, before 4 weeks after planting and 15–20 days after the first application.

Conduct a soil test before fertiliser application

Weeds will reduce yield in the farm

Ensure adequate attention to precautions when spraying the field.

Potato has four growth stages.

Question and Answer Session

1. How do you fertilize your potato farm?
2. Why is a soil test important?
3. What are the recommended herbicides?
4. What are the precautions while spraying the field?
5. At what growth stage does the tuber start enlarging?

Module 6

Diseases and pests of potato

Late Blight (*Phytophthora infestans*)

- Water-soaked lesions on the leaves.
- These lesions turn brown or black after a few days.
- White sporulation is visible at the margin of the Lesions on the lower leaf surface.

Control:

- By spraying with fungicides (Dithane, Ridomil)
- Use resistant varieties,
- Early planting enables plants to escape the peak time of blight
- Earthing-up reduces exposure of tubers to blight

Things to Note

Fungicides must be applied at the recommended rate and preferably just before the onset of blight for effectiveness. Bi-weekly applications are normal. However, the frequency of application depends on the severity of infestation and weather.

Early blight (*Alternaria solani*)

- Brown, angular, necrotic spots marked internally by a series of concentric rings form on leaves.
- Symptoms often appear on the oldest tissue

Control

- Crop rotation and destruction of plant debris and weed hosts.
- Avoid over-irrigation.
- Use of fungicides, spray as soon as symptoms appear and should be applied approximately every 10days.
- Use of resistance varieties
 - Use

Bacterial wilt. (*Rhizoctonia solanacearum*)

- Wilting of the infected plants.
- When cut stems of an infected plant are placed in clean water, milky white strands of the bacterium ooze out from the cut surfaced.
- Infected tubers may ooze out a grayish slime through the eyes.

Control:

- Rouging and destruction of infected plants and tubers.
- Crop rotation
- Ploughing at the beginning of a dry season to expose pathogen to sun heat and dehydration.



onset of late blight of potato



Early blight on the leaf of a potato plant
Photocredit: seedquest.net



Potato plant wilting caused by *Rhizoctonia solanacearum*.
Photo credit: PlantDiseases.org

Things to Note

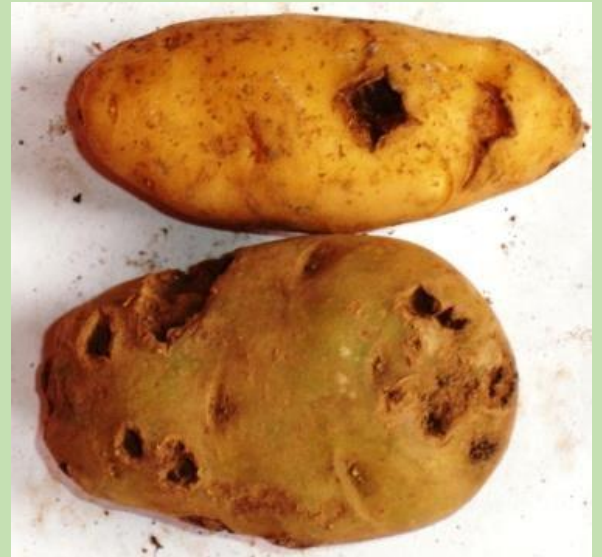
As seed tubers may carry latent infection, it is advisable to use only clean seeds from approved sources

Common Scab (*Streptomyces scabies*)

- Lesions with rough edges on tuber skin.
- Lesions are usually superficial

Control:

- Use of resistant varieties,
- crop-rotation
- Farm sanitation.



Potato tuber showing symptoms of scab
Photo credit: ars.usda.gov

Viral Diseases:

Leaf roll,
Tiny leaves,
Yellowing of leaves

Stunted growth,
Chlorosis,
Rugosity

Bunchy top,
Necrosis
Spindly sprout



Rugosity and stunted growth. Credits: Cornell University



Chlorosis (alamy.com)



(c) Thread-like sprout Figs 10a, b, and c Viral symptoms (credits: Suleiman Olarewaju)

PESTS

Potato Tuber Moth (*Plutella xylostella* L)

- This is a butterfly-like insect that is active mostly in the evening tonight period and can be seen flying around in the potato store or field.
- The female lays a whitish mass of eggs in a furrow made on exposed tuber surfaces in the field or in the store.
- The eggs hatch into worm-like larvae which bore tunnels into the tuber as it feeds.
- The larvae cause most of the damage through their feeding activities.
- The larvae change into brownish, immobile, cocoon-like pupae from which the young adult moth emerges.

Symptoms

- These include black spots on the tuber surface.
- Tunnels on the tuber surface.
- Tunnels in the tuber flesh, at advanced stages.
- The tuber rots at advanced stages.

Control

- Exposed tubers must be covered to prevent the adult female moths from coming in contact with them to lay eggs.
- In the store, there must be good sanitation. All leftover debris must be removed from the store before bringing in tubers from a fresh harvest.
- Many of the available pesticides used in controlling insects such as Cypermetrin, Actellic, can kill the adult moth and the larvae.

Aphids (*Mysus persicae*):

- These are soft-bodied insects, 1 – 2cm long, green or flesh-colored with or without wings
- They suck sap from the cells of the leaves and in the process transmit the virus.

Symptom: -

- Wrinkling of young leaves.
- Old leaves may wilt, turn yellow and die prematurely.

Control

- Many insecticides such as Nuvacron and Perfekthion can control aphids.
- Use of resistant varieties.

Mealybugs (*Pseudococcus* spp)

These are scale insects.

Symptoms:

They suck sap and leave whitish waxy secretions where they attack the plant.

Control:

- Spray insecticides,
- Use resistant varieties.



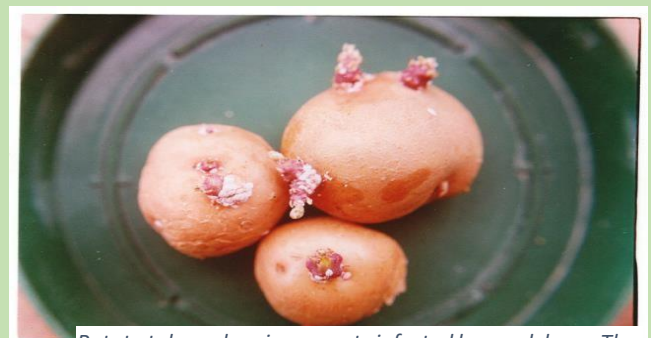
Fig 11: Adult tuber moth
agric.wa.gov.au



Tunnels by tuber moth inside a tuber (agric.wa.gov.au)



Potato aphids. Credits: agricolgy.co.uk



Potato tubers showing sprouts infected by mealybugs. The whitish patches on the sprouts are aggregates of mealybugs feeding on the tubers (Photo credits: Suleiman Olarewaju)

Rodents

- These are small mammals (Rats, Mice, squirrels, and their relatives)

Symptoms:

- They eat tubers and leaves feeding marks on the tubers.

Control:

- Trapping.
- Using a mixture of cow dung and pepper placed in the burrows and burnt to smoke out the rodents.
- Pouring one-week-old fermented cattle urine into the burrows to chase away mole rats.



Tubers attacked by rats. (Credits: Suleiman Olarewaju)

Question and Answer Session

1. What potato diseases do you know of?
2. How can you control early blight in potato?
3. How does bacterial blight affect the plant?
4. Can seed tubers carry infections?
5. How can you control potato tuber moth?
6. What are aphids?
7. How do you control rodents?

Module 8

Harvesting and storage

Key points in this module:

1. Harvesting
2. Curing
3. Storage



Harvest new potatoes using a garden fork. Photo: Elizabeth Birnbaum

Harvesting

- This should be done when the leaves begin to turn yellow.
- This ranges from 80-100 days depending on the variety under Nigeria's condition.
- Usually, the haulms are cut, and the tubers left to stay in the ground for 1-2 weeks before they are lifted with a garden fork or small hoes.

Things to Note

- Leaving tubers in the ground for 1-2 weeks after haulms cutting allows the skin to set to reduce peeling and bruising of the tubers during harvesting and postharvest handling.
- Do not harvest immediately after heavy rainfall to minimize collecting tubers with mud.
- As much as possible avoid bruising or wounding the tubers during harvest as it affects their storability.
- Uproot/ lift the tubers by using handheld hoes or 2-pronged sticks after the haulms are completely dry.
- Using sticks or fork dig out any tubers that could be stuck in the ground along the ridges or furrows.
- After harvest ensure the soil on the tuber is dry before transporting the tubers to the store because soil could spread diseases or pests in the store later.
- Avoid sun heat which could damage the tubers.
- Proper husbandry and use of clean planting material can increase yields to 12 – 20 tons/ha.

Mechanized harvesting

A mechanized harvester can also be used to harvest the tubers, and this saves on time and labour costs. Adequate skin set is crucial to prevent mechanical damage to the tubers. The machine should be used with care to avoid severe tuber bruising, which results in blackening of the flesh underneath the bruise area.

Curing

Up to 80 % of potato tuber content is water and this needs to be maintained to avoid loss of weight and quality. A warm temperature in the shed or holding area before storage is desirable as it promotes wound healing and further skin set. The shed area should be well ventilated to allow good exchange of air and to achieve good temperature control. High humidity of 85 to 90% is essential for optimum wound healing and curing of the tubers.

Seed potato storage (Diffused Light Store)

- Diffused light stores (DLS) is ideal for seed potato storage.
- The method uses natural indirect light and good ventilation or airflow to control excessive sprout growth and associated storage loss.
- Suitable generally for small seed units and not for large scale seed production schemes.
- Seed potatoes stored in diffused light give short and strong sprouts than seed that has been stored for relatively long periods in the dark at higher temperatures.

Point to Note

- DLS is most suitable where temperatures are moderate, and the seed has to be stored for more than four months.
- Integrated DLS with insect management especially potato tuber moth through the use of the pure seed, cleaning the DLS before storage and after storage, use of chemicals (Diazinon).

Ware Potato Storage

- Ware potato is best stored in the dark
- There should be adequate ventilation
- Care must be taken to keep off tuber moths which thrive in the dark
- It can only store for short periods (usually not more than 3 months) under ambient conditions. Cold storage in refrigerated stores are required for longer storage

Summary

Harvesting should be done when the leaves turn yellow, after 80 to 100 days of sowing.

Handle the tubers carefully to prevent bruising

Curing promotes wound healing.

Diffused light helps to control excessive sprout growth

Question and Answer Session

1. How should you harvest your potatoes?
2. Why should you immediately transport your potatoes out of the farm after harvesting?
3. How do you cure potatoes?
4. What is ware potatoes?

Module 9

Processing, marketing, and utilization Processing and Utilization

Packaging and Transporting

If the potato farm is far from the store or homestead, there will be need for packaging and transporting from the field using carts, wheelbarrows, pickups etc. Package the potatoes in bags weighing not more than 50 kilograms for ease of handling and to avoid damaging the tubers.

Sorting and Grading

Select and remove the damaged/bruised, diseased, deformed tubers and any other foreign material such as soil clods. All damaged and cut tubers should be removed after harvesting to discourage infestation and rotting in the case of cut tubers. Grading should be carried out to separate the ware, seed and chatts. It is advisable that each bag is well labeled according to variety description and weight for ease of identification.

Potato can be baked, boiled, roasted, mashed and fried. It can be made into crisp, chips, porridge Potato can be consumed alone or as a side dish with other foods.

General directions for home level potato processing

- Choose potato variety with high dry matter content like Caruso and Diamant.
- Select healthy and firm potato tubers.
- Do not store in the refrigerator rather store in a well-ventilated, dark and cool area until the tubers are needed for cooking. To avoid discoloration, put the peeled potato in water.

Potato chips preparation procedure

- Select potato tubers having oval shaped.
- Wash and peel and then slice the tuber along the length in uniform size of 1cm by 1cm.
- Rinse with clean water and dry.
- Finally, fry with oil until it develops a golden yellowish color.

Potato crisp preparation procedure

- Select potato tubers having round shaped.
- Wash and peel and then slice in round shape with a uniform size of 1.2 to 1.5 mm thickness sizes.
- Rinse with clean water and dry.
- Finally, fry with oil until it develops a golden yellowish color

The mashed potato preparation procedure

- Select healthy potato, wash and peel it
- Mash the potato with a potato masher or hand-held mixer
- Gradually beat in the warm liquid until the potato is smooth, moist and light.
- Season with salt and pepper.

Potato porridge preparation procedure

- Select healthy potato tuber and wash and boil it
- Cool after boiling and then peel and mash it
- Boil the water and after adding table salt and mashed potato and then steer it
- Add three cups of mashed potato
- Add one and a half cup of water and 0.5 teaspoons salt for taste

Marketing

The market is very crucial for the produced product since potato is among those crops that are easily perishable and difficult to transport for long-distance compared to cereal crops. Therefore, the availability of local markets nearby farmers' village minimizes the postharvest loss. However, with good roads and good means of transportation potato tubers can be transported and sold at distant markets for more profits.

Summary

Potatoes can be transported from the farm using carts, wheelbarrows and trucks.

Sorting and grading ensures removal of infected tubers.

Potato can be prepared in a variety of ways.

Potato marketing is an important aspect of the chain and efforts should be made to get a ready market before harvesting.

Question and Answer Session

1. Why should you package and sort potatoes?
2. How do you market your potatoes?

Module 10

Record Keeping, Budget Planning and Decision making

Record keeping

Record keeping is the art of collecting useful pieces of data or information on the happenings of a particular undertaking, with the view of processing it in the future (for example, analysing sales and costs and calculating profits). Although record keeping is an important aspect of the family farm business, many farmers do not keep records. This makes it difficult for them to know how much they spent and how much income was earned from their farm business enterprises. Without good farm records, it becomes difficult for farmers to identify problem areas and know whether their businesses are generating profit or not. Therefore, record keeping is an important activity that is necessary for operating farm businesses

successfully. Family farm businesses should keep records, and this responsibility should be shared by all family members. Responsibility for any type of record should be allocated to the family member who is most capable, regardless of their sex.

Why should records be kept in a farm business?

- To track individual enterprise performance.
- To evaluate farm/enterprise profitability.
- To establish a basis for pricing.
- To facilitate access to loans.
- Records are helpful when farmers seek advice from extension agents.
- Records are a good management tool because they provide figures for planning and budgeting.

What is farm budgeting?

A budget is a formal plan for carrying out business activities in the future. It shows the process of carrying out an activity and the end result. Budgeting is the planning process or the development of a plan of action (budget). Families involved with farm businesses should budget together and share responsibilities in the budgeting process.

Uses of farm budgets

Budgets are normally used to:

- Decide what to produce, how much to produce, and the resources needed.
- Itemise the financial aspects of the farming business.
- List the inputs and production practices required by an enterprise.
- Evaluate the performance of different farm enterprises.
- Estimate benefits and costs of changes in production practices.
- Provide the basis for a total farm plan.
- Show the capacity of the farming business to carry risk.
- Support applications for credit (show the ability of the business to pay debt).
- Inform all interested parties of the costs incurred in producing an agricultural product\

Decision making

Decision-making is central to farm management. Each decision has an impact on the farm and on the farm household. Even deciding to do nothing is a decision and has an impact. The more a farmer is aware of the decision-making processes that affect farm and household, the more sustainable the enterprise will be and the more likely it will be profitable and sustainable.

Two of the main features for understanding economic decision-making are:

- The way farm boundaries (decision-making boundaries) are determined.
- The ultimate social objectives for which farm goods are produced.

Production decisions depend on a number of factors that fall outside the physical/ production area of the farm. One of these factors is the farm family/household. In many parts of Nigeria, the farm and the household are virtually one entity. Decisions about the farm directly impact on the household and decisions about the family directly impact on the farm.

Farm boundaries are determined by family structure.

There may be a family farm under the head of household, but the farm may have various sub-units over which a family member will have some level of control. This will have implications for decision-making, particularly with reference to shared labour and equipment. Traditionally men are heads of households, but there are now many variations. Even within a clearly established arrangement, different members of the family, especially women make different decisions for the family at different times of the year.

Key aspects of decision-making

In order to make fundamental decisions farmers need to develop understanding and skills in four broad decision areas:

- **Diagnosis:** Diagnosis means looking at the farm and household as it functioned over some period of time. For a first diagnosis, the farmer may want to understand how the farm has produced over several seasons.
- **Planning:** Once diagnosis is complete, planning can begin; decisions about what, how and how much to produce. Some planning decisions will be based on knowledge, such as how much land and labour are available. Other planning decisions will be based on less certain things, such as rainfall and product prices. The plan will also include an indication of the expected results in terms of yields and income.
- **Implementing:** Implementing means putting the plan into action. In general, implementing does not require major decisions. Things may not always work according to plan; less rainfall than expected, the price of a crop changes etc. During implementation, plans may need to be adjusted to accommodate such changes.
- **Monitoring & Evaluation:** Monitoring means keeping track of what is happening on the farm and the plan is a guide for monitoring. Monitoring provides the farmer with the information needed to evaluate the success of the plan.

Learning how to make decisions in these four areas will put farmers in greater command of the resources and processes that influence their food security and their income generation.

The four areas flow in a pattern which supports continuous learning processes about what works best for the farmer and the farm family.

Monthly/Revenue record sheet

	Date	Crop	Harvest amount (ton)	Quantity/ hectare	Quantity sold	Price	Total revenue	NOTES:
Exp:	5/1	Maize	24	12ton/ha	6 ton			
1)								
2)								
3)								
4)								
5)								
6)								
7)								
8)								
9)								
10)								
11)								
12)								
13)								
14)								
15)								
16)								

Keep careful track each month of amounts harvested & how much revenue your selected crops bring you. Use a separate line for each crop and for each harvest date. Use additional sheets if necessary.

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