

# POTATO PRODUCTION



# SHERP

**Training Title:** Irish potato Production

**Objective:** To provide a guideline on production of Irish potato

**Specific Objective:**

- To provide basic information on production, post-harvest handling, and marketing of Irish potato

**Contents:**

1. Introduction: Background, Some Common Varieties and Optimal Ecological Requirements
2. Pre-Cultivation Preparation 1 – 5
3. Cultural Practices 1- 9
4. Harvest
5. Post-Harvest Handling
6. Cost & Income Analysis
7. Post-Training Evaluation Exercise

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#### **Disclaimer**

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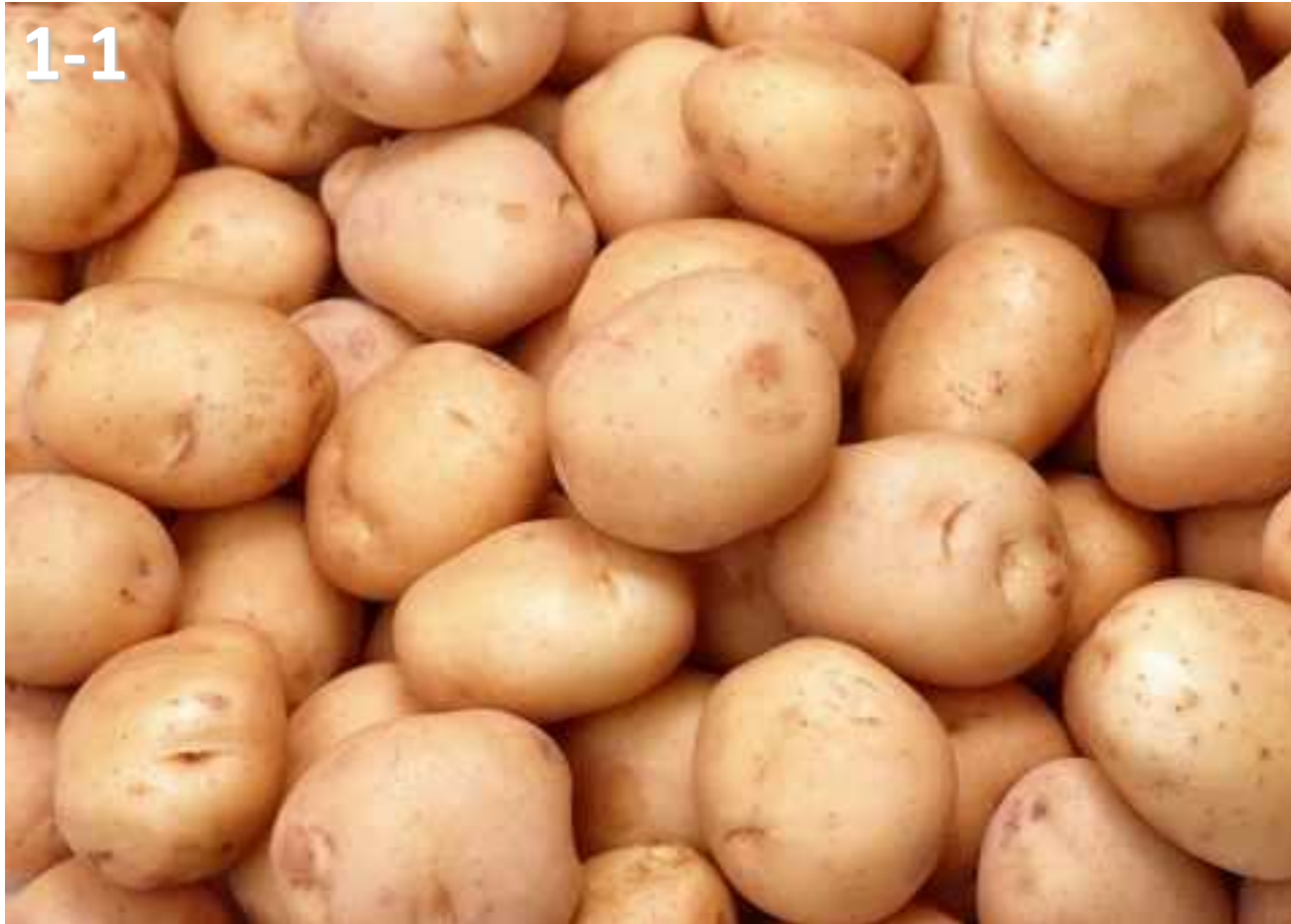
The proposed agrochemicals are in accordance with "Pest Control Product Registered for Use in Edition, 2015". The registered agrochemicals are subject to change. Please refer to the latest registered agrochemicals by Plant variety release, protection and seed quality control directorate .

#### **Preface**

- This training material applies the fundamental practices essential for crop production and successful marketing to put into perspective the case of horticultural crop production.
- The fundamental practices are categorized into seven (7) broad topics and twenty (20) sub-topics; the twenty sub-topics are referred to as the General Horticulture Crop Production and Post-Harvest Handling Techniques (GHCP&PHHT20). This categorization is based on the Smallholder Horticulture Empowerment & Promotion (SHEP ) experience in mitigating production and marketing challenges facing smallholder horticultural farmers.
- The seven (7) broad topics are: Pre-Cultivation Preparation; Land Preparation; Crop Establishment (Planting/Transplanting); Crop Management; Harvest; Post-Harvest Handling; and Cost and Income Analysis.
- The sub-topics under each topic are as follows: **Pre-Cultivation Preparation** (market survey, crop planting calendar(s), soil sampling & analysis, or using ETHIOSIS soil test results as well as regional soil labs, composting, and quality seed/planting material(s)); **Land Preparation** (land preparation practices, incorporation of crop residues, and basal application); **Crop Establishment** (raising seedlings, planting/transplanting, fertilizer application); **Crop Management** (water requirement, managing of weeds, top-dressing, pests & diseases management practices, and safe & effective use of pesticides); **Harvest** (harvesting indices); **Post-Harvest Handling** (appropriate containers/standard packaging materials, and value addition techniques); and **Cost and Income Analysis** (cost and income analysis).
- The issues outlined in the twenty (20) sub-topics might not necessarily be applicable in all the cases. But where applicable, it is recommended that the instructions issued be given due consideration.

# 1. Introduction:

## 1.1 Background

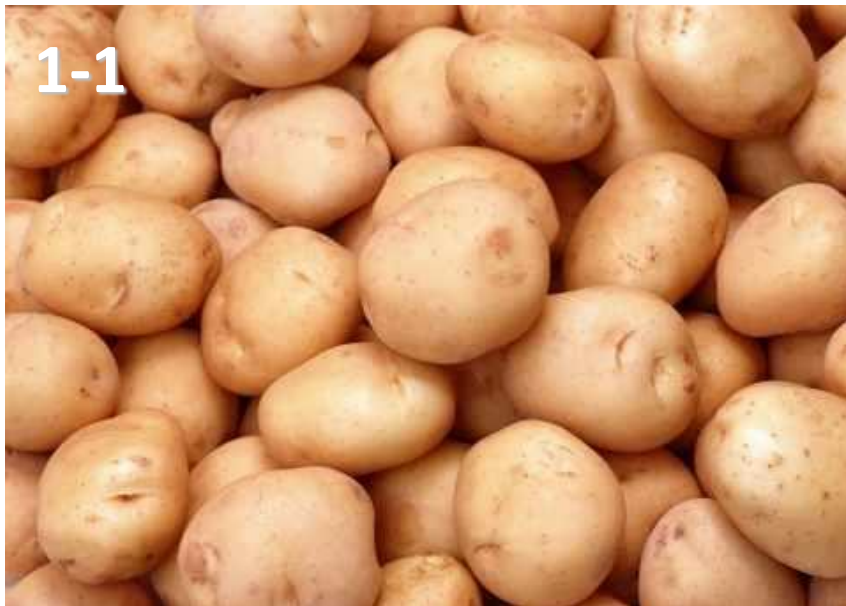


Information Source: <http://gulfbusiness.tradeholding.com>

## Potato (Yedinich Kurt)

# 1. Introduction:

## 1.1 Background



**Potato (Yedinich Kuret)**

### 1. Introduction:

#### 1.1 Background

- Herbaceous perennial cultivated as an **annual crop**
- The crop is grown for its **tuber**- an underground stem
- **Rich in starch (8 – 28 %)** but **low in protein (1 – 4 %)**
- It is also **rich in Vitamin C**
- **2<sup>nd</sup> most important food crop** after maize; and a valuable cash crop to many smallholders
- The most hunger relief root crop in the country
- Can be utilized **boiled, baked, mashed or fried** into chips or crisps among other uses

# 1.2 Some Common Varieties



Information Source: <http://www.infonet-biovision.org/>

**“Belete”**



Information Source: <http://www.infonet-biovision.org/>

**“Gudene”**

# 1.2 Some Common Varieties



**“Belete”**



**“Gudene”**

## 1.2 Some Common Varieties

### Released varieties (by EIAR):

#### “Belete”:

- White flower
- Optimal production altitude: **1,600-2,800m**
- Maturity Period: **3 – 4 months**
- Yield: **400 qt/ha**
- Tolerant to **Late Blight**

#### “Gudene”

##### Released varieties (2006E.C by EIAR):

- White flower
- Optimal production altitude: **1,600 – 2,800 m**
- Maturity Period: **3 – 4 months**
- Yield: **250-300 qt/ha**
- Tolerant to **Late Blight**

# 1.2 Some Common Varieties



Information Source: <http://www.infonet-biovision.org>

**Other Varieties including Digemegn, Jalene, Guasa**

# 1.2 Some Common Varieties



## Other Varieties including Digemegn, Jalene, Guasa

### 1.2 some other common Varieties grown in Ethiopia

Released varieties (by Research) & their characteristics

#### 1. Digemegn

Releasing date: 2002 E.C

Optimal production altitude: **1,600-2,800 masl**

Maturity date: **110-115 days**

Yield: **235-330 qt/ha**

Flower color: white

Reaction to blight: **tolerant**

#### 2. Jalene

Releasing date: 2002 E.C

Optimal production altitude: **>2,400 masl**

Maturity date: **100-110 days**

Yield: **400 qt/ha**

Flower color: white

Reaction to blight: **tolerant**

#### 3. Guasa

Releasing date: 2002 E.C

Optimal production altitude: **2,200-3,200 masl**

Maturity date: **110-115 days**

Yield: **235-330 qt/ha**

Flower color: white

Reaction to blight: **tolerant**



# 1.3 Optimal Ecological Requirements

<b>Altitude</b>	<b>1,800 – 3,500 Meters Above Sea Level</b>
<b>Rainfall</b>	<b>500 - 850 mm of rainfall</b>
<b>Growing Temperature</b>	<b>15 – 20 °C</b>
<b>Soils</b>	<ul style="list-style-type: none"><li>• <b>Well drained medium loams</b></li><li>• <b>pH range 6.0 – 7.5</b></li></ul>

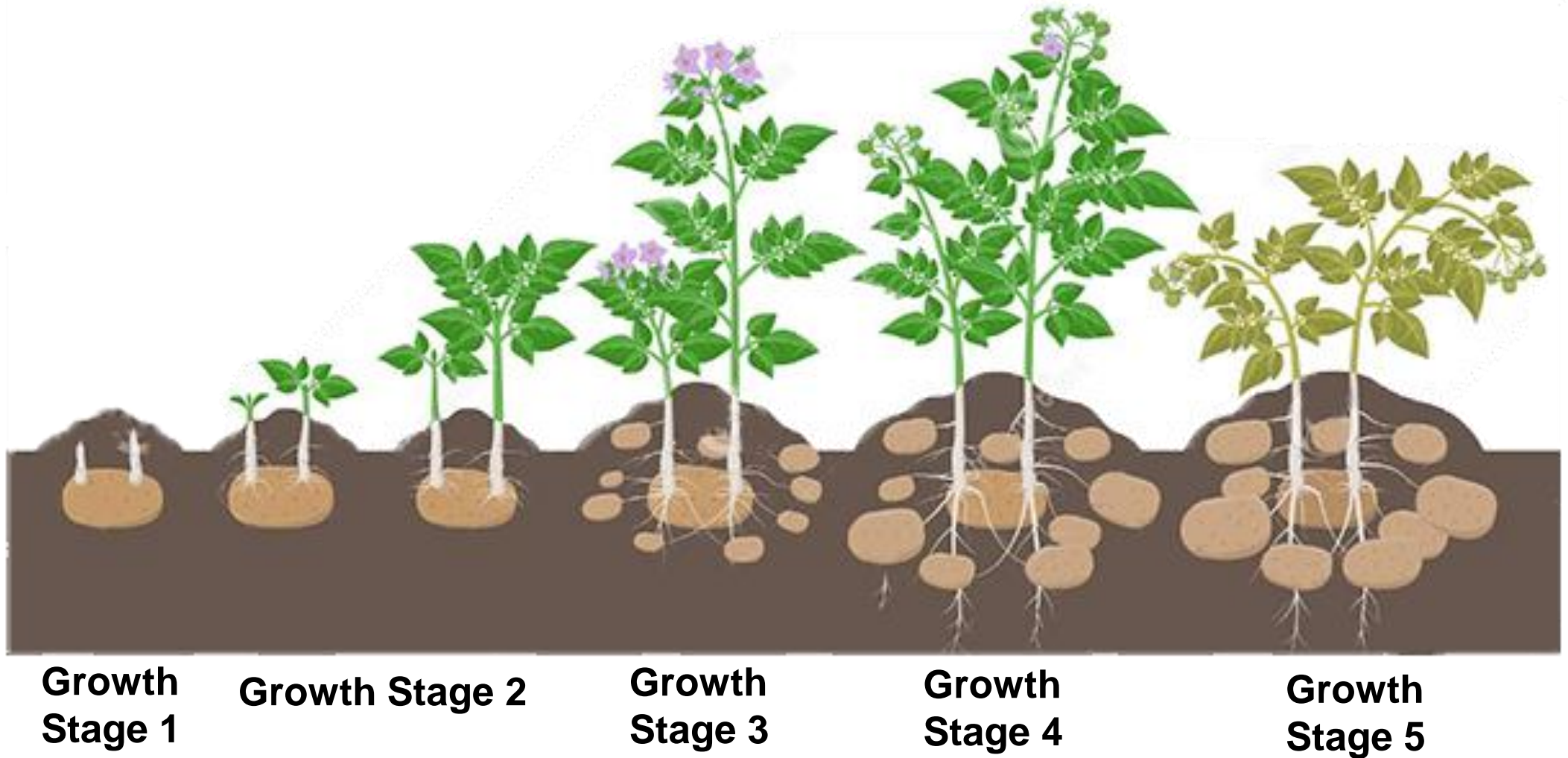
# 1.3 Optimal Ecological Requirements

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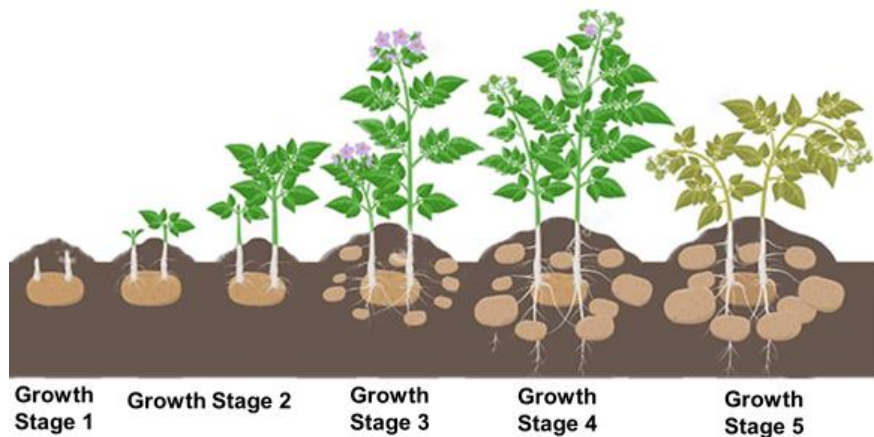
## 1.3 Optimal Ecological Requirements

- **Altitude:** Potatoes are cultivated between **1,800 – 3,500 m.a.s.l.**
- **Rainfall:** Well distributed rainfall of between **500 – 850 mm** is required during the growing period
- **Temperature:** Potatoes perform well in cool climatic conditions and the optimum temperature range is **15 – 20°C**. Temperatures higher than 29°C, when they form new tubers, prevent tubers forming or increasing in size both tuber formation and yield are poor. The temperature for tuberization is **15°C**.
- **Soil:** Free draining fertile medium loams are preferred since heavy clays restrict tuber growth. The optimal soil pH range is **6.0 – 7.5**

# 1.4 Growth Stage



# 1.4 Growth Stage



## 1.4 Growth Stage

### Growth Stage 1:

- **Sprout development:** Sprout develop from the eyes using energy from the seed tuber

### Growth Stage 2:

- **Vegetative growth:** Development of leaves, branches and stolons (**Right time for earthing- up**)
- Growth stage 1 and 2 takes roughly **4 – 10 weeks** depending on environmental conditions, physiological age of the tubers & kind of variety

### Growth Stage 3:

- **Tuber set (initiation):** Tubers begin to form at the stolon tips but with little enlargement
- Flowering starts at the end of this stage and takes **2 weeks**

### Growth Stage 4:

- **Tuber bulking:** Tuber enlargement caused by accumulation of water, nutrients & carbohydrates
- Critical stage for yield & quality
- This stage is the longest and can last **up to 3 months**

### Growth Stage 5:

- **Maturation:** Vines turn yellow & tuber growth slows down
- Decline in photosynthesis
- Dry matter content is at maximum
- Dehulm (Removal of above ground part of the potato plants) to harden the skin at this stage (very important to ensure good quality produce)

# 2. Pre-Cultivation Preparation:

## 2.1 Market Survey



**Conducting a market survey on Potato**

# 2. Pre-Cultivation Preparation:

## 2.1 Market Survey



**Conducting a market survey on Potato**

### 2. Pre-Cultivation Preparation: 2.1 Market Survey (GHCP&PHHT20: Q1)

#### How to conduct a market survey

- Identify major dealers of the target crops
- Introduce yourself what the purpose of a market survey
- Find the potential market nearby your area (local market, big market in town, hospital, University, boarding school)
- It is important to consider seasonal or religious event, such as Christmas or fasting
- People consume more vegetables during fasting season
- Continuous surveys are important in order to find new market opportunities and also establish business relationships with the market players.

**Note:** It is recommended to conduct a market survey when you go to local market during your local market day

# 2. Pre-Cultivation Preparation:

## 2.2 Market Survey Questionnaire

### Market Survey Questionnaire

Date : \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Region: \_\_\_\_\_

Zone: \_\_\_\_\_

Woreda: \_\_\_\_\_

Name of Group: \_\_\_\_\_

Name & Contact of the Produce Dealer	Produce & Variety	Produce Quality Market Requirements	Peak Demand (months)	Quantity (kg) & Frequency (daily/weekly etc.) of Supply	Place of Production	Purchasing Unit Price (ETB/kg)	Mode of Payment	Terms of Payment	Marketing Challenges	Dealer's Willingness to Purchase the Produce from the farmers
Mr. Abdela Qasim (0917-xxxxxx)	Potato (Belete)	Large size	February to March	120 qt/week (1qt = 110 kg)	Waliso	3.5 ETB/kg	Cash	Cash on Delivery	Poor quality (diseased)	Willing to buy at shop
Mr. Kernal Husen (0911-xxxxxx)	Potato (Gudene)	Medium size	January to February	80 qt/week (1qt=100 kg)	Shewarobit	300 ETB/qt	Credit	Within a week	Poor quality (small size and not well cured)	Willing to buy at farm gate

# 2. Pre-Cultivation Preparation:

## 2.2 Market Survey

### Market Survey Questionnaire

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### Market Survey Questionnaire

### 2. Pre-Cultivation Preparation: 2.2 Market Survey Questionnaire

Prepare sample questions to enable you gather the following information

- When (month) is the peak demand for Potato
- The price of Potato during the peak demand
- The Potato variety(s) that has the highest demand
- Supply requirements (quantities and frequency)
- Quality market requirements
- Potential buyers and terms of payment etc.

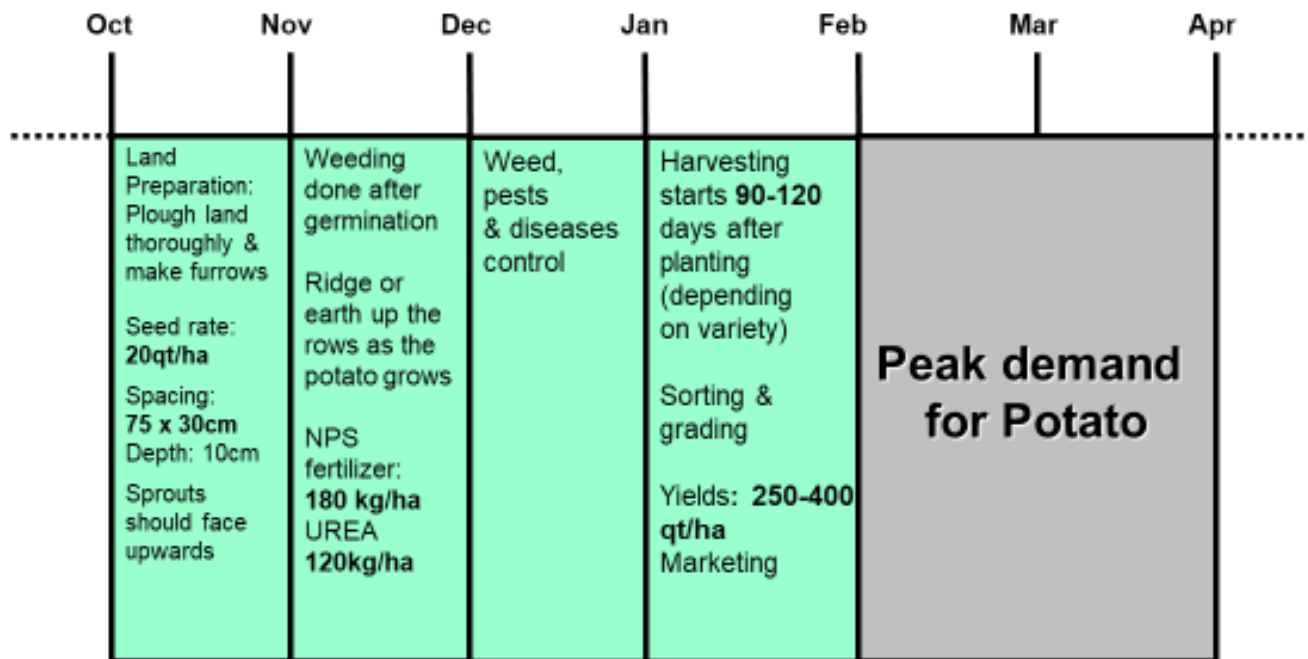


# 2.2 Cropping Calendar

## A Sample of a Potato Cropping Calendar in Irrigation

Oct	Nov	Dec	Jan	Feb	Mar	Apr
<p>Land Preparation: Plough land thoroughly &amp; make furrows</p> <p>Seed rate: <b>20qt/ha</b></p> <p>Spacing: <b>75 x 30cm</b> Depth: 10cm</p> <p>Sprouts should face upwards</p>	<p>Weeding done after germination</p> <p>Ridge or earth up the rows as the potato grows</p> <p>NPS fertilizer: <b>180 kg/ha</b> UREA <b>120kg/ha</b></p>	<p>Weed, pests &amp; diseases control</p>	<p>Harvesting starts <b>90-120</b> days after planting (depending on variety)</p> <p>Sorting &amp; grading</p> <p>Yields: <b>250-400 qt/ha</b> Marketing</p>	<p><b>Peak demand for Potato</b></p>		

# 2.2 Cropping Calendar



**A Sample of a Potato Planting Calendar**

## 2.2 Crop Planting Calendar (GHCP&PHHT20: Q2)

- A tool used by farmers to plan for production to ensure that marketing coincides with the period of the year when the market price of a produce is highest

Procedure:

1. Determine from the market survey results (2.1) when there is peak demand for Irish Potato
2. Work backwards from the month when there is peak demand to prepare a monthly farm activities preceding the peak period
3. Use the monthly activities preceding the peak as a procurement plan for farm inputs and a guide for farm operations

Note:

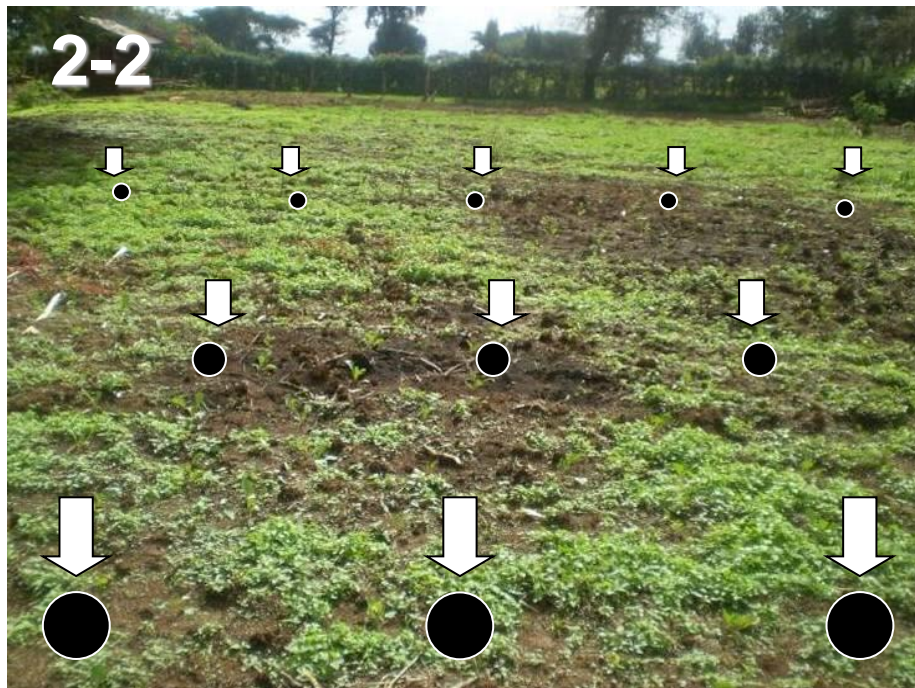
- To meet the peak demand period of the market, there may be need of supplemental irrigation

# 2.3 Soil Sampling & Analysis



**Depending on the farm, sample the soil using the most appropriate method**

## 2.3 Soil Sampling & Analysis



### 2.3 Soil Sampling & Analysis (GHCP&PHHT20: Q3)

- It is recommended to have the soils analyzed for nutrient availability and other factors vital to crop production **after every two 2 – 3 years**
- The results of the soil analysis can be used to determine fertilizer and manure requirement

**Depending on the farm, sample the soil using the most appropriate method**

# 2.4 Composting



## Manure preparation through composting

## 2.4 Composting



**Manure preparation  
through composting**

### 2.4 Composting (GHCP&PHHT20: Q4)

- During compost making, the organic matter need to be covered to prevent leaching of nutrients
- Based on the results of the soil analysis, prepare adequate compost for application
- Well decomposed farmyard manure is recommended to reduce incidences of **Black Scurf** which originates from manures
- Rate of application of farmyard manure is **80-120 qt/ha**

# 2.5 Quality Seed/Planting Materials



Information Source: <http://www.gardenaction.co.uk>

## Farmers grading seed Potato



Information Source: <http://in2eastfrica.net>

## A sprouting seed potato

## 2.5 Quality Seed/Planting Materials



**Farmers grading seed potato**



**A sprouting seed potato**

### 2.5 Quality Seed/Planting Material (GHCP&PHHT20: Q5)

- Use **disease-free** or **certified seed**
- Certified seed potatoes have 3 grades:
  - **Size I:** Small sized seed potatoes (**25 – 35 mm** diameter)
  - **Size II:** Medium sized seed potatoes (**35 – 45 mm** diameter, egg sized tubers). This is the preferred size since it produces a good balance of big sized & small sized seed tubers
  - **Size III:** Large sized seed potatoes (**45 – 55 mm** diameter). This class of seed yields more of seed sized tubers
- Seed tubers are kept in diffuse light to allow **development of short sturdy sprouts**: this is to ensure a uniform stand (Fig. 2-5)
- Number of sprouts should be at least 4
- Quality planting materials to be collected from research centers and cooperatives
- Potato growers should obtain fresh planting seed every 3 seasons
- Positive selection of growing plants to obtain own seed for planting the following season is a good short-term alternative



# 3. Cultural Practices:

## 3.1 Land Preparation



**Land preparation by oxen plough**

# 3. Cultural Practices:

## 3.1 Land Preparation



**Land preparation by  
oxen plough**

### 3. Cultural Practices:

#### 3.1 Land Preparation

##### Land Preparation Practices:

**(GHCP&PHHT20: Q6)**

- Land set aside for potato production should **Not** have been grown with another ***solanaceous*** crop for **3 years** to control soil organisms e.g. nematodes and diseases
- Soils should be **ploughed thoroughly** to eliminate **grasses, weeds, clods** and to allow aeration
- The field is ploughed to a depth of **30 cm**
- **Furrows are made in which the seed tubers will be planted**
- Remove volunteer plants in the field in order to avoid spread of diseases

## 3.2 Incorporation of Crop Residues



**Crop residues to be incorporated in a field**

# 3.2 Incorporation of Crop Residues



**Crop residues to be incorporated in a field**

## 3.2 Incorporation of Crop Residues (GHCP&PHHT20: Q7)

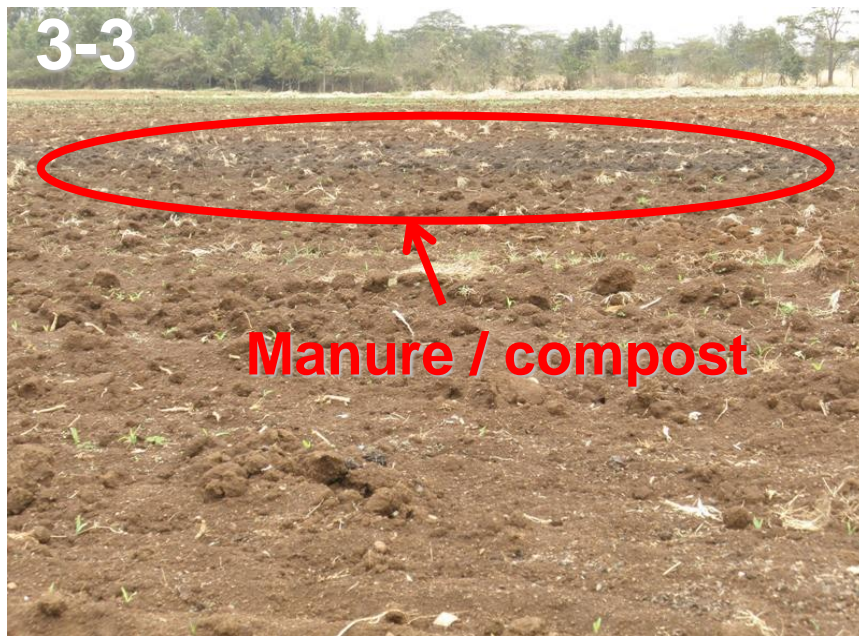
- Incorporating crop residues in the farm land can significantly increase the soil organic content
- The crop residues should be ploughed in during land preparation
- **However, if the crop residues belong to the Solanaceae family (such as tomatoes, potatoes, green peppers, chilli peppers, eggplants, black night shades etc.), remove and burn the residue to avoid possible risk of disease build up**

# 3.3 Basal Application



## Manure incorporation as a basal application

# 3.3 Basal Application

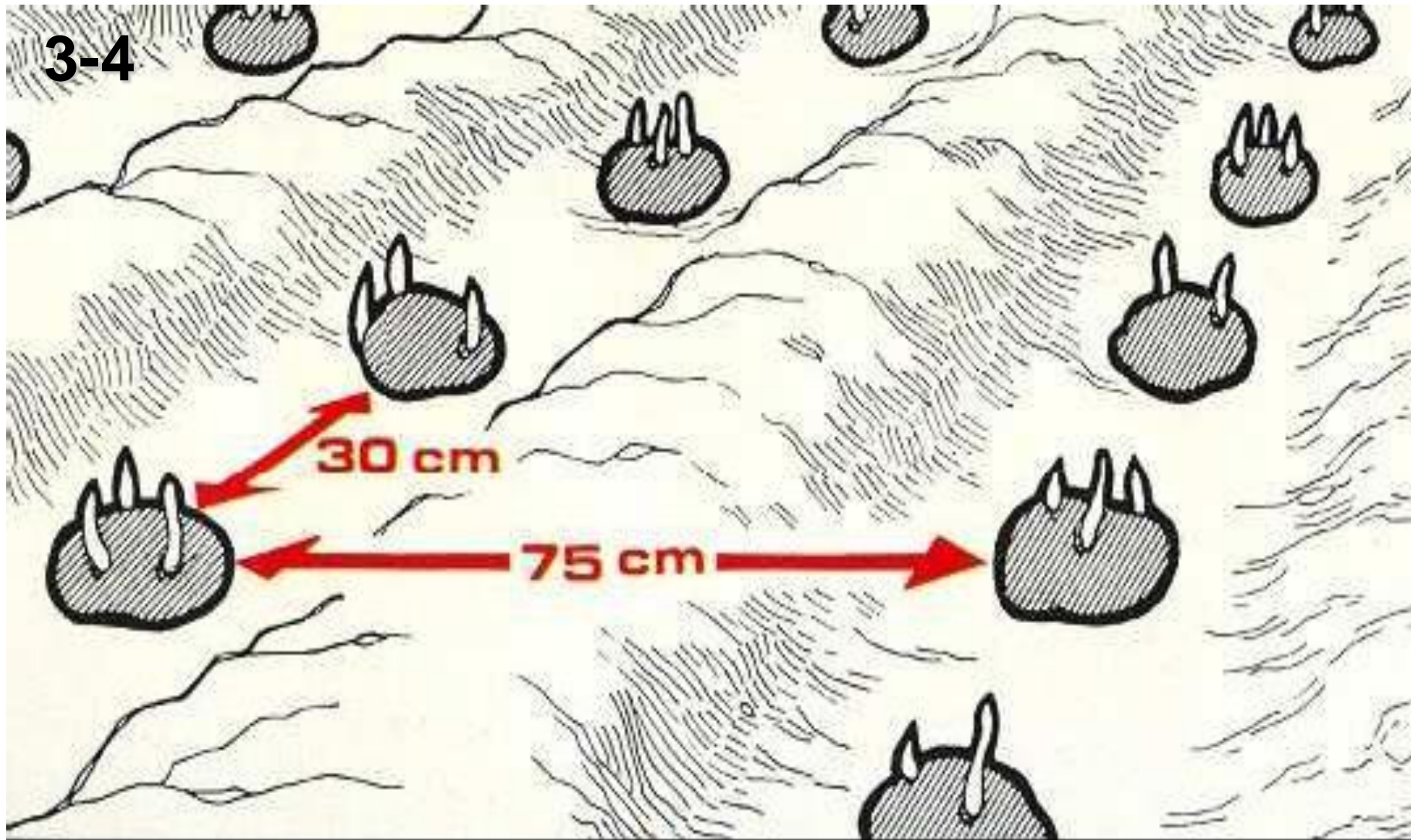


**Manure & compost incorporation as a basal application**

## 3.3 Basal Application (GHCP&PHHT20: Q8)

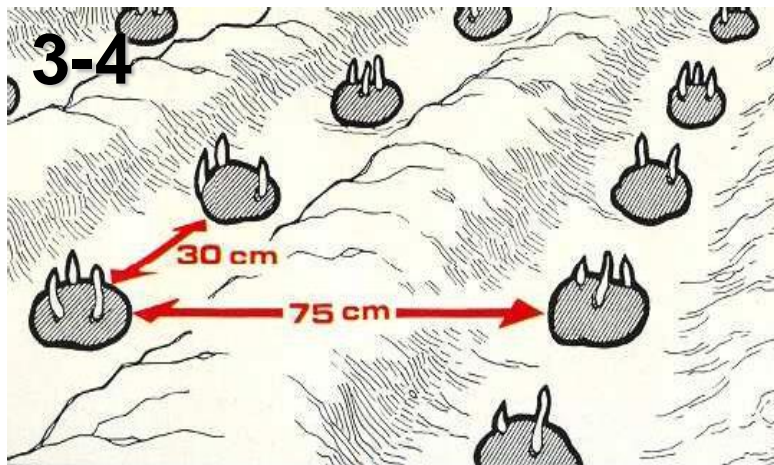
- Potatoes respond well to high soil fertility and manure or compost is needed if the land has been continuously cropped
- However, to prevent excessive production of vegetative part at the expense of tubers, it is recommended to add compost or manure on the crop preceding the potato
- Well-decomposed animal manure or compost is recommended
- Apply manure at a rate of **200 qt/ha**
- Potatoes have a poor root system, so fertilizer should be applied at the same level, or just below, that of the seed tubers in the furrow during planting
- Seed tubers and fertilizer should not come into direct contact

# 3.4 Planting



**A field planted with seed potatoes**

# 3.4 Planting



**A field planted with seed potatoes**

## 3.4 Planting

### 3.4.1 Appropriate Time:

- Planting is done at frost free time
- **Seeding rate: 20 qt/ha**

### 3.4.2 Recommended Spacing (**GHCP&PHHT20: Q10**):

- **30 cm** (between plants) and **75 cm** (between ridge)
- Planting depth is **10 cm** and the sprouts should be placed facing upwards & the seed covered by a layer of soil

### 3.4.3 Fertilizer Application Rates (**GHCP&PHHT20: Q11**):

- DAP recommendation is **150kg/ha** or in NPS form it will be **180 kg/ha**
- Urea **120 kg/ha** :**1/2 two weeks after emergence** by top dressing and **1/2 at flowering time**
- Fertilizer should thoroughly mixed to avoid scorching of sprouts

### Note

- Use of excess nitrogen should be avoided as it encourages vegetative growth at the expense of tuber formation



# 3.5 Water Requirement



**Vigorous potato crop under furrow irrigation**

# 3.5 Water Requirement



**Vigorous potato crop under furrow irrigation**

## 3.5 Water Requirement

**(GHCP&PHHT20: Q12)**

- Potatoes require **500 – 850 mm** rainfall during the growing period
- Production in Ethiopia is both rain fed and irrigation
- Low and fluctuating moisture contribute to scab, hollow heart, low dry matter, low tuber set & mis-shapen tubers
- **Furrow irrigation** is recommended during early and late hours to reduce evaporation
- However, leave should be dried out until sunset in order to control blight disease

# 3.6 Managing of Weeds



**Weed free Potato crop**

# 3.6 Managing of Weeds



**Weed free Potato crop**

## 3.6 Managing of Weeds (GHCP&PHHT20: Q13)

- Adequate control of weeds is required to ensure **high yields**
- **Manual weeding**
- Weeding is done **after germination** to avoid uprooting of seed tubers
  - **1<sup>st</sup> Weeding:** 1 – 2 weeks after emergence
  - **2<sup>nd</sup> Weeding:** 4 – 5 weeks after crop emergence
- **Do Not** weed **when the soil is wet** to avoid compaction

### Chemical Control:

- **Use of selective herbicides**, such as
  - **Sencor®** (a.i. Metribuzin)
  - **Linurex®** (a.i. Linuron)
  - **Tata Panida®** (a.i. Imidacloprid)
- After the plants have completely covered up the space in between the rows, weeds are suppressed

# 3.7 Crop Management:

## 3.7.1 Ridging/Earthing-up



**Potato crop that has been  
earthed up / ridged properly**

# 3.7 Crop Management

## 3.7.1 Ridging/Earthing-up



**Potato crop that has been earthed up / ridged properly**

### 3.7 Crop Management

#### 3.7.1 Ridging/Earthing-up

- Ridging (or hilling) is a cultivation practice during which the soil surrounding the young potato plants is used to build a ridge or hill in which the tubers can develop
- Done together with weeding
- Final ridging done **before plant starts to bloom**
- **Do Not** earth-up **when the soil is wet** to avoid compaction
- A well built hill helps to **control weeds, prevents greening of tubers, reduces attack** by the potato tuber moth and facilitates harvesting

# 3.8 Pests & Diseases Control

## 3.8.1. Control/Management Strategies

<b>1.</b>	<b>Cultural Control</b>
<b>2.</b>	<b>Mechanical Control</b>
<b>3.</b>	<b>Biological Control</b>
<b>4.</b>	<b>Chemical Control</b>
<b>5.</b>	<b>Integrated Pest Management (IPM)</b>

# 3.8 Pests & Diseases Control

## 3.8.1 Control/Management Strategies

1.	Cultural Control
2.	Mechanical Control
3.	Biological Control
4.	Chemical Control
5.	Integrated Pest Management (IPM)

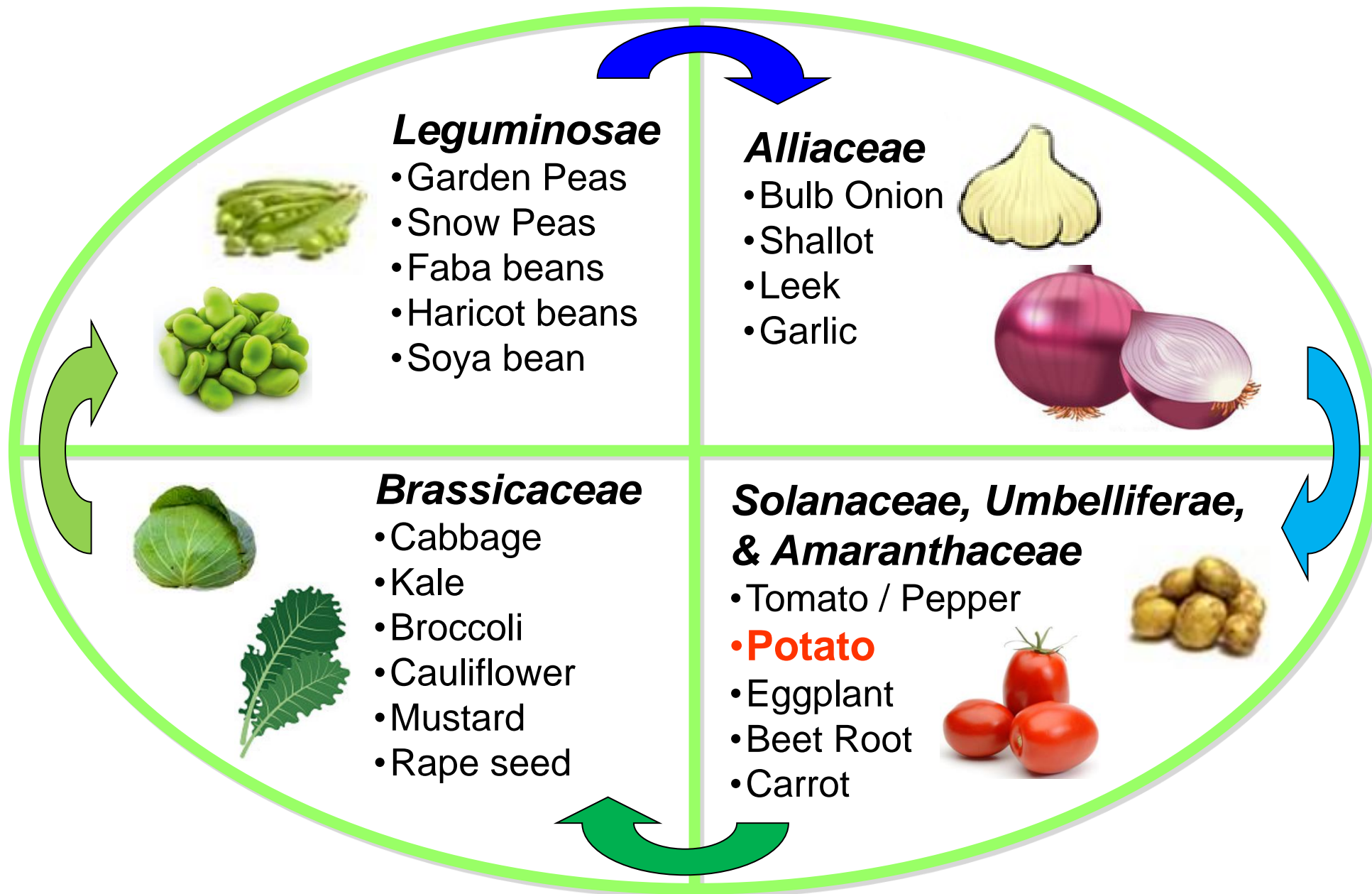
### 3.8 Pests & Diseases Control

#### 3.8.1 Control/Management Strategies (GHCP&PHHT20: Q15)

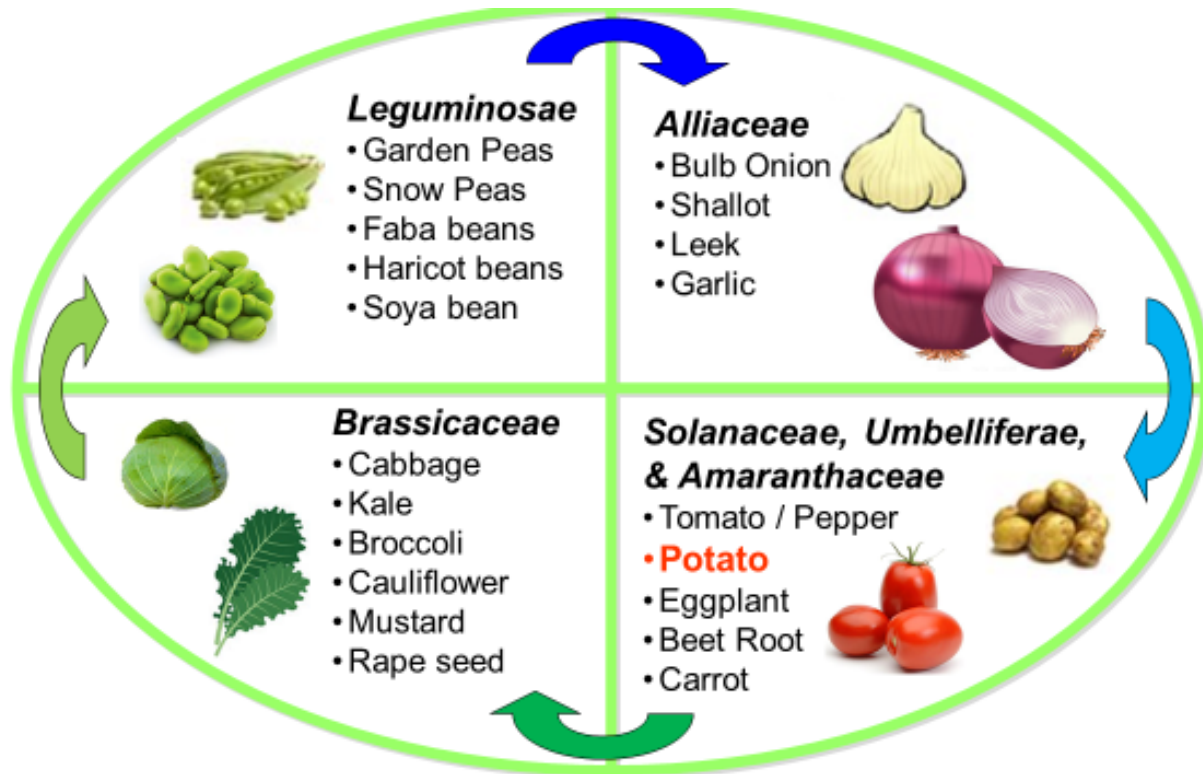
- Pests and diseases can be managed through either single control strategies or an integration of two (2) or more methods. The single control strategies are: cultural; physical; biological; and chemical.
- 1. **Cultural Control:** This involves managing the environment in which the crop is growing/grows with a view of maintaining pest and disease below the harmful level. The cultural methods include field sanitation/hygiene, intercropping, crop rotation, furrowing, flooding, solarization etc.
- 2. **Mechanical Control:** This involves use of insect traps, hand picking, screening house, weeding etc.
- 3. **Biological Control:** This involves use of natural enemies (predators and parasitoids), resistant/tolerant varieties, trap plants, push and pull system, and repellent plants
- 4. **Chemical Control (GHCP&PHHT20: Q16):** This involves use of pesticides. Pesticides are preferred because of the quick knock down effect; they have high efficacy. Pesticide usage has been linked to environmental degradation and should be used as last resort
- 5. **Integrated Pest Management (IPM):** Due to limitation of a single control strategy, use of IPM is a more recommended strategy. IPM integrates cultural, mechanical, biological and as a last resort, chemical control to minimize the crop loss caused by pests and diseases.



# 3.8.2 Crop Rotation



## 3.8.2 Crop Rotation



An example of a Crop Rotation

### 3.9.2 Crop Rotation

- One of the most important strategies of IPM is crop rotation
- Crop rotation prevents pest and disease build-up and in addition, it replenishes soil nutritional status
- DO NOT plant after growing tomato, green pepper or eggplant since they are the same family with potato
- It is recommended to rotate crops with those from different families; an effective rotation program should last for 3 – 4 years

# 3.8.3 Major Pests



## 3.8.3 Major Pests



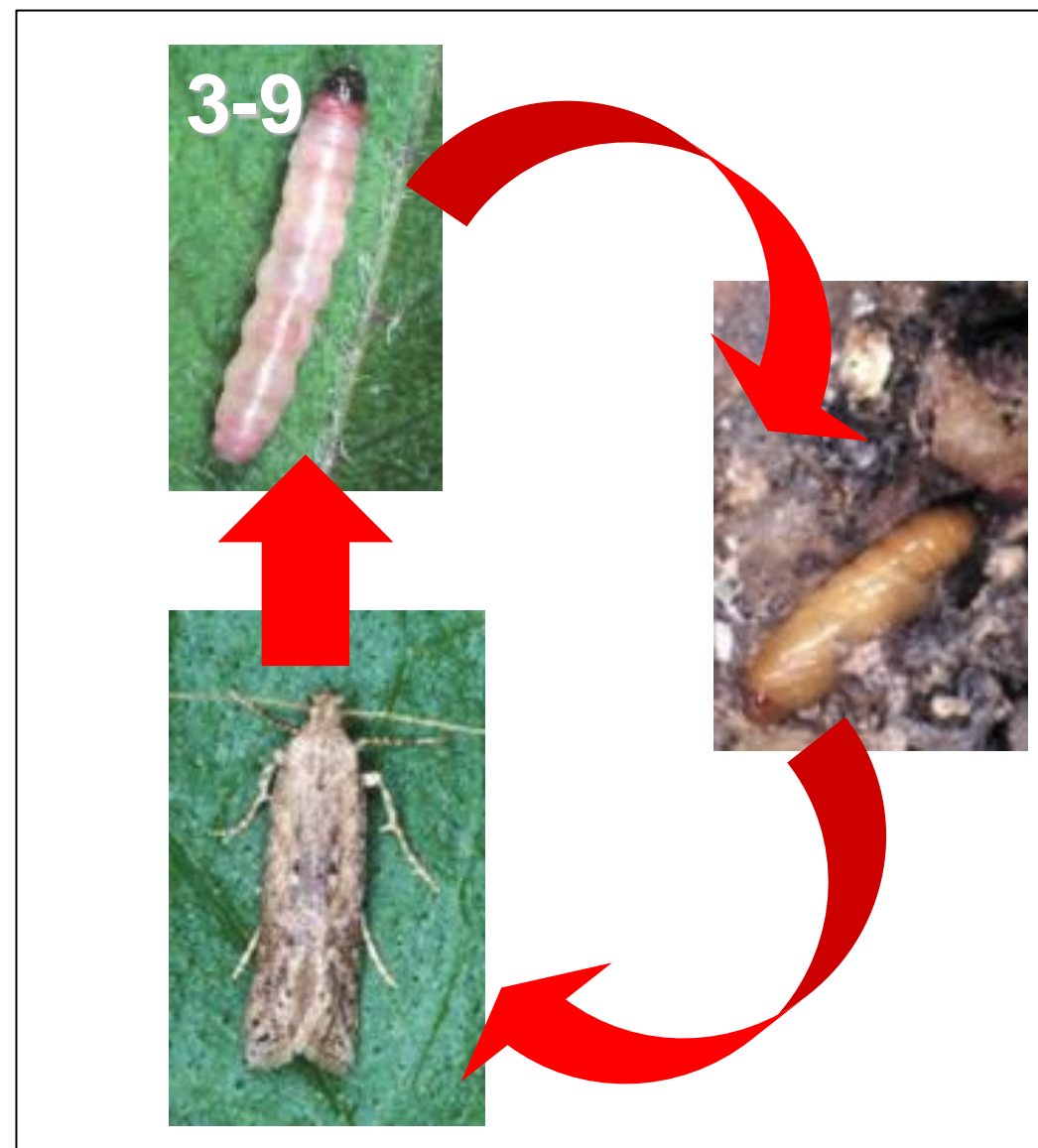
### 3.8.3 Major Insect Pests

- Pests damage causes a reduction in quality and quantity of produce
- The following are the major pests of Potato in Ethiopia :
  - A. Potato Tuber Moth
  - B. Aphids
  - C. Cutworms

# 3.8.3.A: Potato Tuber Moth



Information Source: <http://www.infonet-biovision.org>



Information Source: <https://cipotato.org/riskatlasforafrica/phthorimaea-operculella/>

## Potato Moth on a tuber

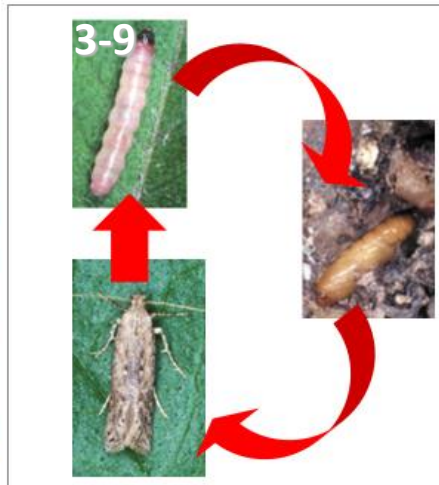
## Life cycle of Potato Moth

# 3.8.3.A: Potato Tuber Moth



Information Source: <http://www.infonet-biovision.org>

Potato Moth on a tuber



Information Source: <https://cipotato.org/riskassessmentforafrica/pthorimasa-coerculella/>

Life cycle of Potato Moth

## Potato tuber damaged by Potato tuber Moth

### 3.8.3.A: Potato Tuber Moth

#### Identification:

- The moth is **small, brownish grey** in color with **narrow fringed wings**
- The moths are active mainly at dusk
- The female lays eggs singly or in batches on **leaves, stems & near eye buds** on exposed tubers in the field or in the store
- The caterpillars are up to **12 mm long, whitish to pale greenish** in color

#### Damages:

- Caterpillars burrow in the tubers making **long irregular tunnels** filled with excreta exposing tubers to secondary bacterial and fungal infection
- These tunnels make the potatoes unfit for human consumption
- The pest is transferred with **the harvested tubers** to the potato store, where it can reproduce and infest other tubers
- The moth is active at night and hides between plants during the day

#### Control:

- Use **healthy and clean seed**, since infested seed tubers are the main cause of re-infestation in the field
- Plant as deeply as possible (**10 cm deep**) and ridge at least **3 times** during the growing season
- **Deep ridging:** very important to prevent moths reaching the tubers to lay eggs (ensure all cracks are covered)
- Store all harvested tubers before dusk to avoid moths laying eggs on them
- Don't leave harvested tubers in the field overnight during dry season
- Spray using appropriate insecticides e.g. diazenon 60% E.c, endosalphen 39%, celecron 50%
- Use of repellants e.g.) **Lantana camara** and **Eucalyptus** leaves

# 3.8.3.B: Aphids



Information Source: <http://www.agroatlas.ru>

## Aphid on the leaf of a Potato Plant

## 3.8.3.B: Aphids



**Aphid on the leaf of  
a Potato Plant**

### 3.8.3.B: Aphids

#### Identification:

- Many aphid species attack the potato including the **green peach aphid, potato aphid & cotton aphid**
- Aphids are mainly found on plant terminals and on the underside of leaves

#### Damages:

- Feeding by aphids causes **irregular curling of young potato leaflets** and **hinders growth of the leaflets**
- Direct damage caused by aphids sucking sap from the plant is usually of little importance
- Most damage is caused by **honeydew production on foliage** and **virus transmission**
- Aphids are important pests as **vectors of potato viruses**, such as the **Potato Leaf Roll Virus**, a serious disease affecting potatoes

#### Control:

- **Use of pesticides**, such as malathion 50% E.c
- Control aphids in potato planted for **seed production**
- Keep seed production areas **separated from** commercial potato production
- Grow the crop at the right (high) altitude



# 3.8.3:C: Cutworms



Information Source: <http://www.infonet-biovision.org>

## A Cutworm larva

## 3.8.3.C: Cutworms



**A Cutworm larva**

### 3.8.3.C: Cutworms

#### Identification:

- The larvae of cutworms stay **buried in the soil** and **cut stems during the night**
- The pest is **destructive during dry weather**

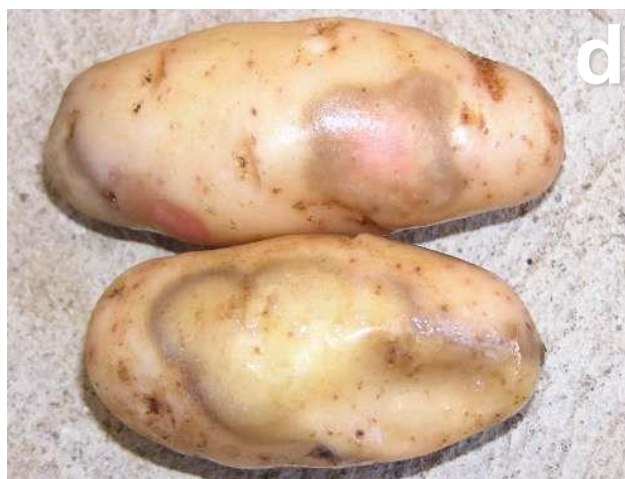
#### Damages:

- Cutworms feed on **tubers** and **roots**, boring a **wide shallow hole**
- They are also serious pests of **newly sprouted potato plants**, and can leave great empty patches in a potato field

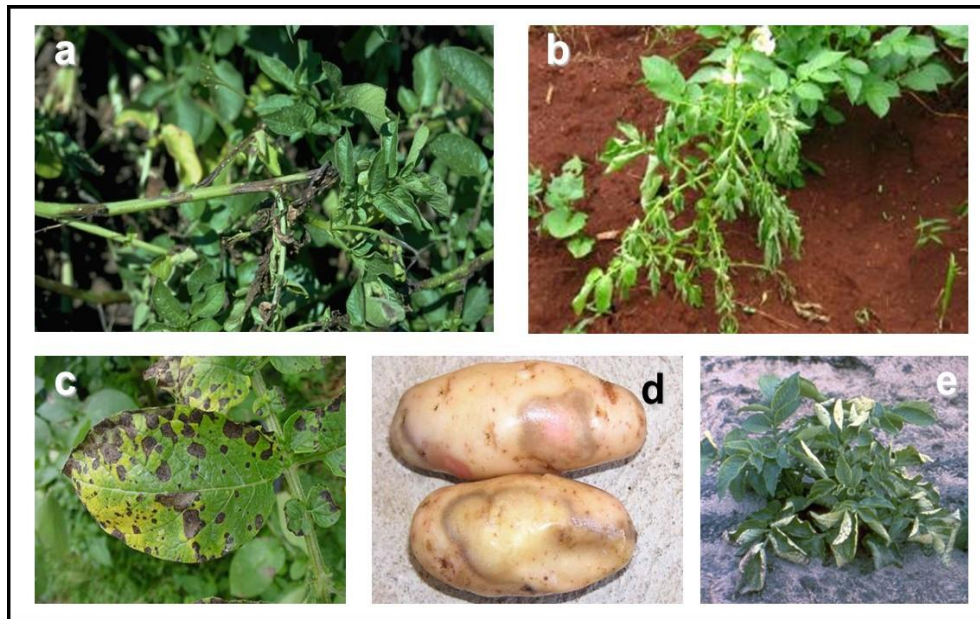
#### Control:

- Ploughing and hand picking
- Prepare field and **destroy vegetation and weeds 10 – 14 days** before planting
- **Ploughing** exposes caterpillars to predators and desiccation by the sun
- **Flooding of the field for a few days before planting** can help kill cutworm caterpillars in the soil
- Ploughing and hand picking

# 3.8.4 Major Diseases



## 3.8.4 Major Diseases



### 3.8.4 Major Diseases

- Disease infestation leads to reduction in quality and quantity of produce
- The following are the major diseases of Potato in Ethiopia:
  - a. Late Blight
  - b. Bacterial Wilt
  - c. Early Blight
  - d. Bacterial Soft Rot
  - e. Potato Leaf Roll Virus (PLRV)

# 3.8.4.a: Late Blight



Information Source: <http://imgkid.com/late-blight-potato.shtml>

**Leaves and stem of potato plant  
infected by Late Blight**

# 3.8.4.a: Late Blight



**Leaves and stem of potato plant infected by Late Blight**

## 3.8.4.a: Late Blight

- This is a **fungal disease** which is favored by **cool, cloudy wet conditions**
- It is one of the most destructive disease of potato

### Symptoms:

- **Water soaked spots on leaves** which enlarge and **turn brown**
- Below the leaf, the fungus produces **white mouldy growth** seen clearly at the edge of the spot
- The affected leaves wither, yet frequently remain attached to the stem

### Control:

- **Resistant varieties**, such as “**Belete**”, “**Gudene**”, “**Degemegn**”, “**Jalene**” and “**Dagme**” are claimed to have some tolerant
- Practice **Crop Rotation** with **non-solanaceous crops**
- Practice **good field hygiene by rouging**
- Select only **certified, disease-free seed potatoes**
- **Spray with appropriate fungicides** both protective & curative, such as

#### Protective:

- **Antracol®** (a.i. Propineb)
- **Dithane M45®** (a.i. mancozeb)
- **Nando®** (a.i. Fluazinam)

#### Curative:

- **Ridomil Gold®** (a.i. metalaxyl + mancozeb)
- **Milraz®** (a.i. Propineb 70 % + Cymoxanil 6 %)
- **Victory®** (a.i. metalaxyl + mancozeb)

## 3.8.4.b: Bacterial Wilt



**Potato leaves wilting due to  
Bacterial Wilt infection**

## 3.8.4.b: Bacterial Wilt



**Potato leaves wilting  
due to Bacterial Wilt  
infection**

### 3.8.4.b: Bacterial Wilt

- The disease is caused by a bacteria known as *Pseudomonas solanacearum*
- It is **soil borne** and **the most serious disease** which can destroy an entire field
- The bacteria survives in the soil for a long time and enters into the host plant through **wounds on the roots and the base of stems**
- The disease is spread by infected tubers, crop residues, contaminated surface water, contaminated soils, and tools

#### Symptoms:

- **Affected plants wilt** even when there is adequate moisture in the soil
- **Wilting is rapid** and **wipe out** the entire fields in few days
- Slimy continuous white discharge emanate from the eyes of the affected tubers

#### Control:

- Use of **certified seed**
- Practice **Crop Rotation (5 – 7 years)** rouging volunteer potato plants during rotation
- Destruction of infected plant debris by burning
- Avoid contaminating the field with soil from an affected field
- Avoid cutting of seeds as a way of multiplying seeds when having insufficient seed potato
- Spot treatment with **10 % of Sodium hypochlorite (bleach)**



# 3.8.4.c: Early Blight



## Early Blight on Potato Leaf

## 3.8.4.c: Early Blight



**Early Blight on Potato  
Leaf**

### 3.8.4.c: Early Blight

- This is caused by a fungus: *Altenaria solani*
- The fungus persist in debris of affected plants **for several years**
- Early Blight thrives best under **warm wet conditions**

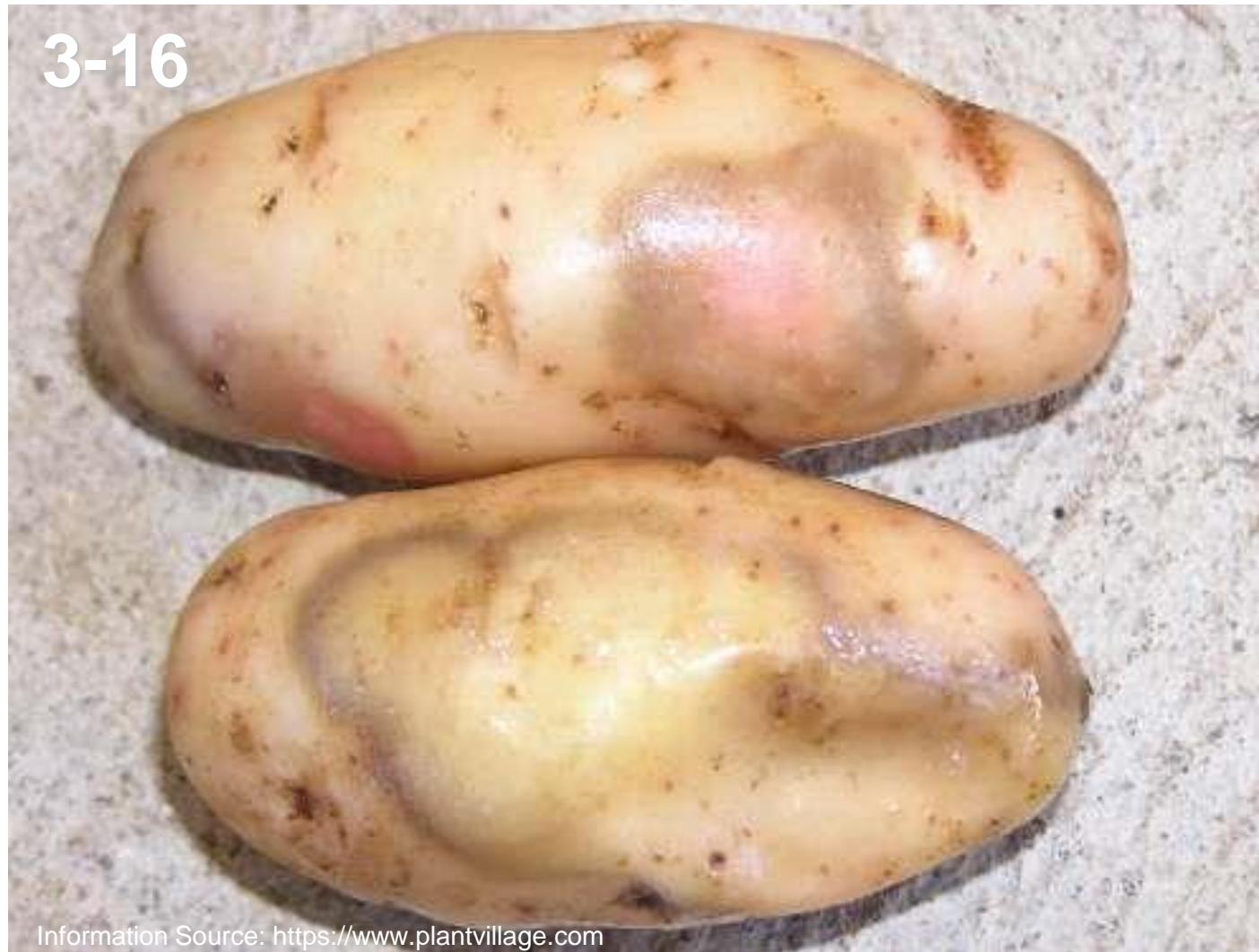
#### Symptoms:

- First, **oval or angular dark brown to black “target” spots** appear on leaflets
- Usually, a **narrow chlorotic zone** is around the spot which fades into **the normal green**
- Lowest, oldest leaves are infected first, and they **droop** and **dry** as the disease progresses and eventually fall off

#### Control:

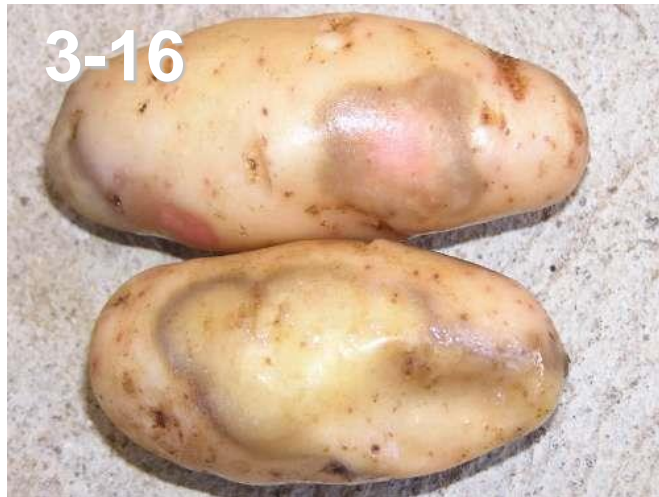
- Use **certified seeds**
- Good field sanitation by rouging
- When using own seeds, carry out **hot water treatment**
- Practice **Crop Rotation**
- Destroy all infected crop residue
- **Spray with appropriate fungicides**, such as
  - **Protective:**
    - Antracol®** (a.i. Propineb)
    - Dithane M45®** (a.i. mancozeb)
    - Nando®** (a.i. Fluazinam)
  - **Curative:**
    - Ridomil Gold®** (a.i. metalaxyl + mancozeb)
    - Milraz®** (a.i. Propineb 70 % + Cymoxanil 6 %)
    - Victory®** (a.i. metalaxyl + mancozeb)

## 3.8.4.d: Bacterial Soft Rot



**Potato tubers infected by Bacterial Soft Rot**

## 3.8.4.d: Bacterial Soft Rot



**Potato tubers  
infected by Bacterial  
Soft Rot**

### 3.8.4.d: Bacterial Soft Rot

- The disease is caused by **the bacteria: *Erwinia spp.***
- It enters the plant through **wounds** on leaves or **stems** near the soil surface and **young tubers**
- The disease development is favoured by **high temperatures and humidity**
- The bacteria is spread by **rain splash**
- **In poorly drained fields**, tubers decay
- The infected tubers and soils acts as **a source of inoculum in subsequent years**

#### **Symptoms:**

- Stems and leaves develop lesions which are **water soaked, dark green** and eventually develops to **a soft rot with a foul odour**
- On tubers, **reddish brown spots** form at the lenticels
- The inner parts of the tubers shows **a soft rot and a creamy exudate** is seen and may decay during transportation or storage in **poorly ventilated, high temperature and humidity**

#### **Control:**

- Practice crop rotation with crops such as cereals
- Use of **healthy seed tubers**
- Improved **field drainage**
- Store and transport tubers in **dry, well ventilated conditions**
- Field hygiene
- Crop rotation
- Sorting before storage

# 3.8.4.e: Potato Leaf Roll Virus (PLRV)



Information Source: <http://www.forestryimages.org>

**PLRV-infected plant next to an uninfected potato plant**

## 3.8.4.e: Potato Leaf Roll Virus (PLRV)



**PLRV-infected plant next to an uninfected potato plant**

### 3.8.4.e: Potato Leaf Roll Virus (PLRV)

- This is an important potato disease which occurs in **all potato growing areas**
- It is transmitted by **aphids**.
- The virus is also spread through **infected tubers** and diseased **volunteer plants**

#### Symptoms:

- In plants infected through aphid transmission, **the apical leaves roll upwards** and occasionally become **pinkish in color**
- In plants infected through use of infected seed tubers, **the lower leaves roll upwards** (after sprouting) and becomes **spoon-like**
- Severely affected leaves develop a **tubular shape**
- Plants are **stunted** and plants develop small tubers
- If these tubers are used as seeds, plants are stunted and crop produces very low yields

#### Control:

- **use appropriate agronomy practice**
- **Use of chemicals**, such as
  - **Nuprid 200 SC** (a.i. Imidacloprid)
  - **Karate Zeon** (a.i. Lambda Cyhalothrin)
- Use of **virus-free seed tubers**

# 4. Harvest



**Farmers harvesting and bagging Potatoes**

# 4. Harvest



**Farmers harvesting  
and bagging  
Potatoes**

## 4. Harvest

### 4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- **Maturity Period:** Range between **3 – 4 months** after planting depending on the variety
- Tubers harvested while still immature tend to have **low dry matter content** and to suffer **more skin damage**, resulting in easier infection by **fungal and bacterial pathogens**
- However, **seed potatoes are often harvested early**, to avoid virus infection that may occur during the latter part of the growing season

#### Important Notes:

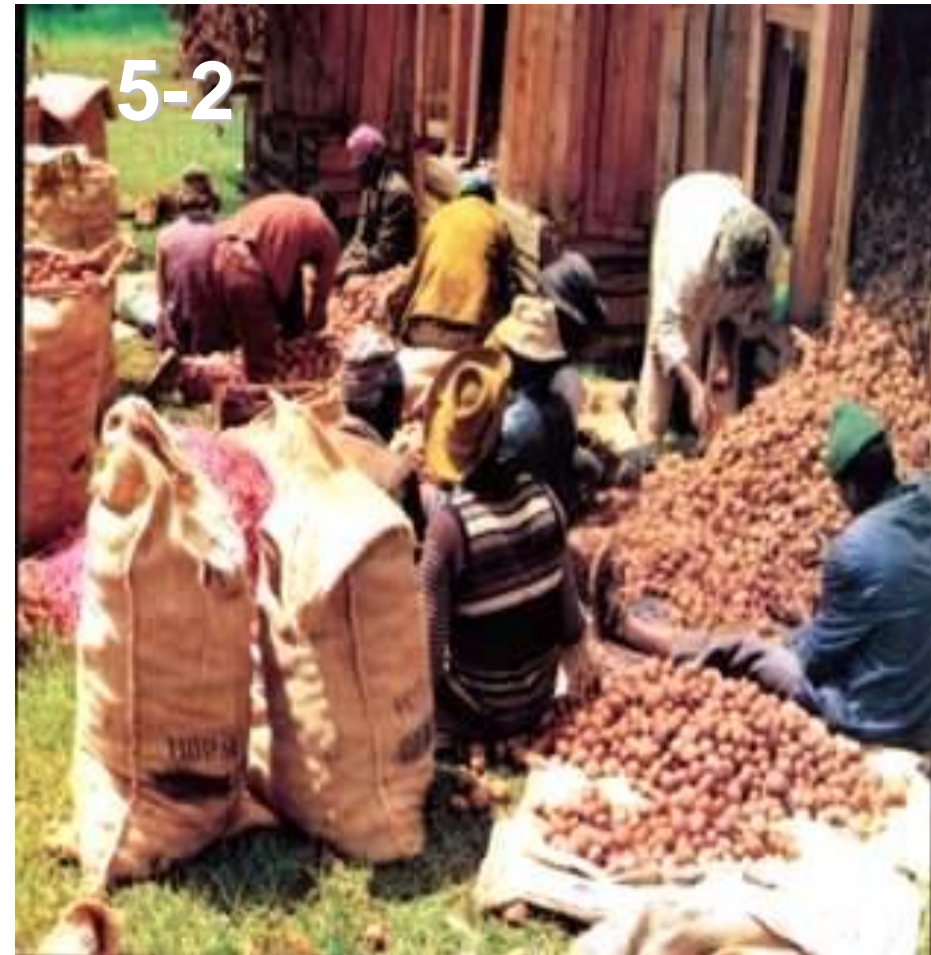
- Tubers should be **completely covered with soil** to **reduce greening** and **entry of potato tuber moth**
- Cutting vegetative material **2 weeks before harvesting** hardens the skin of tubers (**dehaulming**). Hardening of skin tuber reduces **damage of tubers** during harvesting & post-harvest handling
- The skin of the tubers will be properly set (or matured) about 2 weeks after the plants have died
- Dug potato tubers should be stored **clean, dry** with mature skins free from **wounds, insect pests** and **diseases**

**Yields:** Average yield in Ethiopia : **350-400 qt/ha** (Yields potential:520 **qt/ha**)

- Depending on **variety** and **degree of maturity at harvesting**, potatoes can keep for **1 – 2 months** before sprouting
- Mature Potato can be **dehulmed (cutting the leaves)** and left in soil for **1– 4 months** (depending on the availability of market)



# 5. Post-Harvest Handling



## Packing Potatoes in sacks and baskets

# 5. Post-Harvest Handling



**Packing Potatoes in sacks and baskets**

## 5. Post-Harvest Handling

### 5.1 Containers & Packaging Materials (GHCP&PHHT20: Q18)

- Potatoes are supposed to be sold in the standard **50 kg sacks** in the markets

### 5.2 Value Addition Techniques: Cleaning, Sorting, Grading, & Processing (GHCP&PHHT20: Q19)

#### Sorting:

- **Diseased, cut and mis-shapen tubers** are sorted out to avoid losses in storage due to rotting

#### Grading:

- Potatoes are graded depending on **size and shape of tuber**
- Tubers of are graded into:
  - **Ware: > 55mm**
  - **Seed: 45 – 55 mm** in diameter
  - **Seed: 25 – 35 mm** in diameter

#### Storage:

- **Ware Potatoes**
- Ware tubers should be kept in a dark store to prevent greening
- The store should be cool and well ventilated
- **Seed Potatoes**
- **Seed potatoes** are kept in a **cool store with diffuse light** for coloured, short sprouts to develop, however, avoid **direct sunlight**

# 5. Post-Harvest Handling Cont'

5-3



**Ware house  
potato storage**

5-4



**Defused light potato  
storage**

# 5. Post-Harvest Handling Cont'

5-3



**Ware house potato storage**



5-4

**Defused light potato storage**

## 5. Post-Harvest Handling

### 5.3 Ware house

#### Storage:

#### Ware Potatoes

- Ware tubers should be kept in a dark store to prevent greening
- The store should be cool and well ventilated

#### Seed Potatoes

- **Seed potatoes** are kept in a **cool store with diffuse light** for **coloured, short sprouts** to develop, however, avoid **direct sunlight**

# 6. Cost & Income Analysis

Item	Quantity	Unit Price	Total (ETB)
<b>Marketable Yield</b>			
<b>Variable Costs</b>			
Land Preparation			
Manure/Compost			
Seeds			
Fertilizers			
Fungicides			
Insecticides			
Others e.g.) selective Herbicides			
<b>Labour</b>			
Planting			
Spraying/Weeding/Harvesting/Grading			
Transportation/Packaging			

# 6. Cost & Income Analysis

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Insecticides			
Others e.g.) selective Herbicides			
<b>Labour</b>			
Planting			
Spraying/Weeding/Harvesting/Grading			
Transportation/Packaging			

**A sample sheet of items and activities to be considered for determining an enterprise's gross margin**

## 7. Cost & Income Analysis

- Farmers are encouraged to keep accurate records of all enterprise activities **(GHCP&PHHT20: Q20)**
- This is vital in determining the enterprise profitability
- Record keeping is very important for farmers practicing commercial agriculture

**There are 2 types of records:**

### •Individual Records:

- Kept by individual farmers and include the cost of production and sales
- Useful in analyzing whether the farmer is making profit or losses in his farming enterprise
- Records are very important for traceability of produce

### •Group Records:

- Include activities such as group purchase of inputs, selling of produce etc.

# 7. Post-Training Evaluation Exercise

QUESTION	YES	NO
1. Potato is the fourth most important food crop in Ethiopia		
2..Temperature higher than 29°C will prevent tubers formation		
3. Market survey enable buyers to understand the price of potato during the peak demand.		
4. Potato planting calendar should be prepared before the market survey.		
5. Excessive nitrogen will promote root growth and increase total yield		
6. Ridging potato plants is an important crop practice to cover up the tubers and prevent greening and attack by potato moth.		
7. Late Blight is one of the most destructive disease, but it is possible to control with fungicide if start spraying at the beginning of the symptoms		
8. “Bacterial Wilt” causes wilting of potato plants even when there is adequate moisture.		
9. Maturity period of Potato is 5 – 6 months after planting.		
10. Grading is one of the value addition techniques which farmers can do right after the harvest.		

# 7. Post-Training Evaluation Exercise

\* Please ask the farmers to appropriately indicate answers to each of the following questions.

PAGE NUMBER	QUESTION	YES	NO
1/35	1. Potato is the fourth most important food crop in Ethiopia	✓	
4/35	2..Temperature higher than 29°C will prevent tubers formation	✓	
6/35	3. Market survey enable buyers to understand the price of potato during the peak demand		✓
8/35	4. Potato planting calendar should be prepared before the market survey.		✓
15/35	5. Excessive nitrogen will promote root growth and increase total yield		✓
18/35	6. Ridging potato plants is an important crop practice to cover up the tubers and prevent greening and attack by potato moth.	✓	
26/35	7. Late Blight is one of the most destructive disease, but it is possible to control with fungicide if start spraying at the beginning of the symptoms	✓	
27/35	8. “Bacterial Wilt” causes wilting of potato even when there is adequate moisture.	✓	
31/35	9. Maturity period of Potato is 5 – 6 months after planting.		✓
32/35	10. Grading is one of the value addition techniques which farmers can do right after the harvest.	✓	

**[Note]**

- If there is any question which half of the participants gave the wrong answer, you need to repeat the specific area regarding to question