

KALE PRODUCTION



SHERP

Training Title: Kale Production

Objective: To provide a guideline on production of Kale

Specific Objective:

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

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, 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



Source <https://farmerstrend.co.ke/complete-guide-plant-best-sukuma-wiki-kales-kenya/>

Harvesting Kale

1. Introduction:

1.1 Background



Harvesting Kale

1. Introduction

1.1 Background

- Kale is a member of the ***Brassicaceae*** family which includes crops such as **Cabbage, Cauliflower, Broccoli, and Radish**
- A popular **leafy vegetable** in Ethiopia grown mainly for the domestic market
- **High in iron** which is essential for good health
- **Rich in vitamin K** which helps in protecting the body against various cancers
- Has anti-inflammatory properties which helps in fighting against **asthma, arthritis** and **autoimmune disorders**
- Other vitamins present include **Riboflavin** and **Niacin**
- A source of income for most smallholder farmers
- Has a **lower cost of production** compared to other horticultural crops

1.2 Some Common Varieties Cont'



“Ethiopian Kale (yabesha gomen)”

1.2 Some Common Varieties Cont'



“Ethiopian Kale (yabesha gomen)”

1.2 Some Common Varieties Cont'

“Ethiopian Kale (*Brassica carinata*,)”

- It is also known as **Ethiopian mustard**, **Ethiopian rape**, **Abyssinian mustard** in English
- Locally known as **yabesha gomen** in Amharic language
- The cultivation of **yabesha gomen** as oil crop is restricted to Ethiopia
- As a leafy vegetable it is often grown in East and southern Africa, less so in West and Central Africa.
- Very perishable unlike other varieties
- **Yield: 15 tons per hectare**

1.2 Some Common Varieties



“Collards”



“Thousand Headed”

1.2 Some Common Varieties



“Collards”



“Thousand Headed”

1.2 Some Common Varieties

- “Collards” and “Thousand Headed” are some of the common varieties

“Collards”:

- Tolerant to **Soft Rot** and **Black Rot**
- Widely adapted even to warmer areas
- Flowers after a **short period of harvesting**
- **Yield: Up to 20 - 25 tons / ha**

“Thousand Headed”:

- It has smaller leaves than Collard and is slow growing compared to other varieties
- It has long harvesting time
- A popular variety with succulent leaves
- Extended **production period of up to 3 months**
- **Yield: 25 – 30 tons/ha**

1.3 Optimal Ecological Requirements

Altitude	800 – 2,200 meter above sea level
Rainfall	750 mm of rainfall
Growing Temperature	17 – 22 °C
Soils	<ul style="list-style-type: none">• Well drained loam soils• High organic matter content• pH range 5.5 – 7.0

1.3 Optimal Ecological Requirements

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Rainfall	750 mm rainfall
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Soils	<ul style="list-style-type: none">• Well drained loam soils• High organic matter content• pH range 5.5 – 7.0

1.3 Optimal Ecological Requirements

Kales can grow almost anywhere in Ethiopia. The following are the optimal ecological requirements.

- **Altitude:** The optimum altitude range is **800 – 2,200 m** above sea level. In lower or higher altitudes, use the recommended varieties
- **Rainfall:** A high water requirement throughout the growing period and **750 mm** of rainfall is considered optimal. Rainfall should be well distributed throughout the growing period is required.
- **Temperature:** Kale perform well under cool temperatures & the optimum temperature range for production is **17 – 22 °C**
- **Soil:** Kale requires **fertile, well-drained loam soils** with high organic matter content and high water holding capacity. The optimal soil pH range is **5.5 – 7.0**

2. Pre-Cultivation Preparation:

2.1 Market Survey



Carrying out a market survey

2. Pre-Cultivation Preparation:

2.1 Market Survey



Carrying out a market survey

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)	Kale (Collards)	Large size leaf, Fresh leaf	January to March	8-10qt/week (1 qt = 40 kg)		10 ETB / bunch	Cash	Cash on Delivery	Quality problems (transport damage)	Willing to buy at shop
Mr. Kernal Husen (0911-xxxxxx)	Kale (Yabesha gomen)	Medium to Large size	February to April	2qt/day		8 ETB / bunch	Cash	Cash on Delivery	Poor quality (freshness)	Willing to buy at farm gate

2. Pre-Cultivation Preparation:

2.2 Market Survey

Market Survey Questionnaire

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

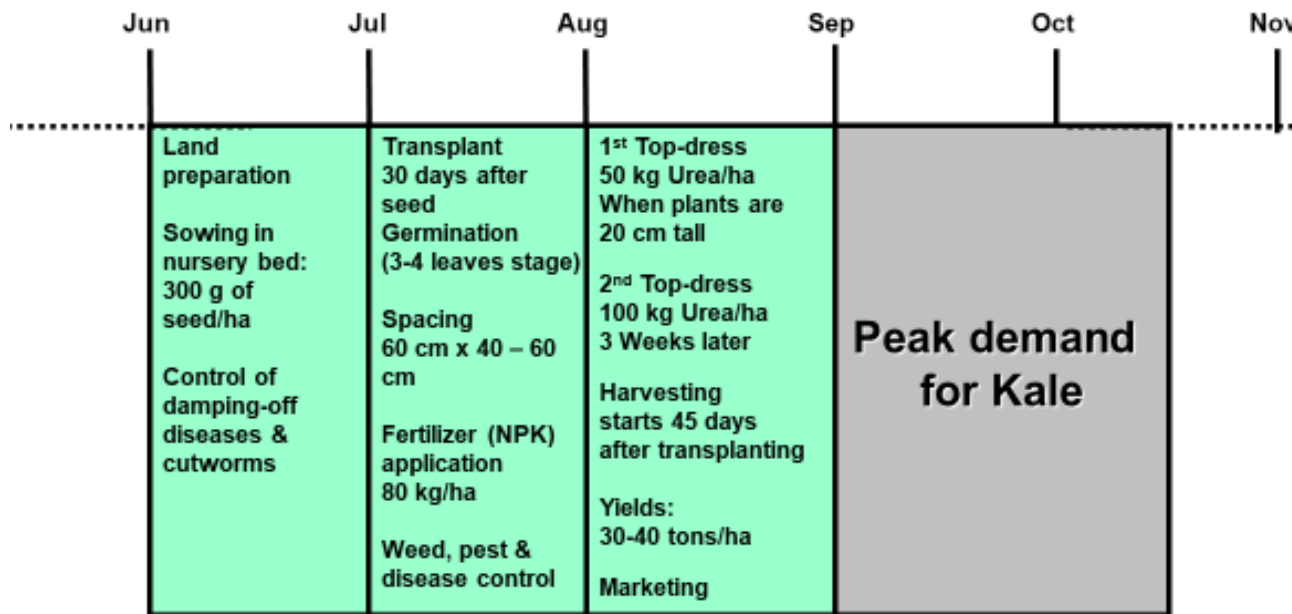
Market Survey Questionnaire

2.2 Crop Planting Calendar

A Sample of a Kale Planting Calendar

Jun	Jul	Aug	Sep	Oct	Nov
<p>Land preparation</p> <p>Sowing in nursery bed: 300 g of seed/ha</p> <p>Control of damping-off diseases & cutworms</p>	<p>Transplant 30 days after seed germination (3-4 leaves stage)</p> <p>Spacing 60 cm x 40 – 60 cm</p> <p>Fertilizer (NPK) application 80 kg/ha</p> <p>Weed, pest & disease control</p>	<p>1st Top-dress 50 kg Urea/ha When plants are 20 cm tall</p> <p>2nd Top-dress 100 kg Urea/ha 3 Weeks later</p> <p>Harvesting starts 45 days after transplanting</p> <p>Yields: 30-40 tons/ha</p> <p>Marketing</p>	<p>Peak demand for Kale</p>		

2.2 Crop Planting Calendar



A Sample of a Kale 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

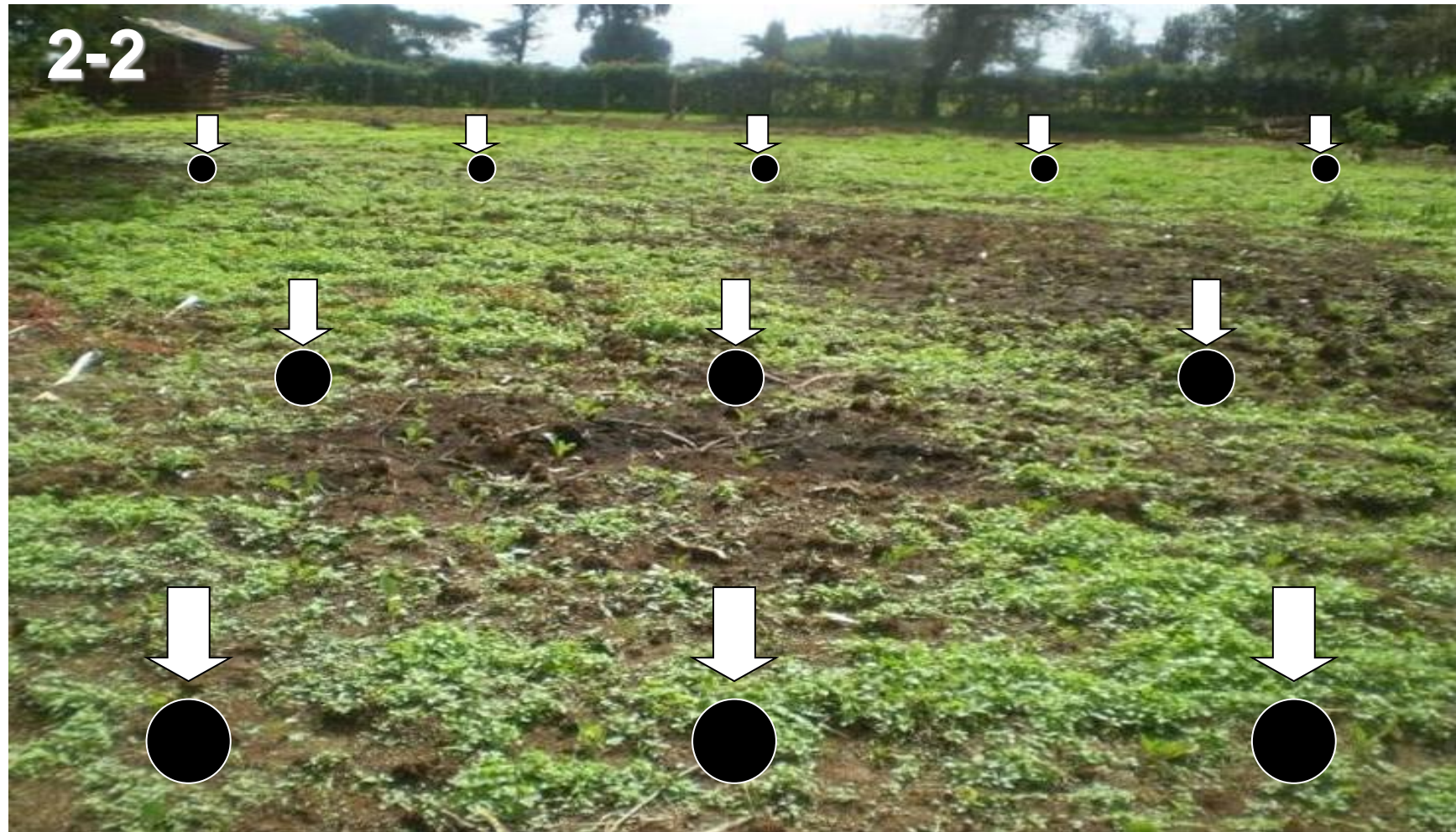
Procedure:

1. Determine from the market survey results (2.1) when there is peak demand for Kale
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

Notes:

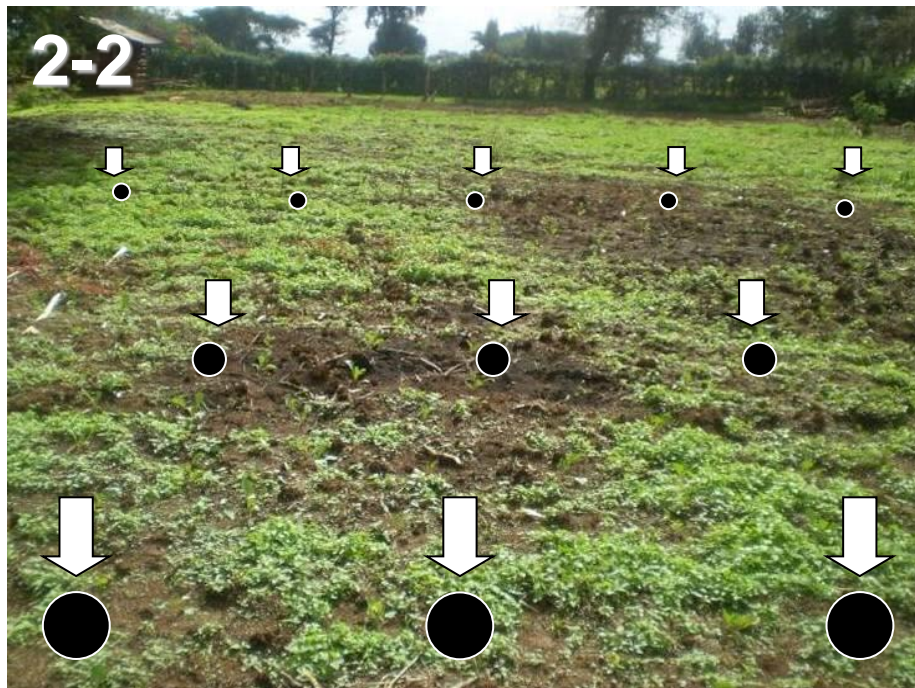
- To meet the peak demand period of the market, there may be need of supplemental irrigation

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 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

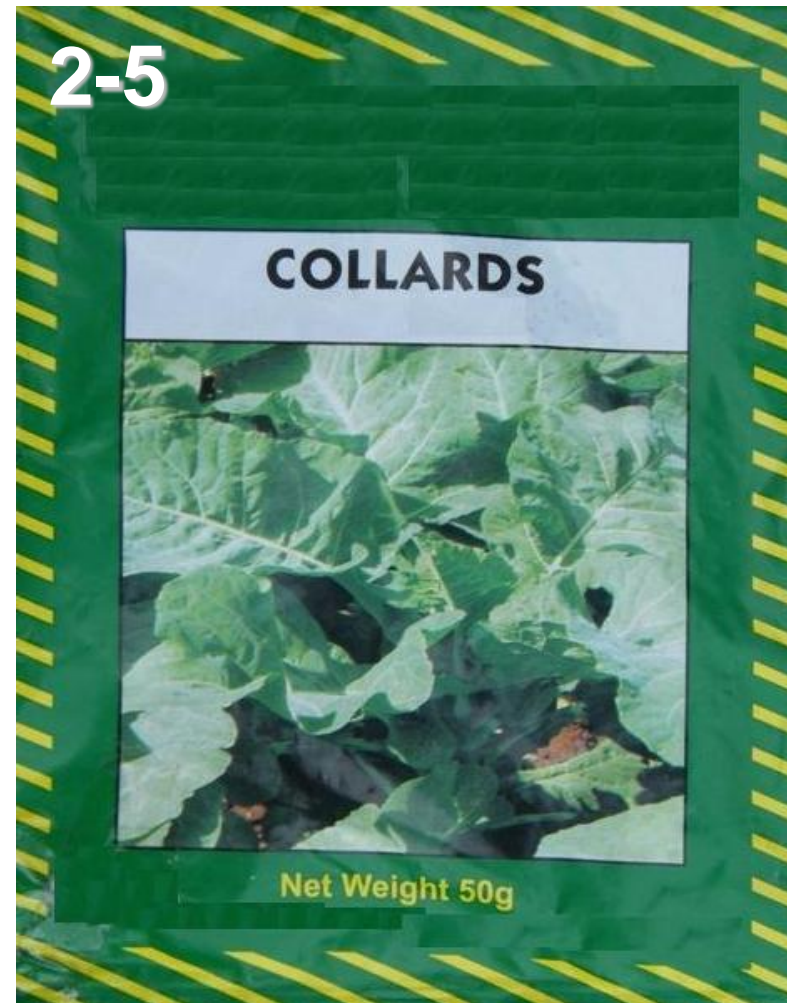
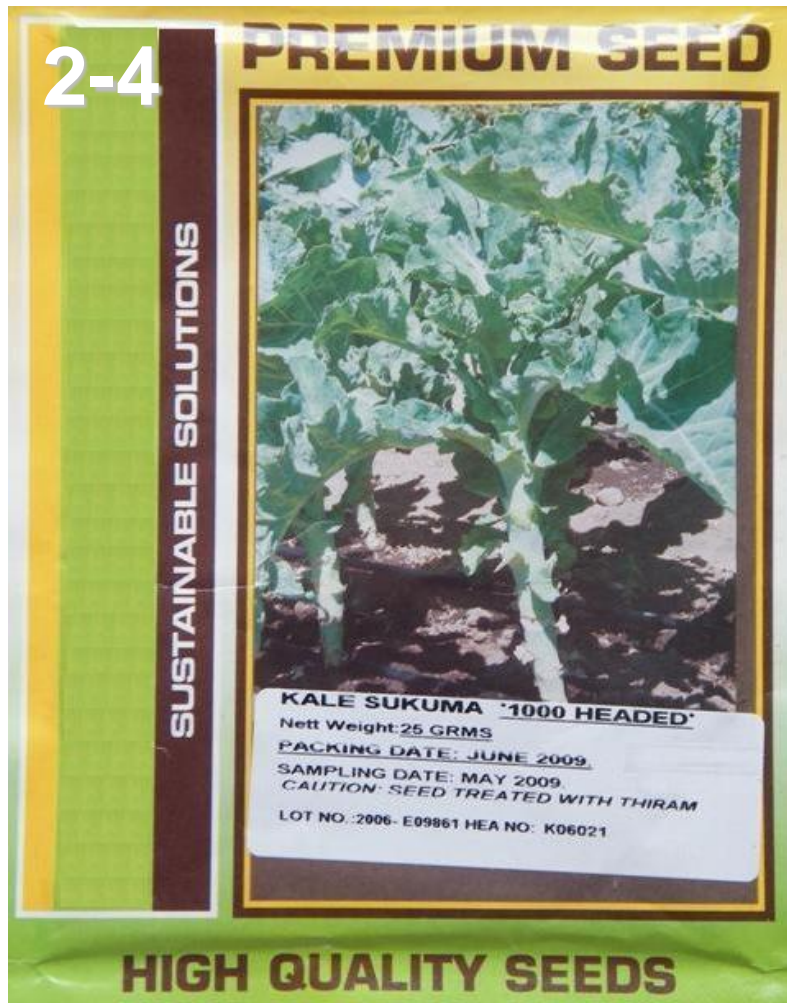


Manure preparation through composting

2.4 Composting (GHCP&PHHT20: Q4)

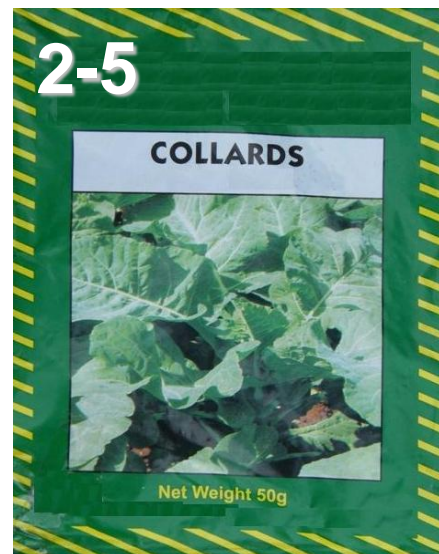
- During compost making, the organic matter need to be covered to prevent leaching of nutrients
- Kale like most leafy vegetables **is a heavy feeder** and does well in soils with high organic matter (manure)
- Based on the results of the soil analysis, prepare adequate compost for application; the recommended rate of application ranges from **20 tons/ha** for Kale

2.5 Quality Seed/Planting Materials



Samples of certified seeds on sale

2.5 Quality Seed/Planting Materials



Samples of certified seeds on sale

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

- Kale is propagated by use of seeds
- Ensure you purchase **certified seed** from **authorized dealers, research station or certified seed producers**
- Seed should be checked for their **purity percentage, germination percentage** and **expiry date**
- Purchase **just enough seed** for the season

3. Cultural Practices:

3.1 Land Preparation



**Raised beds prepared for transplanting
of Kale**

3. Cultural Practices:

3.1 Land Preparation



Raised beds prepared for transplanting of Kale

3. Cultural Practices:

3.1 Land Preparation

Land Preparation Practices:

(GHCP&PHHT20: Q6)

- Soils should be ploughed sufficiently to eliminate debris and clods
- Plough the field to a depth of **20 – 30 cm**
- The field should be ploughed to a fine tilth
- Early land preparation is recommended in order to expose pest to sunlight and birds
- It is recommended that the land be ploughed at least **1 month** before planting

3.2 Incorporation of Crop Residues

3-2



Crop residues to be incorporated in a field

3.2 Incorporation of Crop Residues

3-2



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 incorporated at a depth of about **30 cm** at least **1 – 2 months before transplanting** the Kales
- If the crop residues belong to the Brassicacea family (such as broccoli, cabbage, cauliflower, radish, kale (sukuma) etc.), **remove and burn it to avoid possible risk of disease build up**

3.3 Basal Application



Manure incorporation as a basal application

3.3 Basal Application



3.3 Basal Application (GHCP&PHHT20: Q8)

- The manure/compost should be broadcasted (**20 tons/ha**) then worked into the soil (incorporated) preferably using a hoe
- Manure/compost should be applied **1 – 2 weeks** before transplanting the Kale

Manure incorporation as a basal application

3.4 Raising Seedlings



Kales nursery established by a farmer

3.4 Raising Seedlings



Kales nursery established by a farmer

3.4 Raising Seedlings (GHCP&PHHT20: Q9)

- Use certified seed with special attributes, such as tolerance/resistance to pest and diseases and high yielding
- The seed rate is about **300 g per ha**

Nursery Site Selection:

- The nursery should be located in a plot that has not been planted with crops in the ***Brassicacea*** family for at least three (3) years

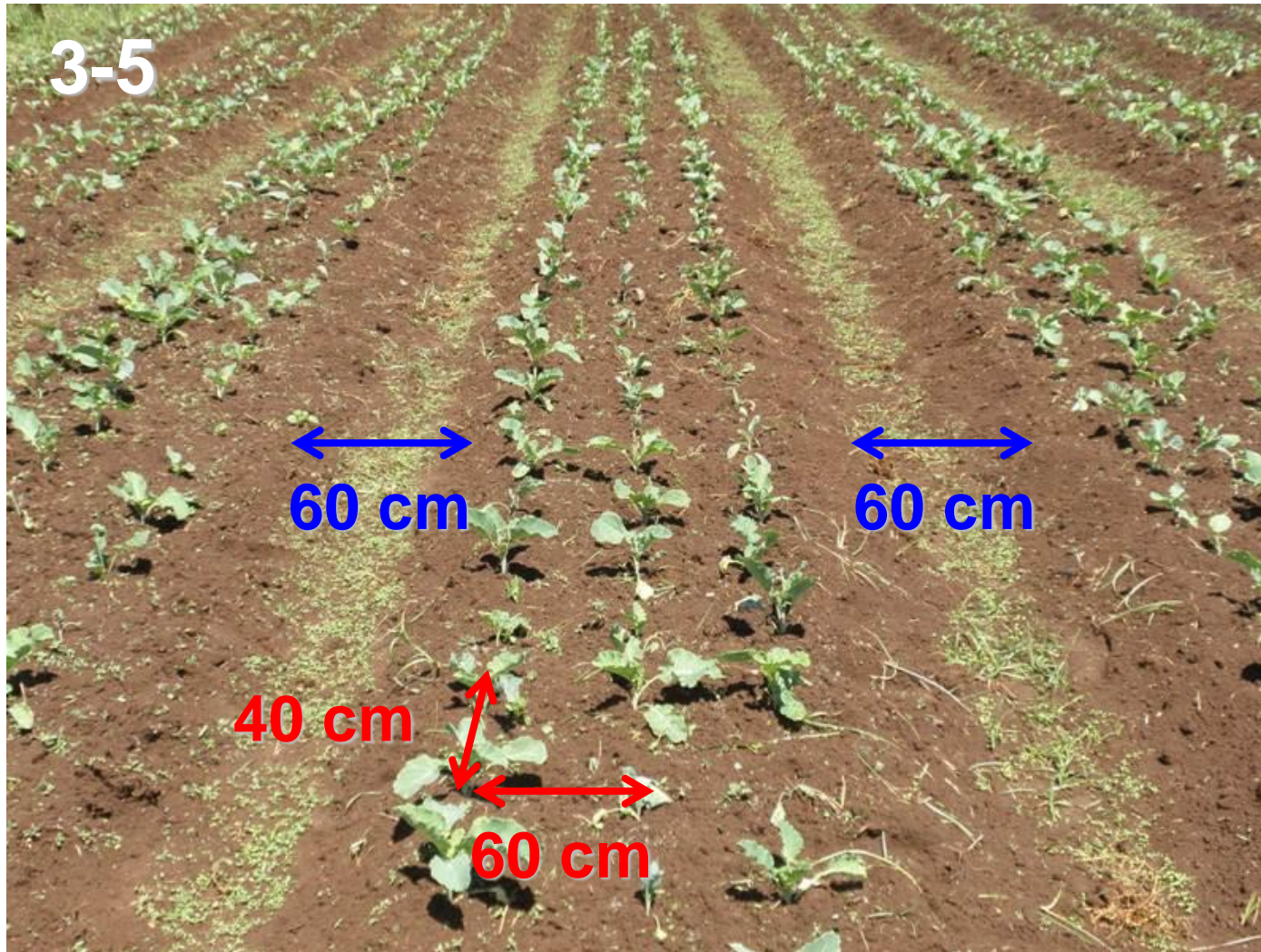
Nursery Establishment:

- Prepare a seed bed of **1 m** width and of convenient length
- Make **2 cm deep drills** on the seed bed at a spacing of **10 – 15 cm** apart
- Thinly sow the seeds in the drills and cover lightly with soil

Management of Nursery:

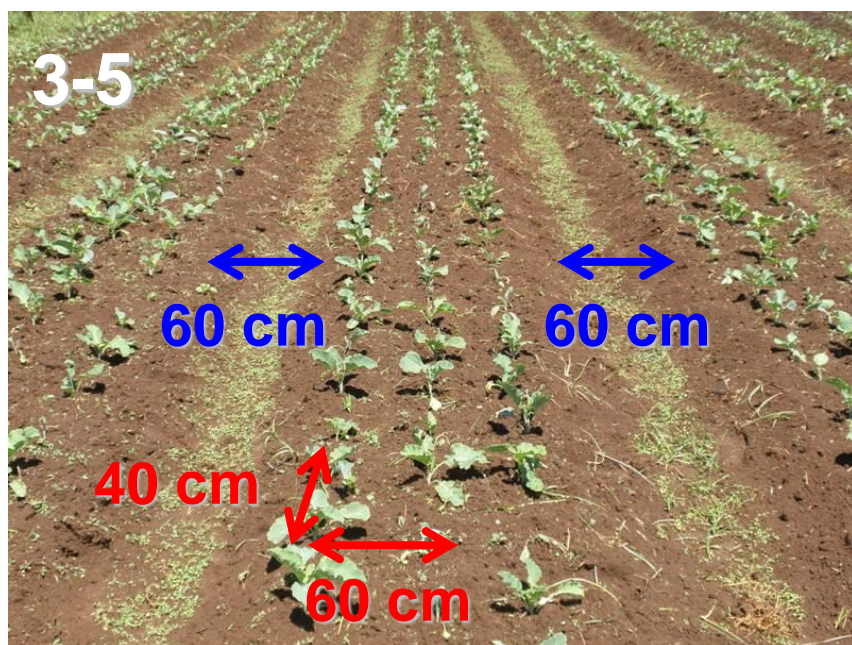
- Water the seedlings regularly
- Avoid over-watering which can lead to “**Damping-off**” disease
- Start hardening the seedlings **1 – 2 weeks** before transplanting by reducing the frequency of watering and the shade over the nursery

3.5 Transplanting



Kale seedlings transplanted on raised beds

3.5 Transplanting



Kale seedlings transplanted on raised beds

3.5 Transplanting

3.5.1 Appropriate Time

- Seedling should be transplanted **30 days** after seed germination
- Transplanting should be done either **early in the morning** or **late in the evening**
- In case farmers did potting, the seedlings can be transplanted **more than 30 days after germination**

3.5.2 Recommended Spacing (GHCP&PHHT20: Q10)

- Transplant the seedling at a spacing of **60 cm** between rows and **40 – 60 cm** between plants depending on the variety

3.5.3 Fertilizer Application Rates (GHCP&PHHT20 Q11)

- In case manure/compost is to be applied during transplanting, apply **1 – 2 handfuls** per hole (**12 – 20 tons/ha**)
- Apply **80 kg/ha** of NPS (**8g/m²** / **one heap of water bottle cap**)

[Note]

- Only thoroughly composted manure should be used to avoid possible introduction of pests and diseases in the field
- The NPS should be mixed thoroughly with the soil to avoid possible scorching of the seedlings

3.6 Water Requirement



Source <https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/pdfs/Tom-Davis.pdf>

Supplementing Kale water requirement through furrow irrigation

3.6 Water Requirement



Supplementing Kale water requirement through furrow irrigation

3.6 Water Requirement

(GHCP&PHHT20: Q12)

- Kale requires an optimal amount of **750 mm** of rainfall during the growing period
- In areas with lower rainfall, water deficit problems should be addressed through irrigation
- Mulching is recommended because it helps in prevents **soil erosion**, **conservation of soil moisture**, **increase organic matter** into the soil after decomposition and suppresses splashing of rain or irrigation water and spread of diseases

3.7 Managing of Weeds



Farmer is weeding beds of Kale

3.7 Managing of Weeds

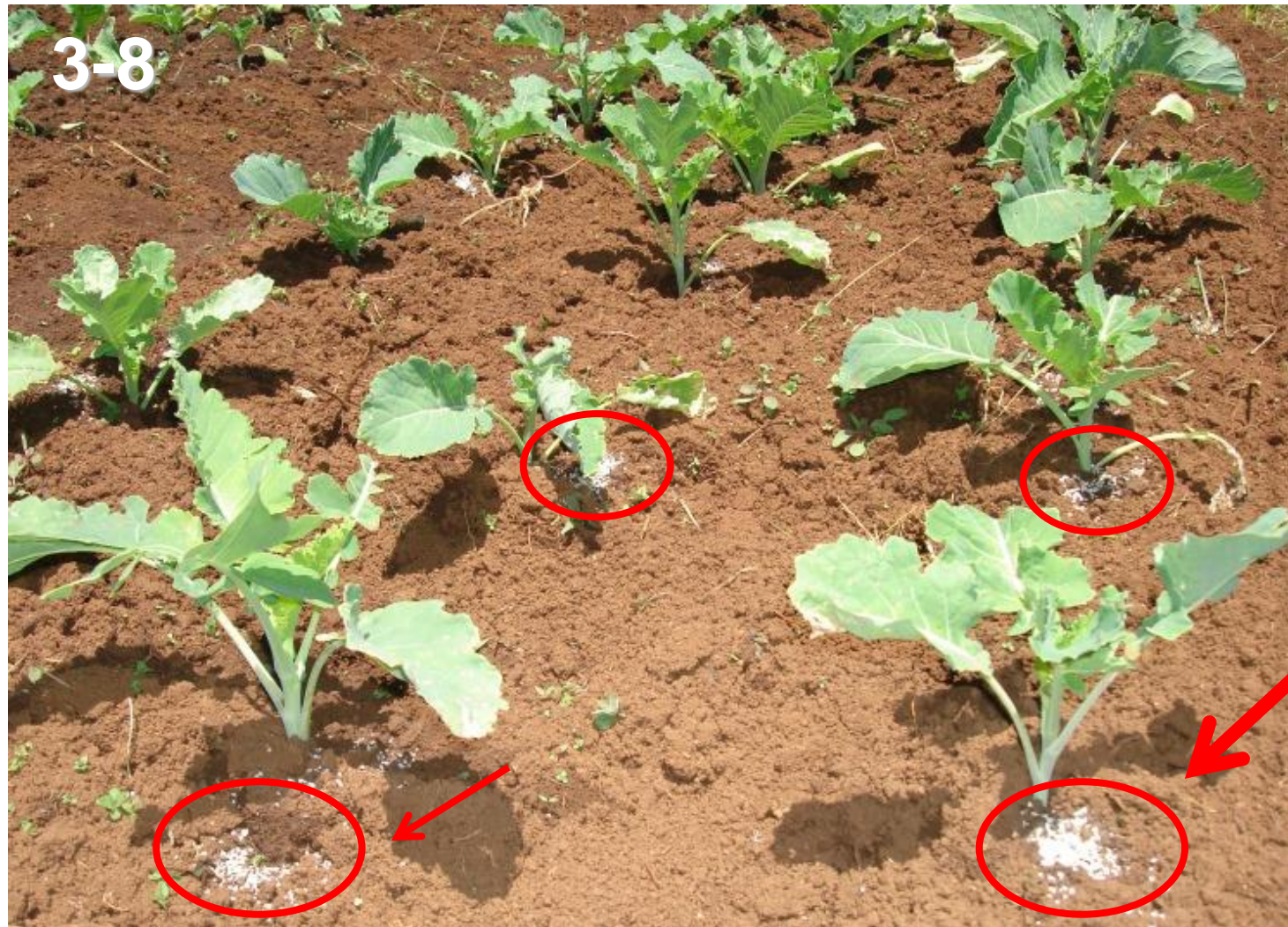


Farmer is weeding beds of Kale

3.7 Managing of Weeds (GHCP&PHHT20: Q13)

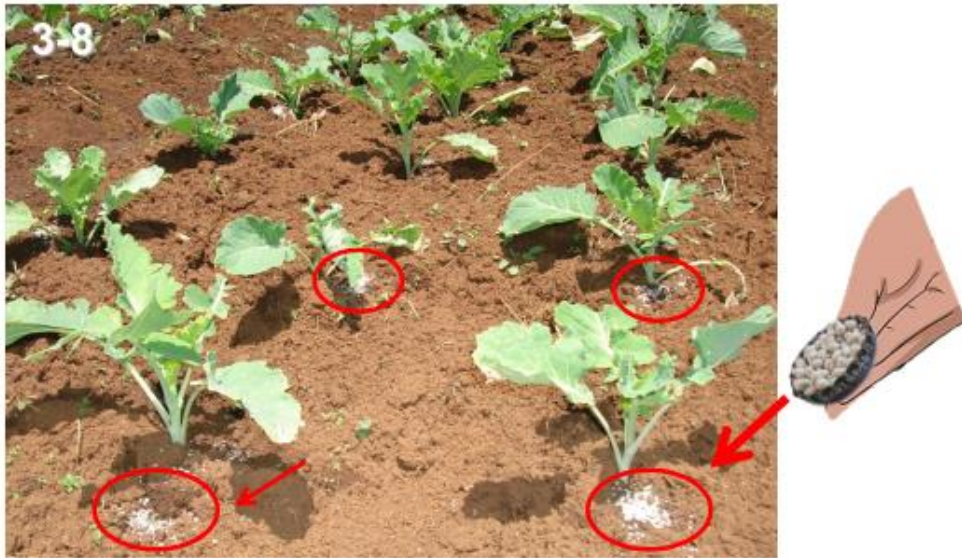
- Kale has a shallow root system, thus care should be taken to **avoid bruising the roots** during weeding
- This can be done through use of appropriate weeding tools
- The frequency of weeding depend on weed infestation
- Keep the field weed free as much as possible to avoid competition for **nutrients, sunlight, and moisture**

3.8 Top-dressing



Top-dressing using the placement method

3.8 Top-dressing



Top-dressing using the placement method

3.8 Top-dressing (GHCP&PHHT20: Q14)

- Two (2) split applications of UREA are recommended to replenish soil nutrient status
- First split is applied at a rate of **50 kg/ha** (1/2 Coca-Cola bottle top / plant) or (5g/ m²) when plant is 20 cm tall
- Second split application is applied at a rate of **100 kg per ha** (2.6 g Urea per plant (one Coca-Cola bottle top per plant or 10g/m²) 3 weeks later
- Placement method is recommended as it is more effective and economical
- After applying UREA, **cover them** with the soil
- If the soil is dry, you need to irrigate before applying fertilizer

3.9 Pests & Diseases Control

3.9.1. Control/Management Strategies

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

3.9 Pests & Diseases Control

3.9.1 Control/Management Strategies

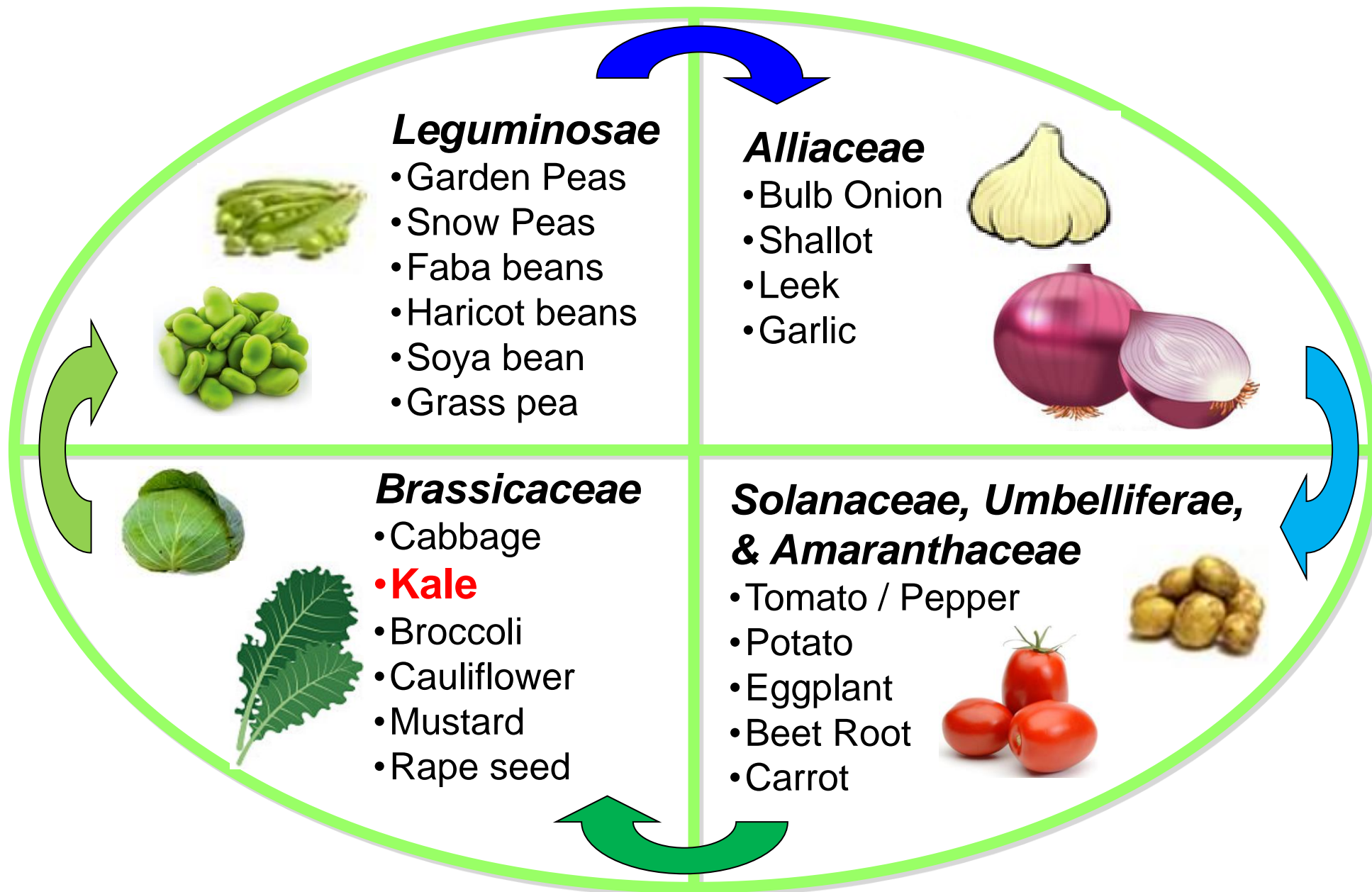
1.	Cultural Control
2.	Mechanical Control
3.	Biological Control
4.	Chemical Control
5.	Integrated Pest Management (IPM)

3.9 Pests & Diseases Control

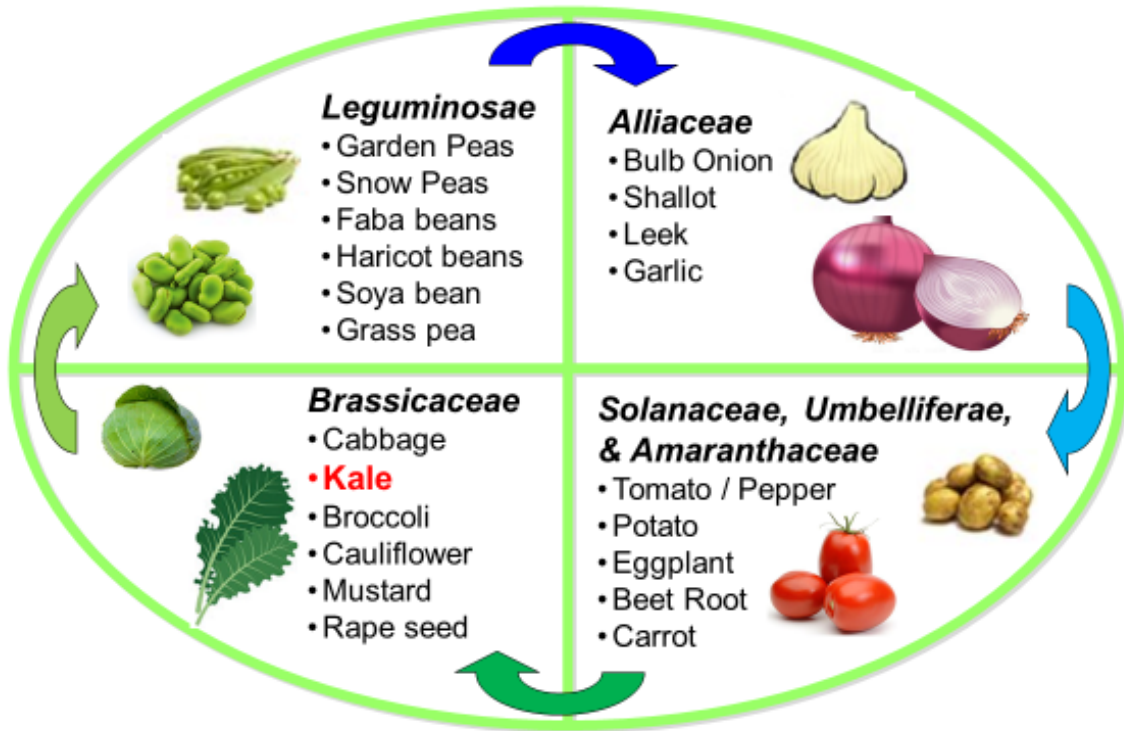
3.9.1 Control/Management Strategies (GHCP&PHHT20: Q15)

- 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.

3.9.2 Crop Rotation



3.9.2 Crop Rotation



An example of a Crop Rotation

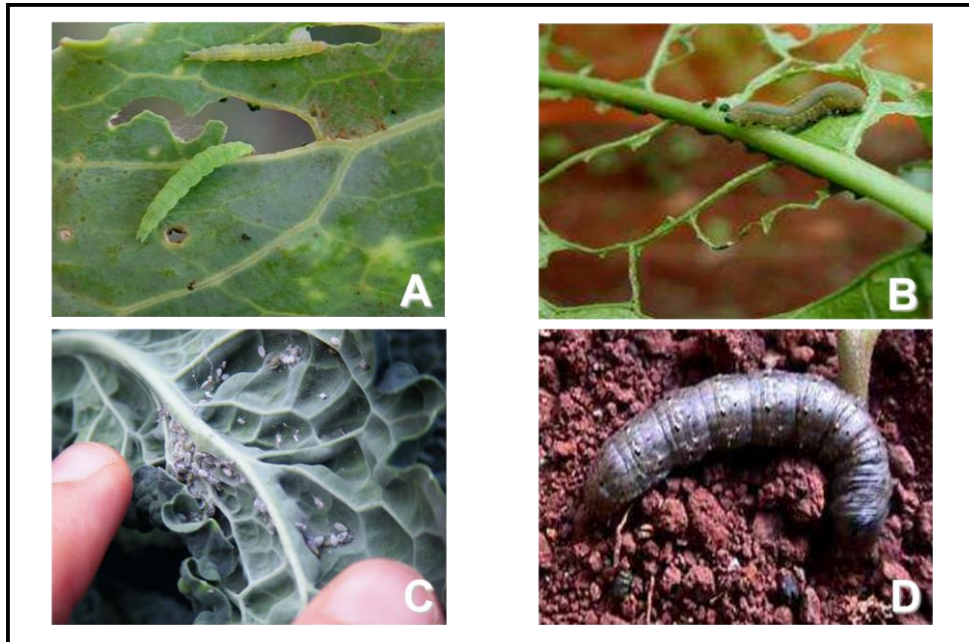
3.8.2 Crop Rotation

- 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
- A three-year rotation is advisable, mainly to reduce the risk of pest and disease build-up

3.9.3 Major Pests



3.9.3 Major Pests



3.9.3 Major Pests

- Pests damage causes a reduction in quality and quantity of produce
- Kale is generally more pest & disease resistant than other crops in the ***Brassicas*** family
- The following are the major pests of Kale in Ethiopia:
 - A. Diamond Back Moth (DBM)**
 - B. Cabbage Sawfly**
 - C. Aphids**
 - D. Cutworms**

3.9.3.A: Diamond Back Moth (DBM)



Information Source: www.infonet-biovision.org

“Windows” caused by DBM larvae on a leaf

3.9.3.A: Diamond Back Moth (DBM)



“Windows” caused by DBM larvae on a leaf

3.9.3.A: Diamond Back Moth (DBM)

Identification:

- The adult is a small grey moth whose wings form a characteristic diamond pattern at the back when closed
- Larvae are **pale yellowish-green to green caterpillars** covered with fine, scattered, erect hairs
- When disturbed, the larvae will wriggle backward violently and may drop from the plant, suspended by a silken thread

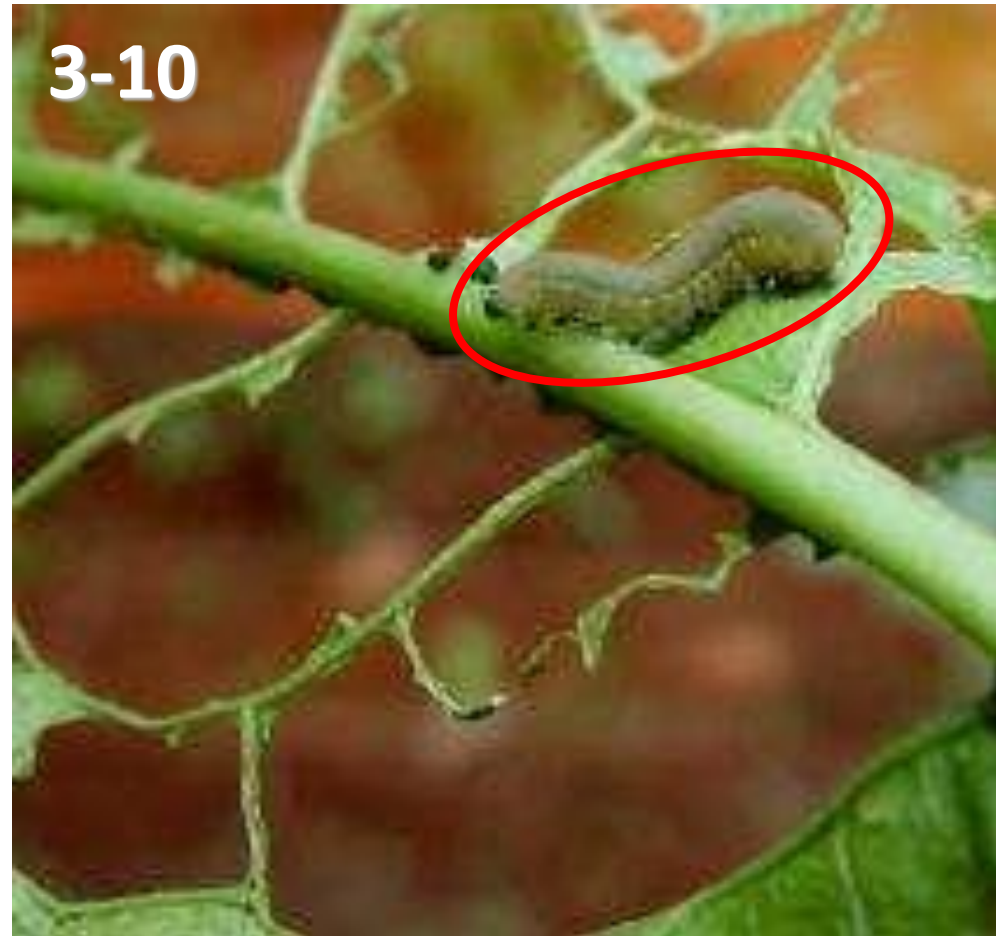
Damages:

- **Windows** on leaves from feeding by larvae
- If larvae are numerous, they may eat **the entire leaf**, leaving only the veins
- Infestations are normally **serious in drier months**

Control:

- **Use of pesticides**, such as
 - Delfin 6.4 W.G® (a.i. **Bacillus thuringiensis: Bt**)
 - Halt 5% WP® (a.i. **Bacillus thuringiensis: Bt**)
 - THURICIDE HP (a.i. **Bacillus thuringiensis: Bt**)
 - Match© 050 EC® (a.i. Lufenuron)
 - Legacy 5% EC® (a.i. Lufenuron)
 - Tata Umeme 2.5 EC® (a.i. **Lambdacyhalothrin**)
 - Avaunt 150 SL® (a.i. **Indoxacarb 150g/L**)
- **Intercropping: Intercropping with repellants** (e.g. **Tomato**)) reduces DBM destruction on Kale since tomato repels DBM.
- **Natural enemies:** Egg parasitoids of genera *Trichogramma* and larval parasitoids in the genera *Diadegma* among are some of the predominant and effective natural enemies.

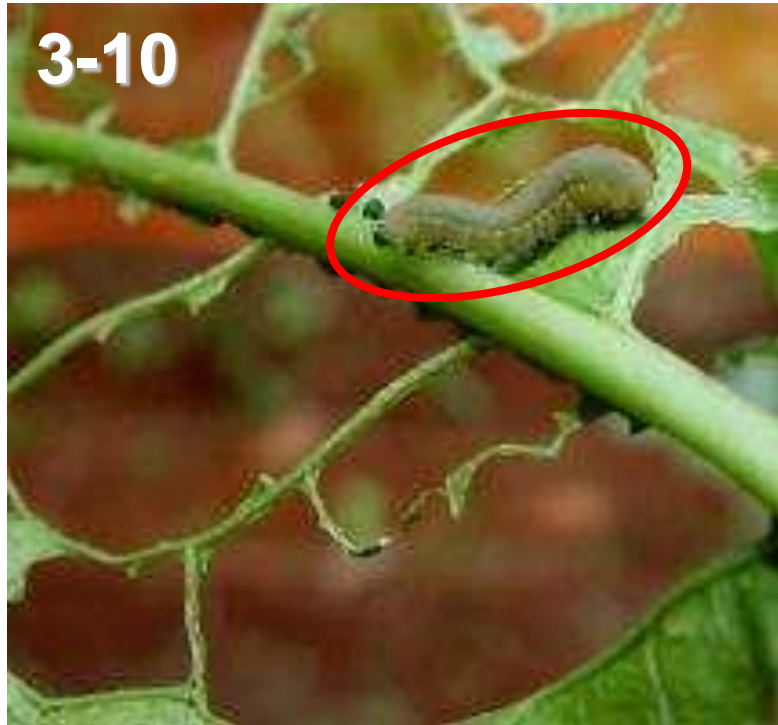
3.9.3.B: Cabbage Sawfly



Information Source: www.infonet-biovision.org

A “Cabbage Sawfly” larva feeding on a Kale leaf

3.9.3.B: Cabbage Sawfly



A “Cabbage Sawfly” larva feeding on a Kale leaf

3.9.3.B: Cabbage Sawfly

Identification:

- Adult insect resembles a fly except for the presence of 2 pairs of membraneous wings with dark head and thorax and bright abdomen
- Eggs are laid singly inside the leaf
- The **grayish green larvae** with a black head and more than six pairs of legs

Damage:

- They feed on the blade of the leaves often leaving only the main veins and midrib

Control:

- Destruction of wild plants in the cruciferae
- **Use of pesticides**, such as
 - **RUNNER 240 SC®** (a.i. **Methoxyfenozide**)
 - **Decis EC 2.5®** (a.i. **Deltamethrin**)

3.9.3.C: Aphids



Information Source: <http://www.urbanfoodwarrior.com>

Underside of a Kale leaf infested with Aphids

3.9.3.C: Aphids



**Underside of a Kale leaf
infested with Aphids**

3.9.3.C: Aphids

Identification:

- Aphids are **pale green** or light green to yellowish green and are usually covered with **a light dust of mealy powder**. But some types of aphids do not form mealy powder
- They suck plant sap from the central part of the plant and near the base of leaves

Damages:

- Aphid attack results in **curled, discoloured and distorted leaves**
- Large colonies of aphids are found on the underside of Kale leaves during drought causing stunted growth

Control:

- **Field hygiene** through removal and destruction of crop residue and alternative wild hosts
- **Use of insecticides**, such as
 - **Achook®** (a.i. **Azadirachtin**)
 - **Nimbecidine®** (a.i. **Azadirachtin**)
 - **Decis®** (a.i. **deltamethrin**)
 - **Atom EC®** (a.i. **deltamethrin**)
 - **Karate Zeon®** (a.i. **lambdacyhalothrin**)
 - **Actara 25 WG®** (a.i. **Thiamethoxam**)

3.9.3.D: Cutworms



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

A Cutworm larva

3.9.3.D: Cutworms



A Cutworm larva

3.9.3.D: Cutworms

Identification:

- The **grayish black larvae** that curl up tightly when disturbed
- They are often found **hiding in soil** near the cut seedlings

Damage:

- They **girdle** and **cut-off young seedlings at ground level** during the night dragging them into the tunnel in the soil and feed on them during the day

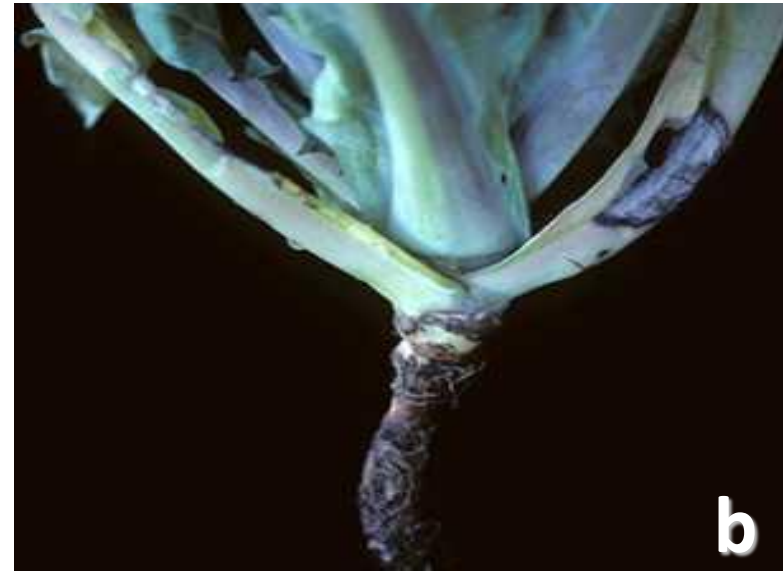
Symptoms:

- Cut stems
- Attacked plant **wilt** and **die**

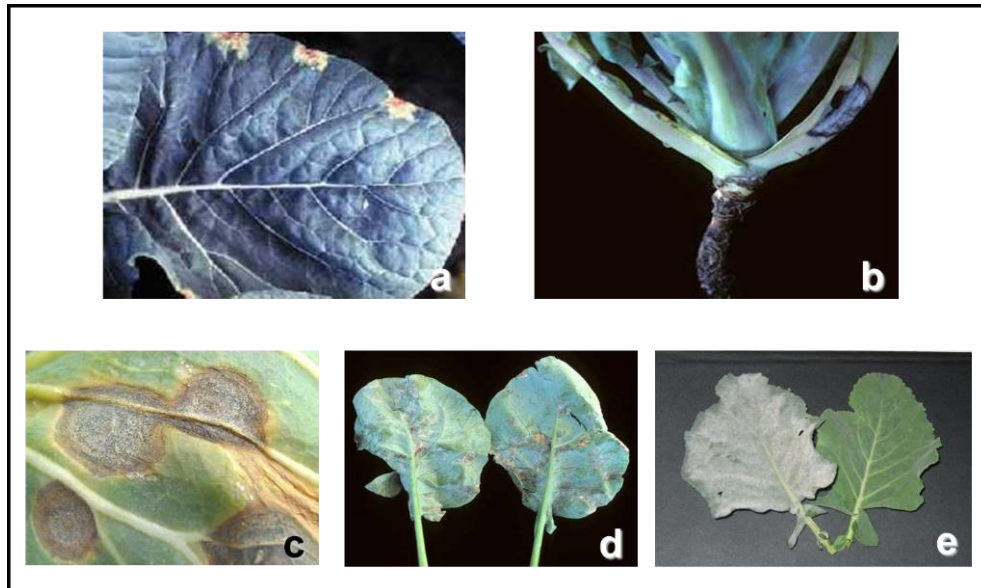
Control:

- **Hand removal** since the pest is easily found near the damaged plant, especially at the beginning of infestation
- **Early weeding** destroys sites for egg laying
- Flooding of the field for a few days before sowing or transplanting can help kill cutworm caterpillars in the soil
- Sprinkled wood ash lightly throughout the field. (Wood ashes repel cutworms, aphids, slugs and snails)
- Chemical control: Spray with pyrethroid insecticides (alpha-cypermethrin) during transplanting

3.9.4 Major Diseases



3.9.4 Major Diseases



3.9.4 Major Diseases

- Disease infestation leads to reduction in quality and quantity of produce
- The following are the major diseases of Kale in Ethiopia:
 - a. **Black Rot**
 - b. **Black Leg (Dry Rot Canker)**
 - c. **Ring Spot**
 - d. **Downey Mildew**
 - e. **Powdery Mildew**

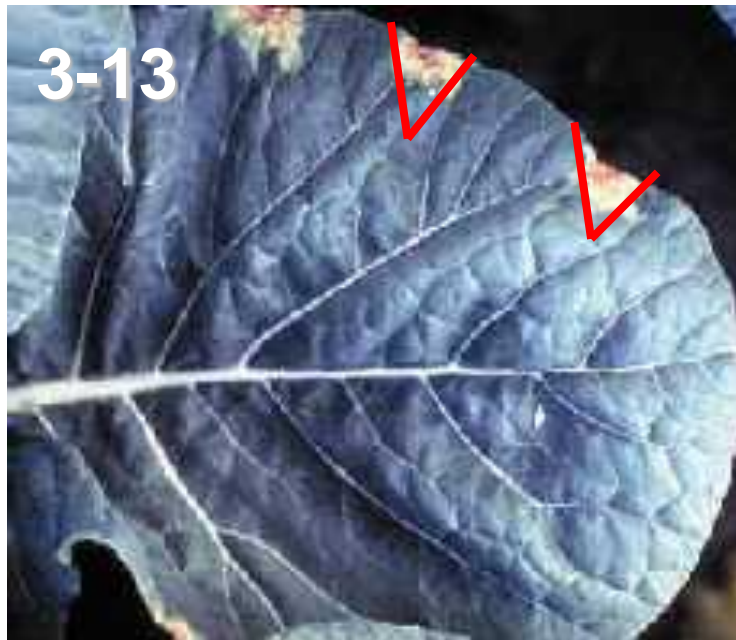
3.9.4.a: Black Rot



Information Source: <http://www.omafra.gov.on.ca>

Yellow V-shaped lesions on the leaf margins of Kale

3.9.4.a: Black Rot



Yellow V-shaped lesions on the leaf margins of Kale

3.9.4.a: Black Rot

General Descriptions:

- This is a **seed borne bacterial disease**
- Black rot infection and spread is favored by **wet conditions** and **high temperatures (20 – 30 °C)**
- The bacterium enters the plant through wounds and other openings in the plant e.g. stomata
- Crowded plants provide conditions that are ideal for bacterial spread to nearby plants

Symptoms:

- In early stage, **yellowish brown V-shaped lesions** are observed on the leaf margins of affected plants
- On the margins of mature leaves, the veins become distinctly **black**
- The lesions extend into the leaf, **killing large areas of affected leaves**
- A cross sectional cut of infected stem reveal a characteristic **black ring**
- Seedlings that are infected systemically become **yellow**, **drop lower leaves**, and **may die**

Control:

- Avoid use of side shoots
- Use of tolerant varieties e.g.) **Collards**
- Use seedlings from raised nursery beds which provide good drainage
- Field sanitation (hygiene)
- Two year crop rotation

3.9.4.b: Black Leg (Dry Rot Canker)



Information Source: <https://extension.umass.edu>

Kale root infected with “Black Leg”

3.9.4.b: Black Leg (Dry Rot Canker)



**Kale root infected with
“Black Leg”**

3.9.4.b: Black Leg

General Descriptions:

- This is a **seed borne disease** caused by a **fungus**
- The inoculum is spread by **infected plants, garden tools** and **crop debris**

Symptoms:

- Leaves have **light brown spots** which may be circular and which later develop **ash grey centers with many black spots**
- Severe stem infection results in a **dark dry rot** above the soil line which extends below and kills the roots
- Affected plants **wilt abruptly** and **die**

Control:

- Use of certified seed
- Avoid use of **side shoots**
- Avoid nursery beds where Kales and related crops have previously been planted
- Field sanitation (hygiene) by removing and destroying infected material
- **3 – 4 year crop rotation**

3.9.4.c: Ring Spot



Information Source: <http://masters.agron.iastate.edu>

Symptom of “Ring Spot” on a leaf

3.9.4.c: Ring Spot



Symptom of “Ring Spot” on a leaf

3.9.4.c: Ring Spot

General Descriptions:

- This is a **seed borne fungus disease**
- **Infected compost** is the source of the inoculum and it is spread by **wind**

Symptoms:

- **Circular brown grey spots** on the leaves which are often bordered by a **green margin** and with **black – speckled concentric zones**
- Oval or rectangular spots are formed on stems and midribs

Control:

- Use of certified seeds
- Field sanitation-remove and destroy infected plants
- Crop rotation for at least 2 years
- **Use of fungicides**, such as
- **Daconil®** (a.i. Chlorothalonil)
- **Cobox 50 WP®** (a.i. Copper Oxychloride 50 %)

3.9.4.d: Downy Mildew



Information Source: <https://extension.umass.edu>

“Downey Mildew” symptom on Kale leaves

3.9.4.d: Downey Mildew



**“Downey Mildew”
symptom on Kale leaves**

3.9.4.d: Downey Mildew

General Descriptions:

- This is a **seed borne fungus disease**
- Spread by **wind, rain, and overhead irrigation**
- It is severe at **high elevations** where the conditions are **cool and wet**

Symptoms:

- Infection starts as black or dark specks on young leaves at the underside
- On older leaves, coalescence of spots occur, resulting in large areas having sunken, paper tan-coloured spots

Control:

- Nursery and field sanitation
- Crop rotation
- **Use of pesticides**, such as
 - **Daconil®** (a.i. chlorothalonil)
 - **Kocide DF®** (a.i. copper oxychloride)
 - **Antracol®** (a.i. propineb)
 - **Thiovit jet®** (a.i. sulphur)
 - **Score 250 EC®** (a.i. Difenconazole)

3.9.4.e: Powdery Mildew



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

“Powdery Mildew” symptom on Kale leaves

3.9.4.e: Powdery Mildew



**“Powdery Mildew”
symptom on Kale leaves**

3.9.4.e: Powdery Mildew

General Descriptions:

- This is a **fungal disease** that affects a wide range of plants
- Powdery Mildews are severe in **warm, dry climates**

Symptoms:

- Recognized by the presence of extensive white powdery fungal growth, principally on the upper surfaces of new and old foliage.
- Leaves infected with Powdery Mildew may gradually turn completely **yellow, die, and fall off**

Control:

- Crop rotation
- **Cultural Control:** Remove infected leaves to reduce the spread
- **Chemical Control:** Use of **fungicides**, such as
- **Thiovit®** (a.i. **Sulphur elemental 80 %**) at the onset of disease symptoms
- **Ridomil Gold®** (a.i. **Metalaxyl + Mancozeb**)
- **Ortiva 325 SC®** (a.i. **Azoxystrobin + Difeneconazole**)

4. Harvest



Information Source: <https://www.flickr.com>

Harvesting Kales

4. Harvest



Harvesting Kales

4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- **Harvesting Period:** Begins 6 weeks after transplanting and can last for 4 – 6 months
- Harvesting can be done weekly or bi-weekly
- **Harvesting Method:**
 - Kale is hand harvested either as a whole plant, shoots or leaves
 - A picker should look for kale with firm, deeply coloured leaves and moist hardy stems
 - Plucking the lower leaves; each time leaving 3 – 4 top leaves (50% defoliation)
 - When harvesting the leaves, always leave part of the stalk attached to the stem
- **Yields: 30-40 tons per hectare** can be obtained
- The **frequency** and **total duration of harvesting** depends on management practices; for instance, irrigation and additional application of UREA shortens the harvesting interval and prolongs the harvesting duration

5. Post-Harvest Handling



Freshly harvested Kales in the market

5. Post-Harvest Handling



**Freshly harvested Kales
in the market**

5. Post-Harvest Handling

5.1 Handling after harvest (GHCP&PHHT20: Q18)

- The leaves are rather perishable and wilt or become yellow when left on the shelf for more than a day
- Therefore, it should be harvest small quantities at a time
- To retain freshness, the leaves are kept moist inside a bag that is left in the shade or in a cool place
- Pack in well ventilated containers, such as crates
- **Do Not** store/package Kale together with ripening fruits or vegetables (the ripening fruits and vegetables emit ethylene which causes yellowing of leaves)

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

- **Sorting:** Separate the yellow or damaged leaves from the good ones
- **Cleaning:** Wash leaves thoroughly with **clean water**
- **Grading:** Grade the leaves by size, bunching those of the same size and tying in small bundles before packing in well ventilated container or sacks for transportation to markets

5.3 Storage

- It should not be washed before storing since this may cause it to become limp
- Store in a place with adequate air circulation
- Alternatively, sell the produce immediately while fresh

6. Cost & Income Analysis

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

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Transportation/Packaging			

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

6. 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. Kale is a highly nutritious leaf vegetable grown mainly for the domestic market.		
2. Market survey enable buyers to understand the market situation.		
3. Kale seedling should be transplanted 2 month after sowing		
4. Kale planting calendar is a tool used by farmers to plan production.		
5. During land preparation, incorporate crop residues at least 1 – 2 weeks before transplanting.		
6. Seedlings are hardened 1 – 2 weeks before transplanting by reducing watering and gradually exposing to sunlight.		
7. After Top dressing of UREA, not necessary to cover the UREA with the soil		
8. Kale can be produced after cabbage production.		
9. The early symptoms of “Black Rot” are yellowish brown V-shaped dry leaf margins of affected plants.		
10. The maturity period of Kale is 3 months after transplanting.		

7. Post-Training Evaluation Exercise

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

PAGE NUMBER	QUESTION	YES	NO
1/34	1. Kale is a highly nutritious leaf vegetable grown mainly for the domestic market.	✓	
5/34	2. Market survey enable buyers to understand the market situation.		✓
6/34	3. Kale seedling should be transplanted 2 month after sowing		✓
6/34	4. Kale planting calendar is a tool used by farmers to plan production.	✓	
10/34	5. During land preparation, incorporate crop residues at least 1 – 2 weeks before transplanting.		✓
13/34	6. Seedlings are hardened 1 – 2 weeks before transplanting by reducing watering and gradually exposing to sunlight.	✓	
17/34	7. After Top dressing of UREA, not necessary to cover the UREA with the soil		✓
19/34	8. Kale can be produced after cabbage production.		✓
26/34	9. The early symptoms of “Black Rot” are yellowish brown V-shaped dry leaf margins of affected plants.	✓	
32/34	10. The maturity period of Kale is 3 months after transplanting.		✓

[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