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Agriculture and Food Authority
Horticultural Crops Directorate

Ministry of Agriculture, Livestock and Fisheries
State Department for Crop Development & Agricultural Research

Smallholder Horticulture Empowerment & Promotion Project for Local and Up-Scaling (SHEP PLUS)

"Changing Farmers' Mindset from "Grow and Sell" to "Grow to Sell""

BLACK NIGHTSHADE PRODUCTION

Photo: © Victor Omari HCD, 2019

Prepared by SHEP PLUS

Training Title: **Black Nightshade Production**

Objective: **To provide a guideline on production of Black Nightshade**

Specific Objective:

- **To provide basic information on production, post-harvest handling, and marketing of Black Nightshade**

Contents:

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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 Unit Project (SHEP UP) 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 cases. But where applicable, it is recommended that the instructions issued be given due consideration.

Disclaimer

Black Nightshade Production, First published by SHEP in 2009, revised by SHEP PLUS in 2019 (Ver.6)

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The cited agrochemicals are in accordance with “Pest Control Product Registered for Use in Kenya 11th Edition, 2018”. The registered agrochemicals are subject to change. Please refer to the latest registered agrochemicals by Pest Control Product Board.

1. Introduction:
1.1 Background

Photo: © Victor Omari HCD, 2019

Black Nightshade
(Mnavu, Managu, Osuga, Rinagu etc.)

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1.1 Background

Black Nightshade (Mnavu, Managu, Osuga, Rinagu etc.)

1. Introduction:
1.1 Background

- The term **"Nightshade"** refers collectively to a wide ranging group of plants including poisonous, medicinal and edible species (from the genus Solanum)
- There are several species with black berries, but the most popular ones are those with orange berries belonging to **"*Solanum Villosum*"**
- This group of species is often erroneously referred to as **"*Solanum Nigrum*"**, a poisonous plant from Europe that is not usually grown in Africa (AVRDC, 2003)
- Some Solanum varieties are preferred for their **bitter taste** while others are considered **sweet/tastier**, particularly after being boiled and the water discarded
- It is rich in **proteins**, **calcium**, **iron**, **phosphorus** and **magnesium, *Beta*-Carotine**, Vitamin **E**, **Folic** acid and **Ascorbic** acid
- Black Nightshade is gaining popularity due to its **nutritional value** and ready market in major urban centers

1.2 Common Varieties

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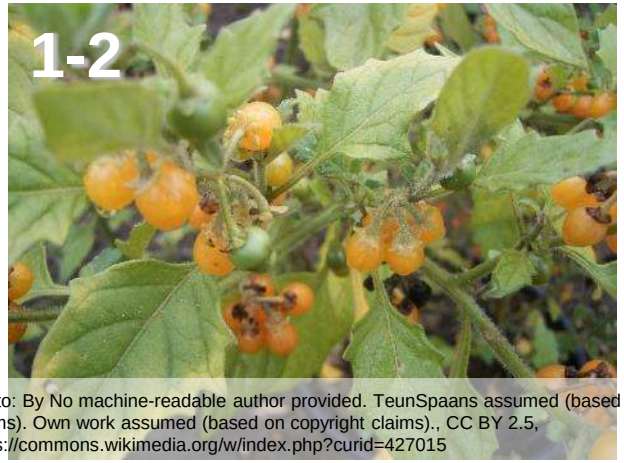
Photo: By David Eickhoff from Pearl City, Hawaii, USA - Solanum americanumUploaded by Tim1357, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=22702159

"Solanum Villosum"

"Solanum Americanum"

1.2 Common Varieties



"Solanum Villosum"

"Solanum Americanum"

1.2 Some Common Varieties

- The following are the common varieties grown in Kenya

"*Solanum Villosum*"

- Grows well in **low altitude areas**
- Produces **orange colored fruits** which are edible

"*Solanum Americanum*"

- Produces **very small fruits** which are **black**
- Grows well in **hot and humid areas**, such as Coastal areas

1.2 Common Varieties Cont’

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“*Solanum Scabrum*”

1.2 Common Varieties Cont'

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"Solanum Scabrum"

1.2 Some Common Varieties Cont'

"*Solanum Scabrum*"

- Bigger in size
- Produces **bigger leaves** and **fruits** which are **black in color when ripe**
- Grows well in **medium altitude areas** which receives a lot of rainfall
- It is unpopular in Kenya

"*Solanum Eldoreti*"

- Broader leaves compared to *Solanum Villosum*
- Grows well in **high altitude areas**
- Produces **small greenish** to **purplish fruits**

1.3 Optimal Ecological Requirements

Altitude	**0 – 2,400 metres above sea level**
Rainfall	**500 – 1,200 mm of rainfall**
Growing Temperature	**Warm Temperatures**
Soils	• **Well drained soils** • **High organic matter content**

1.3 Optimal Ecological Requirements

Altitude	**0 – 2,400 metres above sea level**
Rainfall	**500 – 1,200 mm of rainfall**
Growing Temperature	**Warm temperatures**
Soils	• **Well drained soils** • **High organic matter content**

1.3 Optimal Ecological Requirements

- **Altitude:** The optimum altitude ranges **0 – 2,400 m** above sea level depending on the species:
  - "*Solanum Villosum*" grows **up to 2,400 m.a.s.l**
  - "*Solanum Americanum*" is mainly found at **low altitudes** and in coastal areas
  - "*Solanum Scabrum*" grows **up to 2,000 m.a.s.l**
- **Rainfall:** Requires low to medium rainfall, **500 – 1,200 mm** per year, which is well distributed
- **Temperature:** Does well in warm temperatures
- **Soil:** Black Nightshade requires **well drained soils** and **high in organic matter content** since they require large quantities of nitrogen and other nutrients.

2. G20 technologies

1. Market survey
2. Crop planting calendar
3. Soil testing
4. Composting
5. Use of quality planting materials
6. Recommended land preparation practices
7. Incorporating crop residues
8. Basal application of compost/ manure
9. Recommended practices of seedling preparation/ seedlings from registered nursery

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[G20 Technologies]
Make sure to support farmers carry out G20 techniques for any crop

2. G20 technologies

10. Recommended spacing
11. Recommended fertilizer application rate
12. Supplementing water
13. Timely weeding
14. Top-dressing
15. IPM practices
16. Safe and effective use of pesticides
17. Use of harvesting indices
18. Appropriate post harvest handling containers
19. Value addition techniques
20. Keeping farm records

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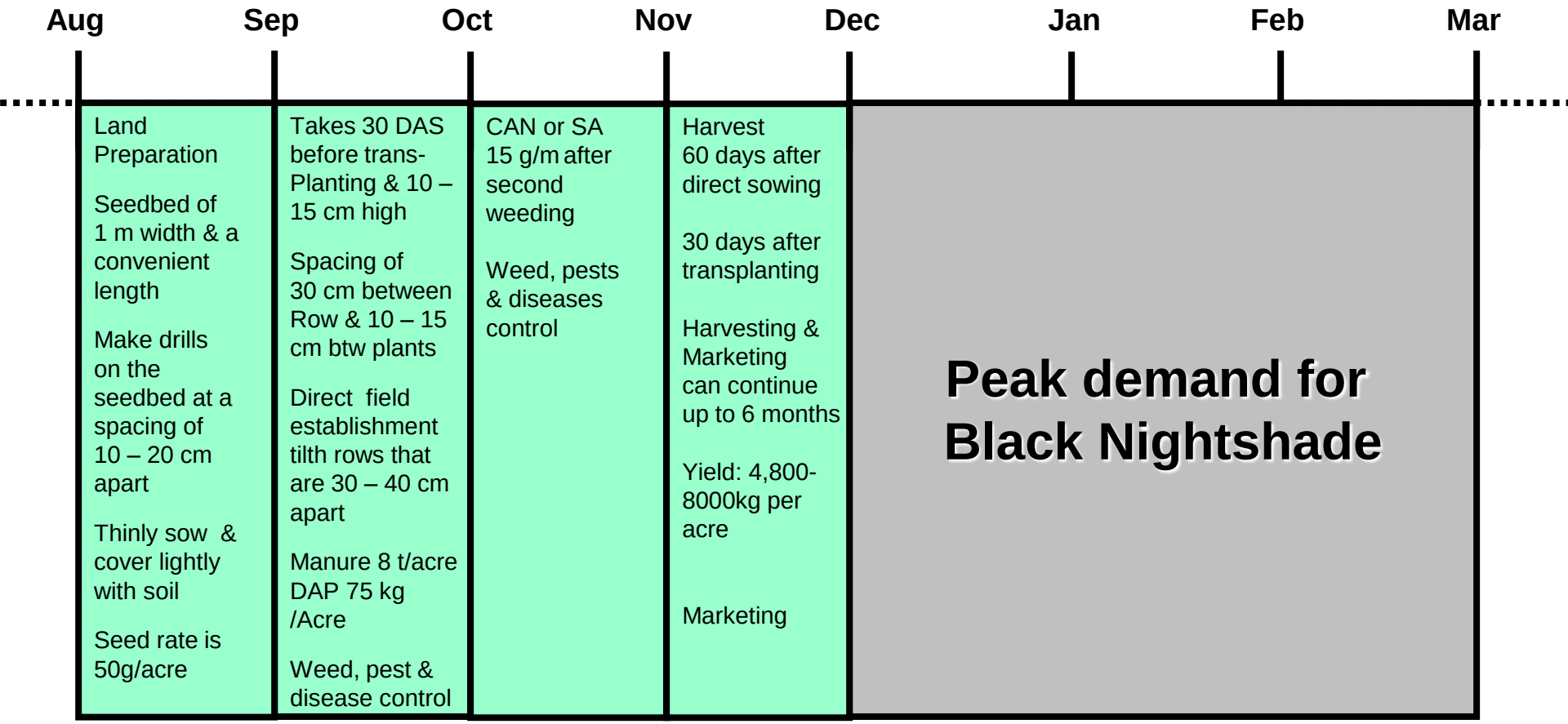
[G20 Technologies]
Make sure to support farmers carry out G20 techniques for any crop

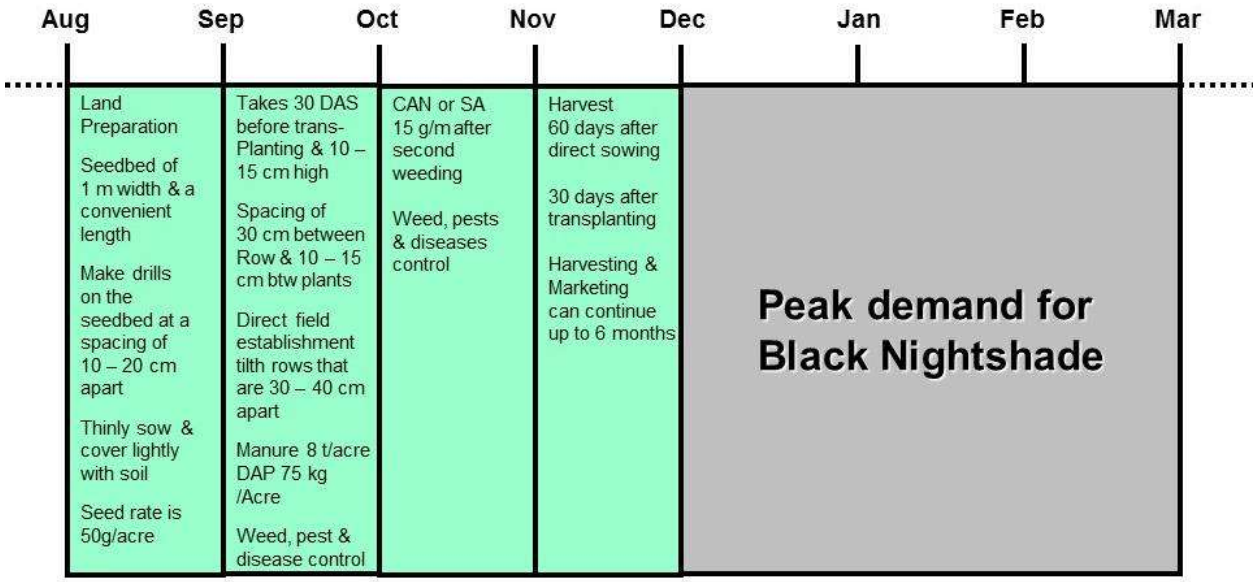
2.1 Crop Planting Calendar

A Sample of a BNS Planting Calendar



2.1 Crop Planting Calendar

A Sample of a BNS Planting Calendar



A Sample of a Black Nightshade Planting Calendar: Targeting a peak market demand beginning just after December

2.1 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 Black Nightshade
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 for supplemental irrigation

2.2 Composting

Manure preparation through composting

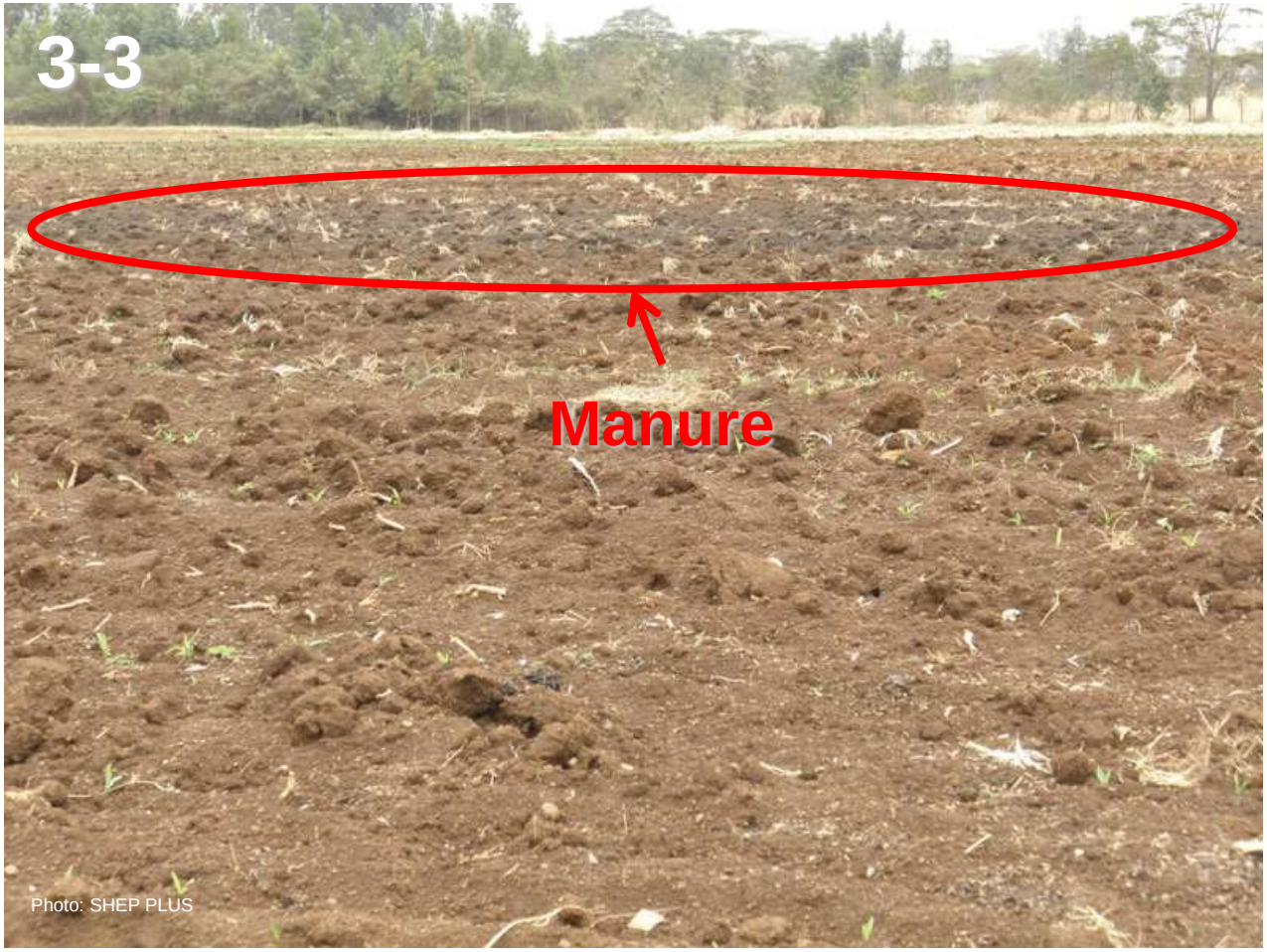
2.2 Composting

Manure preparation through composting

2.2 Composting (GHCP&PHHT20: Q4)

- During compost making, the organic matter need to be covered to prevent leaching of nutrients
- Compost manure has been found to:
  - Be cheaper than inorganic fertilizers
  - Improve soil productivity by readily providing soil nutrients and improving soil structure
  - Increase the water retention capacity
- Black Nightshade like most **leafy** vegetables is a heavy feeder and does well in soils with high organic content (manure/compost)
- Based on the results of the soil analysis, prepare adequate compost for application; the recommended rate of application ranges from **5 – 8 tons per acre**

3.1 Basal Application



Manure incorporation as a basal application

3.1 Basal Application

Manure incorporation as a basal application

3.1 Basal Application (GHCP&PHHT20: Q8)

- To be based on soil analysis results
- Pre-plant phosphorus (**P**) can be applied in form of fertilizer (**DSP**) at the rate of **75 kg per acre**
- Manure/compost should be applied **1 – 2 weeks before** transplanting and incorporated into the soil
- The manure/compost should be broadcasted (**8 tons per acre**) then worked into the soil (incorporated) preferably using a hoe

3.2 Raising Seedlings

Nursery bed of Black Nightshade

3.2 Raising Seedlings

Nursery bed of Black Nightshade

3.2 Raising Seedlings (GHCP&PHHT20: Q9)

- Use of clean seed is recommended due to high incidences of seed borne diseases
- **Seed Rate:** 50 g per acre

Nursery Site Selection:

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

Note:

- Trays can also be used for raising seedlings

Nursery Establishment:

- Involves **site preparation**, **construction of nursery infrastructure** and **basic nursery tools**
- Nursery soil should be **loosened** and **enriched** with well decomposed manure
- Make drills at a spacing of **10 – 20 cm apart**; thinly sow the seeds in the drills and cover lightly with soil

Management of Nursery:

- **Adequate watering** is essential for proper growth
- **Water** the nursery **regularly**
- The nursery should be **mulched** to conserve moisture

3.3 Transplanting

Recently transplanted BNS seedlings

3.3 Transplanting

Recently transplanted BNS seedlings in Khwisero Sub-county

3.3 Transplanting

3.3.1 Appropriate Time

- Seedlings are transplanted **30 days after sowing** or when having **5** – **6 true leaves** and have attained **a height of 10 – 15 cm**

3.3.2 Recommended Spacing (GHCP&PHHT20: Q10)

- Seedlings are planted at spacing of **30 cm** between the row and **10 – 15 cm** between plants
- For the direct seeded, seeds are drilled thinly in fine tilth rows that are **30 – 40 cm apart**
- To ensure uniform distribution, mix the seed with the soil or sand at a ratio of **1:15** or **1:20**, respectively
- Direct seeding enables the plant to establish well and faster which leads to faster production of bigger leaves
- Seed germination takes place between **4 – 7 days**
- Thin seedlings to attain a spacing of **15 cm** between the plants after **30 days**

3.3.3 Fertilizer Application Rates (GHCP&PHHT2: Q11)

- To be based on **soil analysis**
- Manure alone: **8 tons per acre** or,
- Manure and DAP: **8 tons manure per acre** together with **40 kg DAP per acre** or,
- **DAP 75 kg per acre**

3.6 Water Requirement

(G20: Q12)

Photo: © Victor Omari HCD, 2019

Black Nightshade under drip irrigation

3.6 Water Requirement (G20: Q12)

3-5

Photo: SHEP PLUS

Black Nightshade under drip irrigation

3.6 Water Requirement (G20: Q12)

- Frequent irrigation is needed to avoid **water stress** and have optimum growth and yield
- Irrigation interval of the crop **depends on the soil types**
- It is recommended that sandy soil be irrigated **three times a week**, sandy loam **twice a week**, clay loam and loam soils **once a week,** respectively

Irrigation Methods:

- **Drip** and **sprinkler irrigation** can be used but drip irrigation is recommended to save water

3.4 Top-dressing

Photo: SHEP PLUS

Top-dressing using the placement method

3.4 Top-dressing

Photo: SHEP PLUS

Top-dressing using the placement method

3.4 Top-dressing (GHCP&PHHT20: Q14)

- Research indicates that **Nitrogen** is one of the most important nutrient that is required by the crop in fairly large quantities
- Calcium ammonium nitrate (CAN) or Sulphate of ammonia (SA) should be applied at **15 g** (**3 tea spoonfuls**) **per m²** after **second weeding**
- Application of **foliar fertilizer** is beneficial to this crop

Notes:

- **Soil Fertility**
  - Recommendations for supplemental **organic matter**, **fertilizer**, **lime** or **manure** should be based on a soil test and a nutrient management plan
  - Nutrient management plans balance the crop requirements and nutrient availability, with the aim to **optimize crop yield** and **minimize ground water contamination**, while improving soil productivity

3.5.1 Major Pests

Photo: A. M. Varela, icipe
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Photo: A. M. Varela, icipe
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Photo: By Bob Peterson from North Palm Beach, Florida, Planet Earth! - Metallic blue flea beetles (Altica sp.)Uploaded by Jacopo Werther, CC BY-SA 2.0,
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Photo: © Magnus Gammelgaard
http://www.infonet-biovision.org/PlantHealth/Pests/Aphids (CC BY-NC-SA 3.0)

3.5.1 Major Pests

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Photo: © Magnus Gammelgaard
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3.5.1 Major Pests

- Pest damage causes a reduction in quality and quantity of produce
- The following are the major pests of Black Nightshade in Kenya:

A. Root-Knot Nematode
B. Cutworm
C. Flea Beetle
D. Aphid

3.5.1.A: Root-Knot Nematode

Photo: A. M. Varela, icipe
http://www.infonet-biovision.org/PlantHealth/Pests/Root-knot-nematodes (CC BY-NC-SA 3.0)

“Root-knot Nematode” infection

3.5.1.A: Root-Knot Nematode

“Root-knot Nematode” infection

3.5.1.A: Root-Knot Nematode

Damages:

- Root-Knot Nematodes induce characteristic **swellings of the roots** which are commonly referred to as **galls**
- This deformation of the root system inhibits the translocation of water and mineral salts thus resulting in **stunted plant growth**

Control:

- Crop rotation
- **Keep weed free** land fallow for one or two seasons
- Intensive use of manure

3.5.1.B: Cutworm

A Cutworm larva

3.5.1.B: Cutworm

A Cutworm larva

3.5.1.B: Cutworm

- Cutworms are often found **hiding in soil** near the cut seedlings

Damages:

- **Grey to black caterpillars** feed at night, either bite out the side of the stem at ground level causing the plant to **fall over** or may **cut it** completely

Management/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

3.5.1.C: Flea Beetle

Photo: By Bob Peterson from North Palm Beach, Florida, Planet Earth! - Metallic blue flea beetles (Altica sp.)Uploaded by Jacopo Werther, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=24649912

A Flea Beetle on a leaf

3.5.1.C: Flea Beetle

Photo: By Bob Peterson from North Palm Beach, Florida, Planet Earth! - Metallic blue flea beetles (Altica sp.)Uploaded by Jacopo Werther, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=24649912

3.5.1.C: Flea Beetle

Damage:

- Feed on leaves where they create **big holes** on the **foliage**
- The damage is serious in **young plants**

Control:

- Keep fields **weed-free**
- **Destroy plant debris**

A Flea Beetle on a leaf

3.5.1.D: Aphid

Aphids on a leaf

3.5.1.D: Aphid

Aphids on a leaf

3.5.1.D: Aphid

- Most destructive pest for this crop especially during the dry season

Identification:

- Aphids are **pale green** and are usually covered with **a light dust of 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** and **distorted leaves**

Control:

- Use of **ash**
- **Use of pesticides**, such as
  - **Karate 2.5 WG®** (a.i. **Lambdacyhalothrin. PHI 3days**)

3.5.2 Major Diseases

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3.5.2 Major Diseases

Photo: By Forest & Kim Starr, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=6169049

Photo: © A. M. Valera, icipe http://infonet-biovision.org/PlantHealth/Crops/African-Nightshade

3.5.2 Major Diseases

- Disease infestation leads to reduction in quality and quantity of produce
- The following are the major diseases of Black Nightshade in Kenya:

  a. Bacterial Blight
  b. Early Blight

3.5.2.a: Bacterial Blight

Photo: By Forest & Kim Starr, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=6109049

Symptoms on a Black Nightshade leaves

3.5.2.a: Bacterial Blight

Symptoms on a Black Nightshade leaves

3.5.2.a: Bacterial Blight

Symptoms:

- The disease is characterized by **small**, **round**, **water-soaked spots**, which eventually turn **dark brown to black** and become **hard and dry**

Control:

- Once the soil has been infected with the disease, it is advisable not to plant Black Nightshade for **at least 4 years**
- Use **certified disease-free seeds**
- When using own seeds, do hot water treatment

3.5.2.b: Early Blight

Symptoms on a Black Nightshade leaves

3.5.2.b: Early Blight

Symptoms on a Black Nightshade leaves

3.5.2.b: Early Blight

General Description:

- Early Blight thrives best under **warm wet conditions**
- Controlling Early Blight once it has established is **very difficult**

Symptoms:

- Leaf spots of early blight are **circular**, up to **1 cm in diameter**, **brown**, and often show a **circular pattern** which distinguishes this disease from other leaf spots
- Leaf spots first appear on **the oldest leaves** and **progress upwards** on the plant
- Entire plant could be **defoliated** and **killed**

Control:

- **Crop Rotation** with other crops, like **Amaranth** is essential
- **Do Not rotate** with **Tomato**, **Potato** or **Capsicum** as these belong to the same family and susceptible to the same diseases
- In areas with high humidity, **wider plant spacing** should be used
- Practice **good field hygiene**
- **Remove infected leaves** during the growing season, **discard all badly infected plant debris** at the end of each season
- Use **certified disease-free seeds**
- When using own seeds, treat with **hot water**

4. Harvest

Farmers Harvesting Black Nightshade

4. Harvest

Harvested Black Nightshade

4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- **Maturity Period: 60 days** after direct seed sowing in the field or **30 days** after transplanting
- **Harvesting Method:**
  - The most common way of harvesting is regular plucking of leaves (multiple harvesting), twice per week
  - **14 days after transplanting**, cut the growing point of the plant to encourage branching; and **2 weeks later** start plucking the young shoots and continue harvesting **every 1 to 2 weeks** for **3 to 4 months**
- Harvest the fruit when it turns into **a black/purple** colour if the crop is for **seed production**
- Another method is **once-over harvesting** where the whole plant is removed by uprooting
- This is done either as **thinning** or if there is close spacing
- **Plucking method** determines the longevity of harvesting
- **Regular removal of flowers** ensures longer harvesting period
- **Yields:** Range from **4.8 tons to 8 tons of foliage per acre** depending on the variety and management

5. Post-Harvest Handling

Black Nightshade at a market

5. Post-Harvest Handling

Black Nightshade at a market

5. Post-Harvest Handling

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

- The crop can be harvested and placed on **plastic sheets** or **banana leaves**
- Blanched leaves can be **dried** and **stored** in **plastic containers**

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

- **Sorting:**
  - Black Nightshade should be sorted to **remove insects** and **yellow** or **damaged leaves** before packing
  - Airing of the harvested leaves is done to **remove field heat**
- **Cleaning:** Leaves should be **thoroughly washed** with portable water
- **Grading:** Grade the leaves by **size**, bunching those of the same size and **tying in small bundles** before packing in well ventilated container for transportation to markets

5.3 Storage

- Fresh leaves should be stored in the refrigerator or stored in cool place