Japan International Cooperation Agency

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""

EGGPLANT PRODUCTION

Presented to the County & AFA (HCD) Staff in charge of the SHEP PLUS Model Farmer Groups during the FT-FaDDE

Prepared by SHEP PLUS

1. Introduction:

1.1 Background

Egg Plant (Biringania)

1. Introduction:

1.1 Background

- **Eggplant** is a member of the ***Solanaceae* family** which includes **Tomato**, **Potato**, **Black Nightshade, Sweet Pepper** and **Chili**
- Eggplant is also known as **“Brinjal”** or **“Aubergine”**
- It is **a perennial crop** but grown commercially as annual
- The unripe fruit is consumed as **cooked vegetable**
- It is **low in** calories and fats, and **a good source of Vitamins** and **minerals**

1.2 Common Varieties

Source: http://www.edenbrothers.com/store/organic-eggplant-seeds-black-beauty.html

“Black Beauty”

http://a4dibbleplants.co.nz/eggplant-long-purple-p-736.html

“Long Purple”

1.2 Common Varieties

“Black Beauty”:

- **Oval** to **heart-shaped glossy purple fruits** which are **almost black**
- **Maturity Period: 100 days** after transplanting
- **Good shelf-life, unsuitable** in **cold areas**.
- Yield: **4,500kg per acre**

“Long Purple”:

- **Early maturing, tall growing** & **high yielding**
- Fruit has an **elongated shape & dark purple**
- Maturity Period**: 70 – 80 days** after transplanting

1.2 Common Varieties Cont'

"Florida High Bush"

- **An old variety** bred in Florida in the 1940's
- Produces **very large**, **dark purple** and **egg shaped fruits**
- **Maturity Period: 85 days** after transplanting

Source: http://www.tomatogrowers.com/FLORIDA-HIGH-BUSH/productinfo/7157/

"Florida High Bush"

1.2 Common Varieties Cont'

"Ravaya"

- **Early maturing** & **high yielding** variety
- Fruits are **slender** and **purple coloured**
- Popular in **export market**

http://www.easeed.com/index.php/component/joomgallery/vegetables/vegetables-85

"Ravaya"

1.3 Optimal Ecological Requirements

Altitude	**0 – 1,600 metres above sea level**
Rainfall	**1,000 – 1,500 mm of rainfall annually**
Growing Temperature	**20 – 30 ^{0}C (day)** **20 – 27 ^{0}C (night)**
Soils	**•Deep fertile and well drained, silt-loam to clay-loam** **•pH range 5.5 – 6.5**

2. G20 technologies

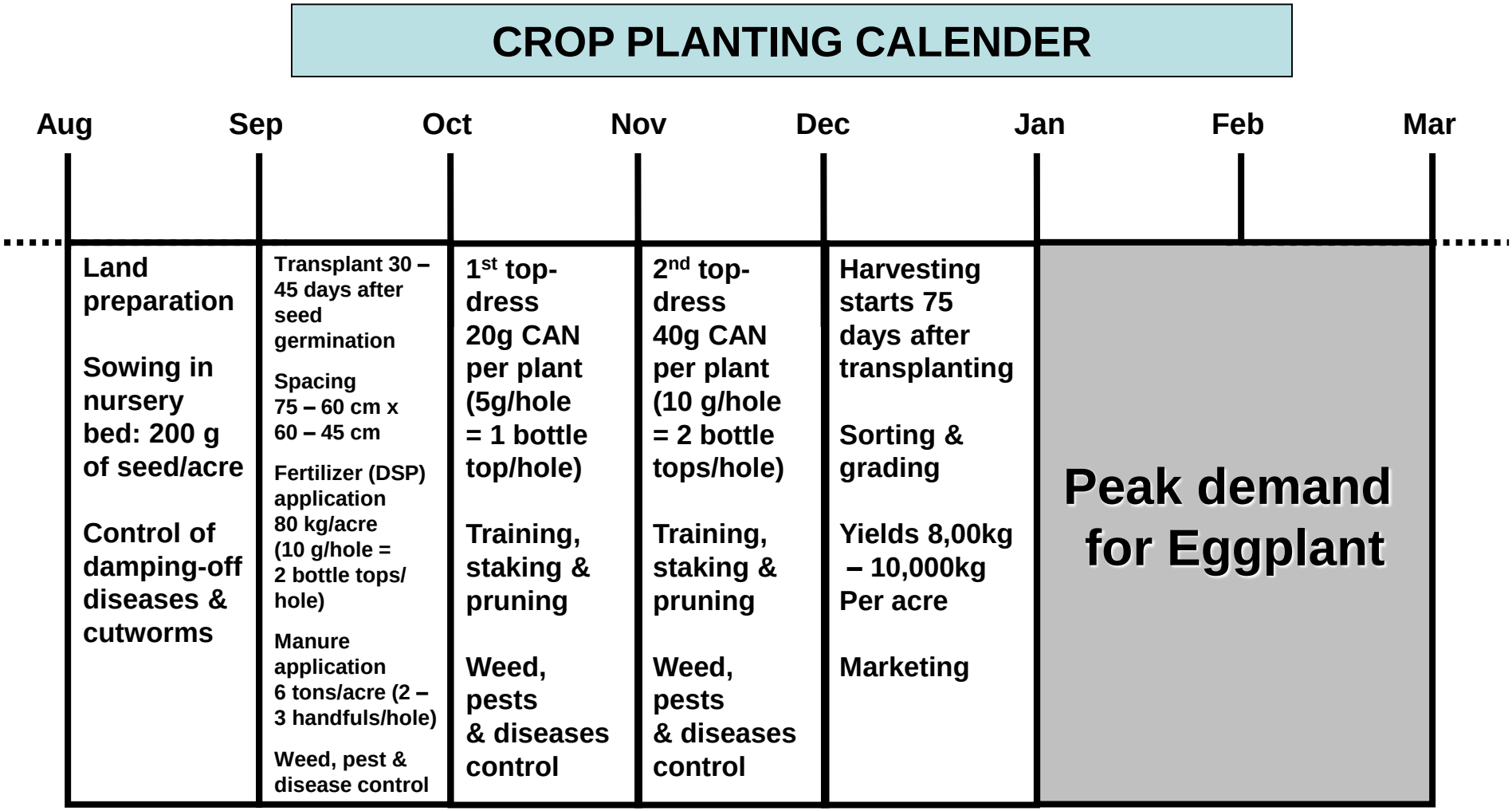
- Make sure to support farmers carry out G20 techniques for any crop

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 nursery preparation/buying seedlings from registered nursery

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

3.1 Crop Planting Calendar



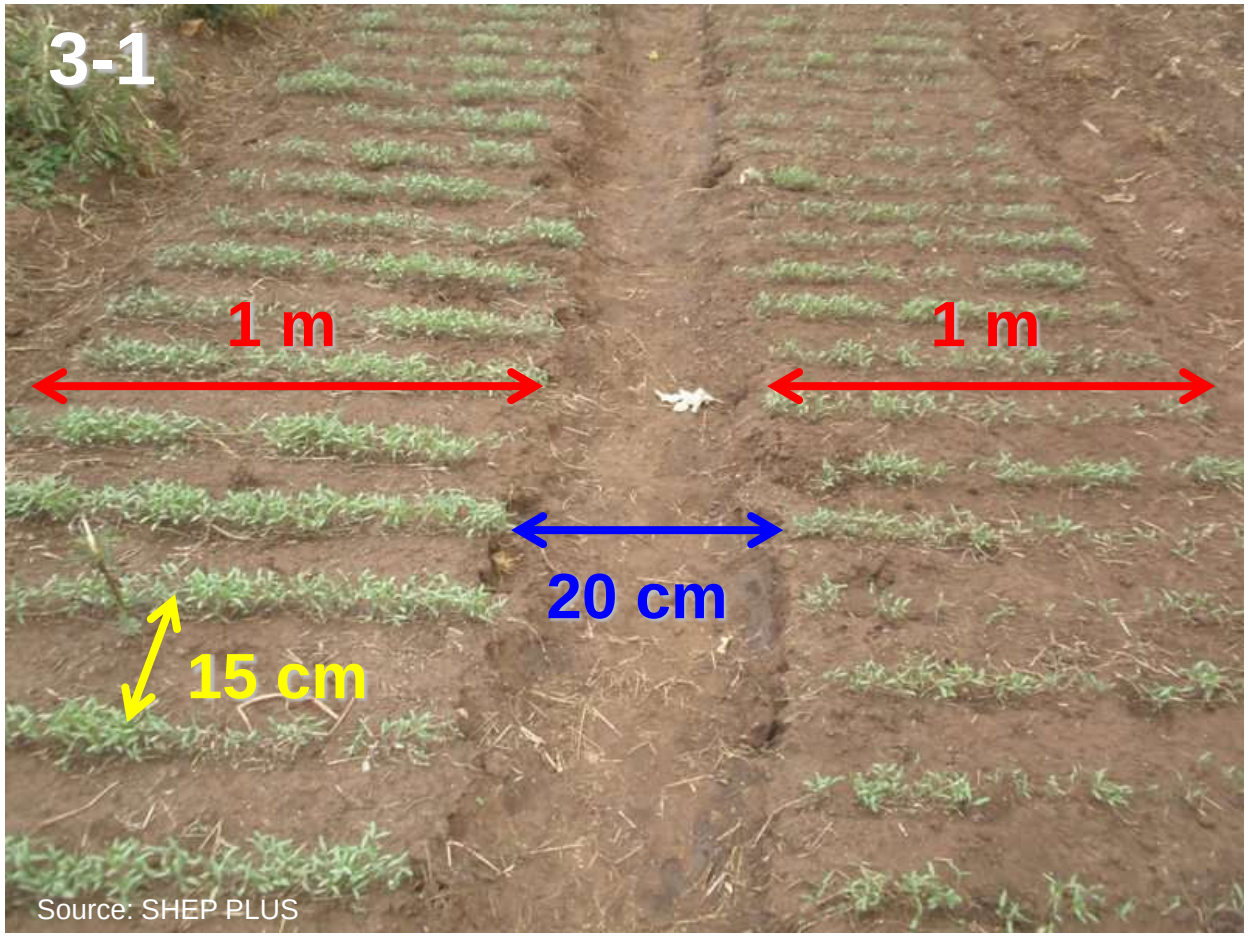
A Sample of Eggplant Planting Calendar

3.2 Basal Application (GHCP&PHHT20: Q8)

- The manure/compost should be broadcasted (**6 tons per acre**) then worked into the soil (incorporated) preferably using a hoe

- Manure/compost should be applied **1 – 2 weeks** before transplanting the Eggplant and incorporated into the soil

3.3 Raising Seedlings



Nursery of Eggplant

3.3 Raising Seedlings (GHCP&PHHT20: Q9)

- Eggplant can be established through the nursery or directly seeded
- The seed rate is about **200g per acre**

Nursery Site Selection:

- The nursery should be sited in a plot that has not been planted with a member of ***Solanaceae*** **family** for the last **3 years**
- Site should also be away from **shade**, should be **flat** or **gently sloping**

3.3 Raising Seedlings Cont’

Nursery Establishment:

- Prepare a seedbed of **1 m width** and a convenient length
- Seeds are sown thinly on rows **spaced at 15 cm apart**
- **Shade** is erected above the nursery to protect young seedlings
- **Manure** is applied at a rate of **3 – 5 kg per square meter**

3.3 Raising Seedlings Cont'

Management of Nursery:

- Water the nursery regularly
- Harden the seedlings **1 – 2 weeks before transplanting** by reducing the frequency of watering and gradually exposing the seedlings to direct sunlight
- Seed beds are kept **free of weeds**
- Insects can be blocked from reaching the seedlings by using **an insect proof net**

3.4 Transplanting

3.4.1 Appropriate Time:

- Seedlings are transplanted **3 – 4 weeks after sowing** at which the height of seedling is **about 10 – 15 cm**
- It is recommended that transplanting should be done either **early in the morning** or **late in the evening**

3.4 Transplanting Cont'

3.4.2 Recommended Spacing (GHCP&PHHT20: Q10):

- **Spacing:** range from **60 – 75 cm** (between rows) by **40 – 60 cm** (between seedlings) depending on the variety
- **Plant population: 8,888-16,666 per acre**

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

- Apply **2 bottle tops** (**10g**) of Triple Super Phosphate (TSP) per hill (**80kg/acre**)
- Excess "P" leads to fruits with too many seeds reducing the quality

3.5 Top-dressing (GHCP&PHHT20: Q14)

- Eggplant crop should be fertilized with organic and inorganic fertilizers to produce high yields
- Top-dressing fertilizer such as **CAN** should be applied in **2 splits** at **40 kg & 80 kg per acre** at **4 and 8 weeks** after transplanting
- **Inadequate top-dressing can result into physiological disorders:**
  - **Hollow cavities** and **poor taste** in fruits due to **potassium** deficiency
  - **Blossom-end rot** due to an imbalance between **Nitrogen**, **Calcium** and **soil moisture**

3.6 Pest & Disease Control:

(GHCP&PHHT20: Q15 & 16)

3.6.1 Major Pests

- The following are the major pests of Eggplant in Kenya:
  - **A. Shoot & Fruit Borer**
  - **B. Epilachna Beetle**
  - **C. Tobacco Whitefly**
  - **D. Gall Midge**
  - **E. Root-knot Nematode**
  - **F. Spider Mite**
  - **G. Aphids**

3.6.1.A: Shoot & Fruit Borer

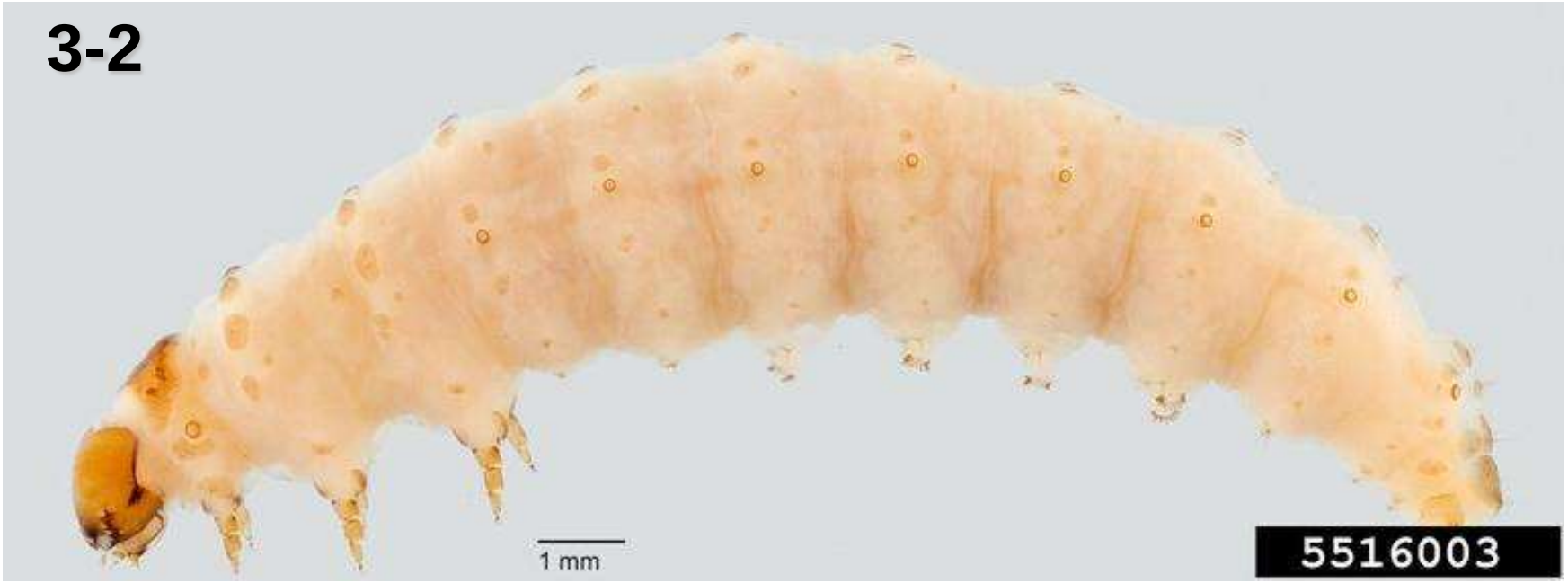


Photo: Todd Gilligan, LepIntercept, USDA APHIS ITP, Bugwood.org (CC BY 3.0 US)

Eggplant borer

3.6.1.A: Shoot & Fruit Borer

Identification:

- The adult is **a small white moth** with **a pink bluish tinge**
- Moths lay **creamy white eggs** underside of leaves
- White caterpillars **hatch and bore** inside fruits and tender shoots

Symptoms:

- In young plants, **appearance of wilted drooping shoots**
- Affected shoots **wither** and **die**

3.6.1.A: Shoot & Fruit Borer Cont’

Symptoms:

- In older plants, **caterpillars bore into flower buds** and young fruits causing **shedding of flower buds**
- Attacked fruits have **small holes bellow the calyx** or **filled with frass** and **exit circular holes.**

Control:

- **Destroy infested fruits and shoots** by burning
- Grow seedlings **under insect proof net** to prevent moths from laying eggs on the crop

3.6.1.B: Epilachna Beetle

Photo: © A。M. Varela, icipe
Source: http://www.infonet-biovision.org/PlantHealth/Crops/ZucchiniCourgette

Adult, Larvae and eggs of Epilachna Beetle on a leaf

3.6.1.B: Epilachna Beetle

Identification:

- Are **small beetles,** oval in shape, **reddish in color** with **black spots on their backs**
- They resemble **beneficial lady bird beetles**

Symptoms:

- They **feed on leaf tissue** between the veins making attacked leaves appear **skeletonized**
- The attacked leaves turn **brown**, **dry up and fall off the plant**

3.6.1.B: Epilachna Beetle Cont’

Control:

- Use neem products: **Aqueous Neem Seed Extract** at **10g per litre** at **10 day interval**

3.6.1.C: Tobacco Whitefly

3-4

Adult Tobacco Whitefly with nymphs

3.6.1.C: Tobacco Whitefly

Identification:

- Are **small insects** which have **pure white wings** and **prominent hind legs**
- They **occur in groups** on underside of leaves

Symptoms:

- Large populations cause leaves to **turn yellow** and may **fall off** the plants
- Whiteflies **transmit viruses**

3.6.1.C: Tobacco Whitefly Cont’

Control:

- Keep Eggplant fields **weed-free**
- Use of **yellow sticky traps** to monitor their levels
- **Water sprays**
- Avoid use of **broad spectrum insecticides** since they reduce natural enemies
- **Use of neem products** to reduce populations
- Spray Thiacloprid (CALYPSO SC480®)

3.6.1.D: Gall Midge

Source: Valéria Cid Maia et al 2009 (CC BY-NC-ND 4.0) http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0085-56262009000200002

© Eric Coombs, Oregon Department of Agriculture, Bugwood.org, (CC BY 3.0 US)

Gall induced by midge (left) and Gall midge (right)

3.6.1.D: Gall Midge

Identification:

- Larvae are **creamy white** to **yellow white** in colour

Symptoms:

- The ovary of infested flower **bulges** prominently towards one side with **whitish coloration**
- Majority of infested **flowers drop**
- Retained flowers develop into **malformed fruits**

3.6.1.D: Gall Midge Cont'

Control:

- **Destroy crop residue** at the end of season
- **Avoid close spacing** since it provides suitable micro-environment for the pest
- Apply **Malathion (OSHOTHION 50 EC®) mixed** with **white oil**
  - The concentration of the white oil **should not exceed 2%** (i.e. 400 ml for 20 lt of water)
  - Higher concentrations are poisonous
  - Avoid application during hot periods of the day

3.6.1.E: Root-knot Nematode

Heavily infested plant showing root distortion (Left)

3.6.1.E: Root-knot Nematode

Identification:

- Formation of **root galls**
- Affected plants have **stunted growth**

Symptoms:

- **Wilting plants**
- Infested plants have **distorted roots**

Control:

- Maintain **high levels of organic matter**
- Incorporating **Marigold** and **Brassicas** into soil **2 weeks before planting**

3.6.1.F: Spider Mite

http://www.infonet-biovision.org/PlantHealth/Crops/Eggplant

Colonies of Red Spider Mites

3.6.1.F: Spider Mite

Identification:

- Are **tiny** and **oval in shape**
- There are **5 stages-egg**, **larva (1st instar)**, **2 nymphal stages** and **adult**

Symptoms:

- Attacked leaves have **white specks** and **fine silky web**
- High levels of infestation causes **drying up** of **leaves**

3.6.1.G: Aphid

Photo: Whitney Cranshaw, Colorado State University, Bugwood.org (CC BY 3.0 US)

Aphids on a leaf

3.6.1.G: Aphid

Identification:

- Aphids occur in **colonies** initially around tender plant parts and on the lower leaf surface
- When numerous, they can be found on all above ground parts of the plant

Damages:

- Aphids damage plants by sucking their sap, excreting **a sticky substance** (**honeydew**) that coats the plants, or/and by **transmitting viral diseases**
- **Curling**, **wrinkling**, or **cupping** of young leaves, **chlorotic spotting**, **mottling of older leaves**, **stunting** and **wilting** of plants
- Growth of sooty mould on honeydew excreted by aphids reduces photosynthesis and **affects fruit quality**

Control:

- **Naturally controlled by predators**, such as ladybird, beetles, hoverflies, anthocorid bugs, spiders, lacewings and by fungal diseases
- Indigenous natural enemy
  - Parasitic wasp (Aphitech®)
- **Spray with insecticides**, such as Lambda Cyhalothrin **(**KARATE 2.5 WG®)

3.6.2 Major Diseases & Physiological Disorders

- The following are the major diseases of Eggplant in Kenya:
  a. **Alternaria Blight**
  b. **Late Blight**
  c. **Fusarium Wilt**
  d. **Bacterial Wilt**

3.6.2.a: Alternaria Blight

Photo: https://www.infonet-biovision.org/PlantHealth/Crops/Eggplant

A leaf Infected with Alternaria Blight

3.6.2.a: Alternaria Blight

- This disease affects **leaves** and **fruits**
- The fungus is **seed borne**

Symptoms:

- Affected leaves develop **leaf spots** which have **concentric rings**
- **Leaf spots** appear on older leaves first and **progress upwards**
- Severely infected leaves **drop off prematurely**

3.6.2.a: Alternaria Blight Cont’

Control:

- **Field hygiene:** remove crop residues which is a source of inoculum
- Use of **certified seed**

3.6.2.b: Late Blight

Photos: Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org, (CC BY-NC 3.0 US)

Symptoms of Late Blight

3.6.2.b: Late Blight

General Descriptions:

- It is **a fungal infection** which gets serious **in cool moist conditions**

Symptoms:

- **Brown spots** with purplish tinge which develop on upper surface of leaves
- The purplish patches turn **brown** and **wither** but remain attached to the plant
- Stems develop elongated **greyish**, **watery brown lesions**

3.6.2.b: Late Blight Cont’

Control:

- **Field hygiene** by removing crop debris
- **Application of fungicides:** Metalaxyl-M- + Mancozeb (AMIDIL 68WG®)

3.6.2.c: Fusarium Wilt

Photo: Florida Division of Plant Industry , Florida Department of Agriculture and Consumer Services, Bugwood.org (CC BY 3.0 US)

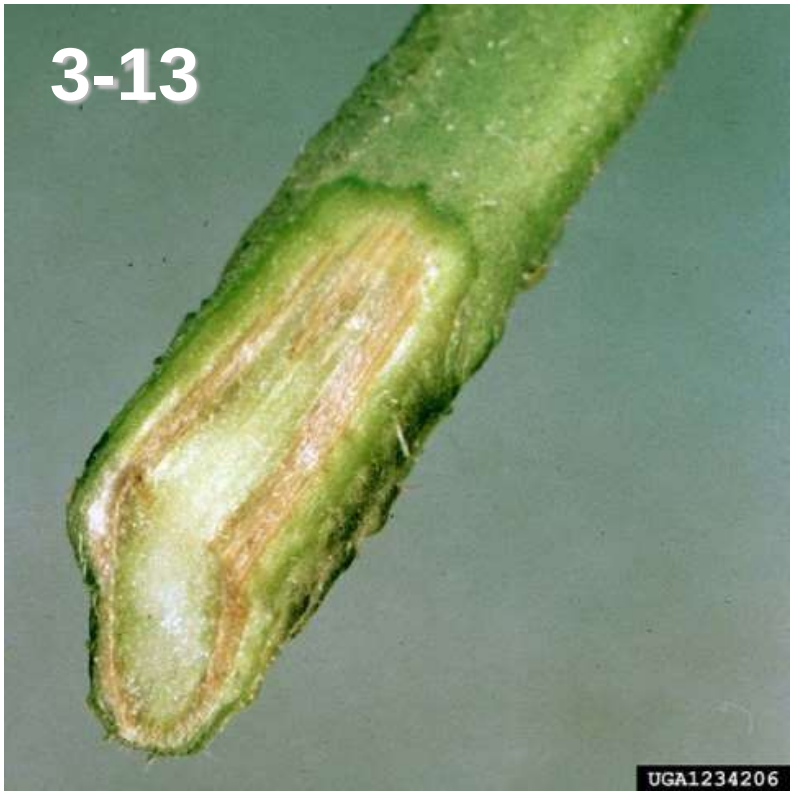


Photo: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org (CC BY 3.0 US)

Fusarium Wilt on a Plant (left) and affected stem (right)

3.6.2.c: Fusarium Wilt

General Descriptions:

- The fungus is both **seed** and **soil borne**
- It causes **more damage** on **light sandy soil**

Symptoms:

- **Yellowing of lower leaves** that **progresses to upper leaves**
- Drooping of **apical portion**
- **Withering of immature fruits**
- **Browning** of vascular bundles
- **Dying** of whole plant

3.6.2.c: Fusarium Wilt Cont'

Control:

- **Long crop rotation** (**4 – 6 years**)
- Use **certified seeds**
- Use of soil amendments e.g.) **organic manures**

3.6.2.d: Bacterial Wilt

Photo: Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org (CC BY 3.0 US)

Eggplant showing symptoms of infection

3.6.2.d: Bacterial Wilt

General Descriptions:

- It is caused by **a soil borne bacterium** which persists for a long period in soil
- Conditions which favour it: **warm temperature**, **moist soil**, **presence of nematodes** and **injured roots**

Symptoms:

- Rapid wilting and death of plants **without yellowing or spotting of leaves**
- The pith of a wilted plant has **a darkened water soaked appearance**

3.6.2.d: Bacterial Wilt Cont’

Identification:

- When a piece of stem is cut and immersed in a glass of water, **milky bacterial threads** are discharged from the cut surface (**oozing**)

Control:

- Control **nematodes**
- Use **certified disease-free seeds**
- **Rogue** and **destroy** infected plants
- Crop rotation with non-solanaceae plants

4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- **Maturity**: Harvesting starts **60 – 90 days after transplanting** depending on variety
- Harvest immature fruits **before seeds begin to enlarge and harden**
- Fruits should have **shiny glossy appearance**
- Over **mature fruits are bitter**
- **Yields:** vary from **8,000 – 10,000kg per acre** depending on the variety and crop husbandry

4. Harvest Cont'

Harvesting:

- **Secateur** or any other tool is used to harvest fruits
- When picking, **2.5 – 5 cm fruit stalk** is left **attached** to the fruit

Notes:

- Fruits should be harvested **early in the morning** when it is cool since the fruit temperature is low
- Harvested fruit should be kept in a **cool**, **shaded** and **ventilated area** in order to minimize heat gain

Reference

- The proposed agrochemicals are in accordance with “Products Registered for Use on Crops Version 1_2018”. The registered agrochemicals are subject to change. Please refer to the latest registered agrochemicals by Pest Control Product Board.
- Eden seeds (accessed on 7 Oct 2016)
  http://www.edenbrothers.com/store/organic-eggplant-seeds-black-beauty.html
- A4 Dibble Plants (accessed on 7 Oct 2016)
  http://a4dibbleplants.co.nz/eggplant-long-purple-p-736.html
- Tomato Growers supply company
  http://www.tomatogrowers.com/FLORIDA-HIGH-BUSH/productinfo/7157/
- East Africa Seeds
  http://www.easeed.com/index.php/component/joomgallery/vegetables/vegetables-85
- IPM Thailand
  http://thailand.ipm-info.org/components/mulching.htm
- Insects in Indian Agro-Ecosystems
  http://www.nbair.res.in/insectpests/Leucinodes-orbonalis.php
- Infonet-Biovision (accessed on 30 Sep 2016)
  http://www.infonet-biovision.org/PlantHealth/Crops/Eggplant
- Wikipedia: *Epilachna varivestis* (accessed on 29 Sep 2016)
  https://en.wikipedia.org/wiki/Epilachna_varivestis
  Stephen Ausmus - http://www.ars.usda.gov/is/graphics/photos/jun06/d496-82.htm

Reference

- MAIA, Valéria Cid; SANTOS, Jean Carlos and FERNANDES, G. Wilson. Asphondylia fructicola, a new species of Cecidomyiidae (Diptera) associated with Solanum sp. (Solanaceae) from Brazil. Rev. Bras. entomol. [online]. 2009, vol.53, n.2 [cited 2016-10-07], pp.166-170. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0085-56262009000200002&lng=en&nrm=iso>. ISSN 0085-5626. http://dx.doi.org/10.1590/S0085-56262009000200002.
- UmassAmherst Umass Extension Vegetable Program (accessed on 5 Oct 2015) https://ag.umass.edu/fact-sheets/root-knot-nematodes-in-vegetable-crops
- Master gardeners of Rutherford County (accessed on 5 Oct 2016) http://www.mastergardeners-rc.org/p-spider-mites.html
- Clemson Cooperative Extension (accessed on 7 Oct 2016) http://www.clemson.edu/extension/hgic/pests/plant_pests/veg_fruit/hgic2217.html Joey Williamson, ©2012 HGIC, Clemson Extension
- Skippy's vegetable garden (accessed on 7 Oct 2016) http://carletongarden.blogspot.co.ke/2009/09/late-blight-on-eggplants.html
- Donsgarden.co.uk (accessed on 7 Dec 2016) http://donsgarden.co.uk/pests/183
- Farm Fresh Eat Local..Eat Fresh http://www.bcfarmfresh.com/dive-into-the-world-of-eggplants/

Reference

- Development of ICT based tools/ technology towards an interactive multimedia Agriculture Advisory System, Tamil Nadu Agricultural University (accessed on 8 Dec, 2016)

  http://agritech.tnau.ac.in/govt_schemes_services/aas/brinjal_ex.html

- University of Minnesota | Extension: Garden

  http://www.extension.umn.edu/garden/diagnose/plant/vegetable/eggplant/leavesdiscolored.html

THANK YOU

ASANTE SANA

DOMO ARIGATO GOZAIMASU

Contact: SHEP PLUS Office (4th Floor, N.H.I.F. Building, Upper Hill, Nairobi)
Tel. No: 0737-293867/0712-504095
E-mail: info.shepunit@gmail.com