



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”**”

TOMATO 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



Tomato (Nyanya)

- Tomato is a member of the ***Solanaceae*** family which includes crops such as **Potato, Sweet Pepper, Chili** and **Egg Plant**
- One of the most produced and consumed vegetables in Kenya
- Important cash crop for smallholder farmers
- Mainly grown in open field but green house production has also grown in popularity
- Rich in **Vitamin A, C** and **Lycopene**
- **Eaten fresh**, added to **salads**, **cooked as a vegetable** or processed into **tomato paste, jam, sauce, puree** and **juice**

1.2 Common Varieties

1-2



Photo: Flora fields
http://www.florafields.com/index.php?route=product/product&product_id=189

“Rio Grande”

Determinate Varieties

“Rio Grande”:

- Fresh market and processing variety
- Plant is slightly bushy and can be staked or left unstaked
- Tolerant to verticillium and fusarium wilt
- **Maturity Period: 75 – 85 days** after transplanting
- **Yield: 18,000kg per acre**

1.2 Common Varieties



Photo: Farm Fresh Seeds
<http://www.farmfreshseeds.com/heirloom-tomato-seeds-cal-j.html>

“Cal J”

“Cal J”

- Open pollinated **determinate** variety
- Tolerant to verticilium & fusarium wilts
- The plant produces red blocky shaped fruits
- The fruits store and transport well
- **Maturity Period: 75 - 85 days** after transplanting
- **Yield: 11,000 – 13,000kg per acre**

1.2 Common Varieties Cont'



Photo: Syngenta kENYA
<https://www.syngenta.co.ke/tomatoes>

“Kilele F1”

“Kilele F1”

- Medium-early maturing, determinate type
- Suitable for drier or humid areas
- Disease tolerance: **Tomato Yellow Leaf Curl Virus, Tomato Mosaic Virus, Verticillium, Fusarium Wilt & Nematodes**
- Fruits: Firm and elongated and has shelf life of 21 days
- **Maturity Period: 75 days** after transplanting
- **Yield: 30,000 – 35,000kg per acre**

1.2 Common Varieties Cont'



Photo: seminis
<https://seminis.co.za/product/assila/686>

“Assila F1”

“Assila F1”

- **Determinate** early maturing (**75 days**) variety
- Tolerant to **Tomato Yellow Leaf Curl Virus (TYLCV)** & **nematodes**
- It produces fruits with attractive **red colour** with **oval shape** & **heavy sweet fruits**
- Yield: **23,000kg per acre**
- Good keeping quality & transportability

1.2 Common Varieties Cont'



Photo: seminis
<https://seminis.co.za/product/eden/687>

“Eden F1”

“Eden F1”

- **Determinate** and vigorous growing variety
- Good tolerance to **Alternaria Canker, Verticillium Wilt, Fusarium Wilt, Nematodes** and **Bacterial Speck**
- Deep red blocky fruits have long shelf life
- **Maturity Period: 75 days** after transplanting
- **Yield: 40,000-50,000kg** per acre (**9 – 10 kg** per plant)



Photo: Kenya Highlands Seed Co.
<https://royalseed.biz/tomatoes>

“Rambo F1”

“Rambo F1”

- Determinate, vigorous plant with uniformly set and firm fruits
- Tolerance: Bacterial wilt, Bacterial spot, Fusarium wilt, Verticilium wilt and Nematodes
- **Maturity 75 days** after transplanting
- **Yield: 30,000kg per acre**
- Good shelf life & transport quality

1.2 Common Varieties Cont'



Indeterminate Varieties

“Anna F1”:

- **Hybrid and indeterminate fresh market variety** that produces blocky oval red fruits that have a **long shelf life, tolerance to Fusarium, *Verticillium* Wilt, *Alternaria* Stem Canker and Nematodes**
- Ideal greenhouse Tomato
- **Maturity Period: 75 days** after transplanting
- **Yield: 64,000kg per acre (18 kg per plant for 8 months)**

“Anna F1”

1.2 Common Varieties Cont'

Indeterminate Varieties

“Tylka F1”



Photo:
<https://www.syngenta.co.ke/product/sed/tomato/tylka-f1>

“Tylka F1”

- Maturity Period: **75 days**
- Plant: **Intermediate**, very vigorous, good cover and **high yielding**
- Fruit: Very firm elongated, **non-green back**, smooth and firm **oval** fruits with an average fruit weight of **120-130g**
- Production/ Yield: **70,000-78,000kg** per acre under good agricultural practices
- Shelf life: Over **21 days**
- Disease tolerance: **Tomato Yellow Leaf Curl Virus (TYLCV), Tomato Mosaic Virus (ToMV 0-2), Verticillium & Fusarium Wilt (race 1&2)**

1.2 Common Varieties Cont'

Indeterminate Varieties

“Corazon F1”

- **Extended** shelf life
- Good resistant to cracking
- Suitable for **green house/** net house production
- **High yielding**, staking growing system
- Oval shape, weight:**130-190g**
- Resistant to: **Verticillium Wilt, Fusarium (race 1,2), Bacterial speck, Tobacco mosaic virus (ToMV), Nematode, Tomato spotted wilt virus, Tomato Yellow Leaf Curl Virus (TYLCV)**

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Photo: Amiran THE COMPLETE FARMERS CATALOGUE

“Corazon F1”

1.3 Choice of Varieties



Tomato crop in the field

Selection of variety need to be based on:

- **Growth Habit:** determinate (bush), indeterminate (climbing) and semi-determinate
- **Disease Tolerance/ Resistance:** indicated by initials after variety name e.g. **“F”** for **fusarium wilt**, **“N”** for **nematodes**
- **Fruit Type (shape, size & color):** Market requirement will determine fruit type.
 - Processing-intensive red color & more solids
 - Fresh market- shape, color & size vary
- **Hybrid or Open Pollinated Varieties (OPV):** Hybrid seeds give higher yields but are more expensive

1.4 Optimal Ecological Requirements

Altitude	0 – 2,000 Meters Above Sea Level
Rainfall	Over 600 mm of rainfall annually
Growing Temperature	20 – 25 °C (day) 15 – 17 °C (night)
Soils	•Well drained sandy, loam, and clay loam soils •pH range 6.0 – 7.5

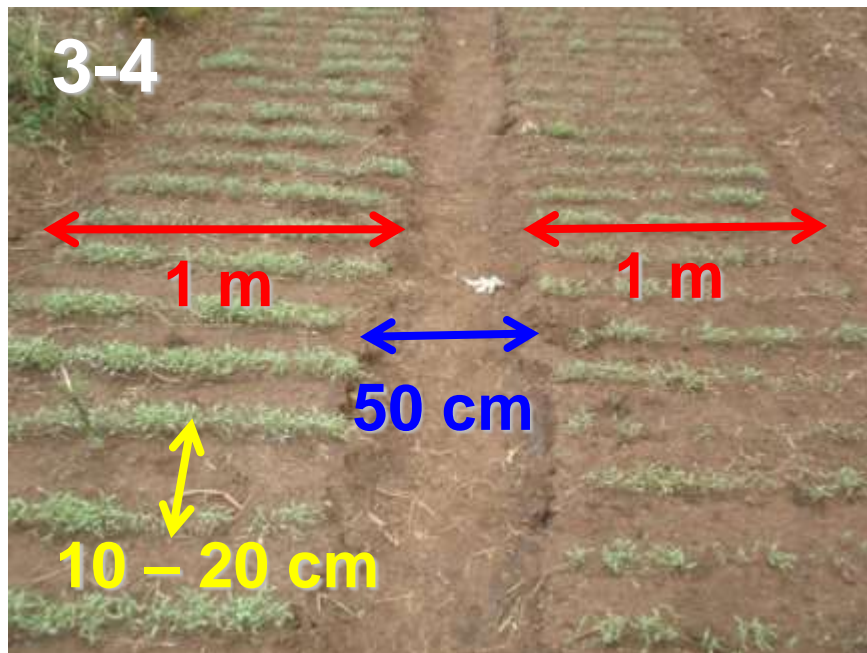
2. G20 technologies

- 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 seedling preparation/ 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 Raising Seedlings



Photos: SHEP PLUS

Tomato nursery

3.1 Raising Seedlings

(GHCP&PHHT20: Q9)

- Tomato can be established through nursery or directly seeded
- Normally, it is raised in nursery before transplanting
- The seed rate is about **40 – 75 g/acre**
- **Seed trays** can also be used to raise seedlings

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**
- Choose the site with **good drainage**

Nursery Establishment:

- Prepare a seedbed of **1 m width** and of a convenient length
- Make drills on the seedbed at a spacing of **10 – 20 cm apart**
- Thinly sow the seeds in the drills and cover lightly with soil

3.1 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
- Insects such as whiteflies can transmit viruses to young tomato plants hence should be controlled using pesticides e.g. Amitraz (Mitac 20EC®), Buprofezin (Applaud 40%SC®), Azadirachtin (Nimbecidine®), Imidacloprid (Confidor 70 WG®)
- The insects can also be blocked from reaching the seedlings by use of **an insect proof net** (agricultural type)

3.2 Transplanting



Recently transplanted Tomato seedlings

3.2 Transplanting

3.2.1 Appropriate Time

- Seedlings are transplanted **30 – 45 days** after seed sowing
- It is recommended that transplanting should be done either **early in the morning** or **late in the evening**

3.2.2 Recommended Spacing (**GHCP&PHHT20: Q10**)

- **Spacing:** range from **75 – 100 cm** (between rows) by **40 – 60 cm** (between seedlings) depending on the variety
- **Plant Population per Acre:** range from **6,666 to 13,333**
- Appropriate spacing produces short, stocky plants with good root system and reduces disease incidences

3.2 Transplanting Cont'

3.2.3 Fertilizer Application Rates (GHCP&PHHT20: Q11)

- Make holes and add **2 – 3 handfuls** of manure per planting hole (**8 tons/acre**)
- The type and quantity of fertilizers will depend on soil analysis results.

[General recommendations]

- Apply **2 bottle tops (10 g)** of Triple Super Phosphate (TSP) per planting hole (**80 kg/acre**)
- Apply Muriate of Potash (**MOP**) to enhance availability of potassium

3.3 Water Requirement

(GHCP&PHHT20: Q12)

- Tomato is sensitive to water deficit:
 - Immediately after transplanting
 - During flowering and fruit development
- Plants should be provided with adequate water
- Tomato plants are sensitive to water logging and flooded fields should be drained within **1 – 3 days**



Drip Irrigation in a Tomato field

Irrigation Methods:

- **Furrow** and **drip irrigation** are the most effective methods
- **Furrow irrigation minimizes** spread of fungal diseases, such as “Early Blight”
- **Drip irrigation** on the other hand is **efficient on water utilization**
- **Overhead irrigation encourages** spread of diseases such as “Early Blight”

3.4 Top-dressing

(GHCP&PHHT20: Q14)

- Tomato 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/acre at 4 and 8 weeks** after transplanting which is a general recommendation
- Soil analysis results provides specific information for each farm
- Application method: circular band around the stem
- **Inadequate top-dressing can result in physiological disorders such as:**
 - **Hollow cavities** and **poor taste** in fruits due to **potassium** deficiency
 - **Blossom-end rot** due to an imbalance between **nitrogen, calcium** and **soil moisture**

3.5 Crop Management

3.5.1 Staking & Training

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Photo: SHEP PLUS

Well staked Tomato field

- Indeterminate varieties need **staking/training** to facilitate pruning, harvesting and other cultural practices
- Determinate varieties don't require staking but may be staked in wet season to prevent fruit contact with the soil. On the other hand, **mulch** may be used instead of staking
- Staking materials: **wooden stakes, bamboo** or any **sturdy material**
- **Strings, plastic strips** or other material can be used to train the plant to the stake

3.5.2 Pruning



Training of tomato plants in the field. A side shoot has been pinched

- This practice is necessary for the **indeterminate** varieties
- It involves **removal of side shoots, extra flowers, fruits and diseased leaves**
- Leads to **early maturity** of fruits and encourages fruits to **increase in size and uniformity**
- **Sterilize** pruning blades by use of chlorine bleach and water at a ratio of **1:1**. Use of unsterilized blades and smoking can lead to spread of diseases e.g. **TMV, Bacterial Wilt**

3.5.3 Major Pests

The following are the major pests of Tomato in Kenya:

- A. African Bollworm**
- B. Red Spider Mites**
- C. Tobacco Whitefly**
- D. Root-knot Nematode**
- E. Thrips**
- F. Tuta absoluta***

3.5.3.A: African Bollworm



Photo: SHEP PLUS

A fruit damaged by “African Bollworm”

3.5.3.A: African Bollworm

Identification:

- Adult moth is **dull yellow** to **brown**
- The female moth lays **tiny round & brownish eggs** near or on flowers or small fruits
- Larvae have alternating **light and dark colored stripes** on either side of the body
- The pupa is **shiny brown**

Damage:

- Caterpillars feed on flowers and green fruits causing **flower abortion** and **sunken necrotic spots**, respectively
- Feeding holes made by the caterpillar serve as entry point for bacteria and fungi which may lead to rotting of fruits

3.5.3.A: African Bollworm

Control:

- **Tilling & ploughing** of old tomato field exposes pupa to desiccation and natural enemies
- **Planting of trap crops** (e.g. **Cucumber, Maize and African Marigold**) which attract the pest before it attacks tomatoes (Need to synchronize planting of both maize and tomatoes so that they flower at same time)
- **Use of selective pesticides** or microbial control agents like:
 - ***Helicoverpa armigera* SNPV virus (HelitecSC®)**
 - **Indoxacarb (Avaunt 150EC®)**
 - **Etofenprox 30%(TREBON 30 EC®)**

3.10.3.B: Red Spider Mites



Photo: SHEP PLUS

**Underside of Tomato leaf infested with
“Red Spider Mites”**

3.10.3.B: Red Spider Mites

Identification:

- Adult red spider mites are **oval in shape** and appear **reddish** and have eight (8) legs
- Eggs are very **tiny, spherical** and **whitish**; and are laid singly on underside of leaves
- Red spider mites **spin silk threads/ web** which protect/ anchor the pest and their eggs to the plant

Damage:

- Leaves when infected show **white to yellow speckling, later turn pale or bronzed**
- **High population causes serious drying** and dropping of leaves (defoliation) which leads to smaller and lighter fruits

3.10.3.B: Red Spider Mites

Control (Scouting & GAP):

- Use of pesticides (miticides) such as:
 - Spiromesifen (**Oberon SC 240®**)
 - Hexythiazox (**Arsur 100 EC®**)
 - Abamectin (**Avirmec 1.8EC®**, **Almectin 1.8%EC®**, **Agrimec 18EC®**)
 - Amitraz (**Mitac 20EC®**)
 - ***Amblyseius californicus* (Amblytech®-predatory mite)**
- Spider mites **rapidly develop resistance to pesticides**, especially when they are used continuously for several seasons
- To avoid development of resistance, farmers need to:
 - Use miticides **with different chemical composition/modes of action**
 - Avoid **routine spraying**
 - Use the **recommended dosage**

3.10.3.C: Tobacco Whitefly



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

“Whiteflies” on a leaf

3.10.3.C: Tobacco Whitefly

Identification:

- Adult whitefly resembles **small white moth** – like insect which cluster on the underside of upper leaves from which they suck sap
- Eggs are laid in arc or circle on the underside of young leaves
- When eggs hatch they produce **greenish white nymphs** which resemble scales

Damage:

- Suck plant sap and remove nutrients which cause **yellowing of infested leaves**
- The larvae secrete honey dew which supports growth of **black sooty mould**
- Transmit viral diseases, especially **Tomato Yellow Leaf Curl Virus (TYLCV)**

3.10.3.C: Tobacco Whitefly

Control:

- Keep tomato fields **weed free**
- Use of **yellow sticky traps** to monitor their population levels
- Covering tomato seedling nurseries with **nylon nets** or **insect proof nets** to protect seedlings from whitefly infestations
- **Use of insecticides in the morning & ring spray**
 - **Amitraz (Mitac 20EC®)**
 - **Buprofezin (Applaud 40%SC®)**
 - **Azadirachtin (Nimbecidine®)**
 - **Imidacloprid (Confidor 70 WG®)**
 - **Lambda Cyhalothrin (Karate 2.5WG®)**
 - **Lambda- cyhalothrin + Thiamethoxam (LEXUS 247 SC®)**

3.10.3.D: Root-knot Nematode



Photo: David L. Clement, University of Maryland, Bugwood.org (CC BY 3.0 US)

**Root galls: characteristic of
“Root-knot Nematode” infestation**

3.10.3.D: Root-knot Nematode

Description:

- Nematodes are **soil inhabitants** easily spread by **infested seedlings, soil washed down the slopes** or by farm **implements**
- Root-knot nematodes are most serious on **light sandy soils** under **furrow irrigation**

Damages:

- Plants are **stunted, yellow** and tend to **wilt** without **yellowing in hot weather**
- The roots of affected plants are severely **distorted, swollen** and **bear galls or knots**
- Heavy infestation results in severe loss in yield

3.10.3.D: Root-knot Nematode

Control:

- **Burn the top soil** using waste plant material after seedbed preparation
- **Solarize seedbeds** if possible by covering soil with clear polythene sheet for **2 – 3 months**
- **Manuring** of soil to reduce nematode population
- Fields should be **ploughed deep** and **harrowed followed by dry fallow**
- **Use trap/ repellent crops** such as **Marigold**
- **Use of nematicides** such as
 - **Azadirachtin (Nimbecidine®), Achook EC®)**
 - ***Paecilomyces lilacinus* (Bio-nematon 1.15% WP®, Mytech WP®)**
 - **Metham sodium (Metham sodium®)**
 - **Abamectin (Adventure 5G®)**
 - **Ethoprophos (MOCAP GR 10®)**

3.10.3.E: Thrips



Photo: © A. M. Varela, icipe (CC BY-NC-SA 3.0)

<http://www.infonet-biovision.org/PlantHealth/Crops/Tomato#simple-table-of-contents-4>

Thrips damage on Tomato

3.10.3.E: Thrips

Identification:

- Adult thrips are **small (0.5 – 2.0 mm)**, **slender** and **winged**
- Wings are long, narrow and fringed with long hairs
- Nymphs are **white or yellow**
- Both adults and nymphs feed on lower leaf surface, buds, flowers and fruits
- It transmits the **Tomato Spotted Wilt Virus/ Tospovirus (“Kijeshi”)**



“Kijeshi” symptoms

3.10.3.E: Thrips

Damages:

- Attack on leaves causes **speckling & small necrotic patches**
- Heavy infection causes **premature wilting, delay in leaf development & distortion of young shoots**
- Attack on buds and flowers leads to **abortion**

Control:

- **Ploughing and harrowing** before transplanting to kill pupae in the soil
- **Use of insecticides** such as
 - **Lambda-Cyhalothrin (Karate 2.5 WG®)**
 - **Abamectin + Acetamiprid (Amazing Top 100WDG®)**

3.10.3.F: *Tuta absoluta*



Photo: By Marja van der Straten, NVWA Plant Protection Service, Bugwood.org - <http://www.ipmimages.org/browse/detail.cfm?imgnum=5432149>, CC BY 3.0 us, <https://commons.wikimedia.org/w/index.php?curid=22440495>

***Tuta absoluta* adult (left)
and larva (right)**

3.10.3.F: *Tuta absoluta*



Photo: By N3v3rl4nd - Own work, Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=6598872>



By Goldlocki - Own work, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=228832>

Tomato Leafminer (left)
***Tuta Absoluta* (right)**

3.10.3.F: *Tuta absoluta*

Identification:

- The moth is **gray-brown**, **same size** and **posture** as diamond back moth (DBM) and has long antenna & lays up to **260 eggs**
- Newly hatched caterpillars are **small** (0.5 mm) and **yellowish**
- Mature caterpillars (9 mm: fully grown) are **yellow-green**, have **pinkish color** on the back and a **black band** behind the head
- Pupae is **light brown** and size is 6 mm
- The larva (caterpillar) is the **damaging stage**
- **Distribution** is through **seedlings, containers, fruits, soil & Green houses**

Damages:

- The caterpillar **burrows (mines)** in the middle of the leaf tissue
- Unlike other leafminers, it feeds indiscriminately and from a distance, it seems like the leaves are **“burning”**
- Most distinctive symptoms are the **blotch-shaped mines** in the leaves
- It bores n fruits, leaving **symptomatic tiny holes**
- It also burrows on stems causing **breakages**
- A serious pest and can cause **100% loss** if not controlled in time

3.10.3.F: *Tuta absoluta*

Control:

- **Early control** is important before the pest pressure builds up
- Carry out cultural practices like **field hygiene, crop rotation**
- Carry out **regular scouting/monitoring** of pest population
- Use of **pheromone traps** to attract male insects for both monitoring/surveillance and pest control e.g. mating disruption, mass trapping 'lure & kill' method, such as **Tutrak, Totalure (1m above the ground, 4-6 traps/ acre)**
- Use of insecticides like
 - **Chlorantraniliprole (Coragen®)**
 - **Indoxacarb (Avaunt 150EC®, Merit 150SC®)**
 - **Spirotetramat + Flubendiamide (Tihan OD®)**
 - **Thiocyclam 50% w/w; Thiocyclam-hydrogenoxalate (Evisect S®)**
 - **Imidacloprid (Grizly 175/30 SC®)**
 - **Flubendiamide (Belt 480SC®)**

Note: The above pest control tactics should be combined in an **IPM strategy**

3.10.4 Major Diseases & Physiological Disorders

- The following are the major diseases and physiological disorders of Tomato in Kenya:
 - a. Damping-off**
 - b. Late Blight**
 - c. Early Blight**
 - d. Bacterial Wilt**
 - e. Tomato Mosaic**
 - f. Blossom-end Rot**
 - g. Fusarium Wilt**

3.10.4.a: Damping-off



Photo: Infonet Biovision (CC BY-NC-SA 3.0)
<http://www.infonet-biovision.org/PlantHealth/Pests/Damping-diseases>

“Damping-off” symptoms on seedlings

General Description:

- This disease is **soil borne**

Symptoms:

- **Decay** of germinating seed
- **Girdling** of stem of young seedling at ground level

Control:

- Use of certified seed
- Avoid locating the seedbed on infected fields
- **Avoid excessive fertilizer** application and **watering** to young seedlings while still at nursery bed
- Apply chemicals such as:
 - Metalaxyl + Mancozeb (Amidjil 68WG®)

3.10.4.b: Late Blight



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

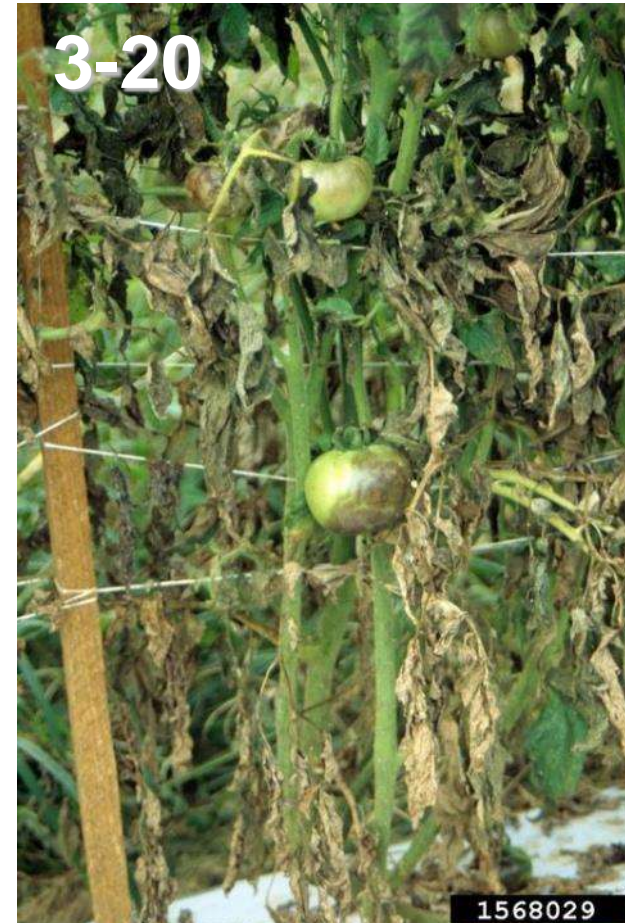


Photo: Edward Sikora, Auburn University, Bugwood.org (CC BY 3.0 US)

“Late Blight” on foliage and fruits

3.10.4.b: Late Blight

General Descriptions:

- This is a **fungal disease** which affects foliage and fruits
- The development of the disease is favoured by **cool** and **wet conditions**

Symptoms:

- Irregular **greenish-black water soaked** blotches/patches on leaves
- The spots on the leaves later turn **brown** and the attacked leaves wither but remain **attached** to the stem giving a **frost-damaged** appearance
- Water soaked **brown streaks** on stem
- Grey water soaked spots on fruits – upper half of the fruit with **foul smell**

Control:

- Crop rotation
- Removal of all volunteer crops that are more susceptible to this disease
- **Pruning and staking** in order to improve air circulation and reduce humidity
- **Use of fungicides**, such as:
 - **Metalaxyl + Mancozeb (Ridomil Gold MZ68®)**
 - **Propineb + Cymoxanil (Milraz WP76®)**
 - **Mancozeb (Dithane M45®)**
 - **Dimethomorph + Mancozeb (Acrobat MZ®)**

3.10.4.c: Early Blight



Photo: SHEP PLUS

“Early Blight” on Foliage

3.10.4.c: Early Blight

General Descriptions:

- This is a **fungal disease** which affects foliage and fruits
- The fungus is seed borne
- It is well adapted to semi-arid areas; warm wet weather
- The disease is favoured by warm rainy weather

Symptoms:

- **Premature loss of lower leaves** is the main symptom
- On leaves, brown circular spots with **dark concentric rings**
- Leaves turn yellow and dry when only a few spots appear
- On fruits, large sunken areas with dark concentric rings appearing velvety

3.10.4.c: Early Blight

Control:

- Use of certified seeds
- Appropriate spacing
- Avoid overhead irrigation, water in the morning and keep plants healthy/ stress-free

- **Use of fungicides**, such as
 - **Chlorothalonil (Odeon® 82.5WDG)**
 - **Mancozeb (Oshothane®)**
 - **Propineb (Antracol WP70®)**
 - **Mancozeb + Cymoxanil (Agromax®)**
 - **Propineb + Iprovalicarb (Melody Duo®)**

3.10.4.d: Bacterial Wilt



Photo: Don Ferrin, Louisiana State University Agricultural Center, Bugwood.org (CC BY 3.0 US)

Symptom of “Bacterial Wilt” infection

3.10.4.d: Bacterial Wilt

General Descriptions:

- This is a **bacterial disease** which is **soil-borne**
- It is easily spread by run off water and infected soil

Symptoms:

- **Rapid wilting** and **death** of entire plant **without yellowing or spotting** of leaves
- When the stem of a wilted plant is cut across, the pith has a **darkened water** – soaked appearance
- When stem of wilted plant is squeezed, a **greyish slimy ooze** is produced
- To distinguish this wilt from others, when a thin slice is taken from the brown stem tissue and placed inside a glass of water, a **milky ooze** is produced from the cut surface

3.10.4.d: Bacterial Wilt

Control:

- Practice crop rotation with crops such as cereals
- Remove wilted plants, with the soil around roots, from the field and destroy
- **Solarize** planting beds
- Spot treatment with **Sodium Hypochlorite** at 10 % dilution (Jik) or with **lime/ ash**
- Sterilize pruning tools
- Use of Metam sodium (METHAM SODIUM 51 Liquid soluble®), Bronopol (ENRICH BM Wettable Powder®)

3.10.4.e: Tomato Mosaic Virus

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Photo: University of Georgia Plant Pathology , University of Georgia, Bugwood.org (CC BY 3.0 US)

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Photo: © A. A. Seif and A. M. Varela, icipe <http://www.infonet-biovision.org/PlantHealth/Crops/Tomato#simple-table-of-contents-4> (CC BY-NC-SA 3.0)

Symptoms of “Tomato Mosaic Virus” infection on foliage and fruit

3.10.4.e: Tomato Mosaic Virus

General Descriptions:

- This is a **viral disease** which is easily transmitted by infected seed and plant debris in the soil
- Mechanically transmitted through transplanting seedlings and pruning tools

Symptoms:

- Mottling of leaves with raised dark green areas
- The shape of young leaves is distorted
- Internal browning of fruits, especially when fruits are affected **at mature green stage**

Control:

- Use certified **disease-free** seeds
- Remove crop **debris** and roots from the field
- Do not **smoke** or touch cigarettes as the virus is transmitted from tobacco leaves even if it is processed

3.10.4.f: Blossom-end Rot

General Descriptions:

- This is a **physiological condition** caused by **calcium-nitrogen imbalance in the soil**, especially when **moisture** level in the soil is **low**

Symptoms:

- A rot at the **blossom-end of the fruit**
- The surface becomes **dark brown** and **sunken**

Control:

- **Maintain adequate soil moisture**, especially at **fruit development stages**
- **Soil liming** in calcium deficient soils, **reduce N** and **mulch** the field
- **Top-dress with CN, Mavuno Planting** and ensure adequate soil moisture
- **Spray the crop with calcium chloride**
- Foliar application of **EASY-GRO CALCIUM®**



Photo: M.E. Bartolo, Bugwood.org (CC BY 3.0 US)

**Tomato fruits affected by
“Blossom-end Rot”**

3.10.4.g: Fusarium Wilt



Symptoms of Fusarium Wilt

3.10.4.g: Fusarium Wilt

General Descriptions:

- The fungus is both **seed- and soil-borne**.
- It causes most damage on **light, sandy** soils.
- It is most active at temperatures between **25** and **32°C**.
- The fungus can survive in the **soil indefinitely** even when no tomatoes are grown.
- It can also survive in **fibrous roots** of **weeds** (e.g. Amaranthus, Digitaria and Malva species).
- **Acidic** soils (pH 5.0 to 5.6) and **excessive nitrogen** fertilisation promote disease development.

Symptoms:

- The lower leaves of the plant usually turn yellow and die.
- Leaflets on **one side** may be affected while those on the other side are asymptomatic.
- Diseased leaves **readily break** away from the stem. When affected stems just above ground level and petioles are **cut diagonally**, a **reddish-brown** discolouration of the water conducting tissues will be observed.

3.10.4.g: Fusarium Wilt

Control:

- Use resistant tomato varieties (e.g. "Fortune Maker", "Rio Grande", "Tengeru 97", "Roma VFN", Eden F1, Rambo F1, Anna F1).
- Use certified disease-free seeds.
- Do not locate seedbeds on land where Fusarium wilt is known to have occurred.
- Where soil is acidic, raise the pH by applying lime or farmyard manure.
- Avoid excessive nitrogen fertilisation and control root-knot nematodes.

4. Harvest



Harvesting of Tomatoes

4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- Maturity period range between **3 – 4 months** after transplanting depending on:
 - The variety
 - Environmental conditions
- Tomato can be harvested at different stages depending on the market requirement and distance to the market
- There are **four (4) main harvesting stages**:
 - **Mature-Green Stage**: where the fruit is green but internal gel is well developed
 - **Breaker/Turning Stage**: up to **30%** of fruit surface has definite color break from **green to yellow**
 - **Pink/Light Red Stage**: **30 – 90%** fruit surface has **pink/red color**
 - **Red/Ripe Stage**: over **90%** fruit surface has changed to **red color**

4. Harvest

- Fruits should be harvested **early in the morning** when it is cool since the fruit temperature is low
- Harvested fruits should be kept in a **cool, shaded and ventilated area** in order to minimize heat gain
- When necessary, wipe fruits to remove dirt
- The yields vary from **12,000 – 40,000kg per acre** depending on the variety and crop husbandry

5. Post-Harvest Handling



Photo: SHEP PLUS

Graded tomatoes packed in crates

5. Post-Harvest Handling

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

- Pack tomatoes in clean well ventilated containers to transport. Normally packed in wooden and plastic crates

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

Sorting:

- Sorting is done to remove damaged or diseased fruits.

Grading:

- Tomatoes are graded depending on the uniformity of ripening and fruit size
- There are **three (3) main tomato grades**:
 - **Grade 1**: big size fruits of uniform color and shape
 - **Grade 2**: medium size fruits of uniform color and shape
 - **Grade 3**: small size fruits with slight variation in color and shape

5. Post-Harvest Handling Cont'

5-2



Photo: SHEP PLUS

Tomatoes in crates ready to be transported to the market

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

Processing:

- Processing tomatoes into high value products such as **jam**, **sauce**, and **pickles** enables farmers to earn more income

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.
- Infonet Biovision (accessed on 7 Dec 2016) :
<http://www.infonet-biovision.org/PlantHealth/Pests/African-bollworm>
<http://www.infonet-biovision.org/PlantHealth/Crops/Tomato#>
- Eden F1 Leaflet (Monsantoafrica)
http://www.monsantoafrica.com/_pdfs/tomato_eden_flier_en.pdf
- Plantwise Factsheets for Farmers “Fusarium wilt of tomato”
<https://www.plantwise.org/KnowledgeBank/factsheetforfarmers/20157800181>

THANK YOU

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