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""

WATERMELON 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

Watermelon (Tikiti Maji)

- Watermelon is a **warm season crop**
- Popular fruit for **fresh consumption** and **agro-processing**, such as juice making
- It contains about **6 % sugar** and **92 % water** by weight
- It is a source of **Potassium, Vitamin A, Vitamin C, Folate and Amino acid. It contains some of the most important antioxidants in nature- e.g. Lycopene**

1.2 Some Common Varieties

1-2

“Sugar Baby”

“Sugar Baby”

- Round dark green to black fruit with deep red flesh
- Very sweet and juicy
- **Maturity Period: 120 days**
- **Average fruit weight: 4 kg**
- **Yield potential: 20 – 30 tons/acre**

1-3

“Sukari F1”

“Sukari F1”

- Early to medium
- Good fruit setting ability
- Fruits are oblong in shape
- Rind color: light green with dark green stripes
- **Maturity Period: 90 days**
- **Average fruit weight:** 7 – 8 kg
- **Yield Potential**: **25 – 35 tons/acre**
- Has good transport and keeping qualities

1.3 Other varieties

- **Zuri F1**: has strong rind; resistant to **Fusarium** wilt.
- **Sweet Rose F1**: maturity **80-90** days, nearly round & good keeper
- **Charleston Grey**: light green strips & hard rind. It is **drought** resistant
- **Crimson Sweet**: resistant to root-knot nematode

1.4 Optimal Ecological Requirements

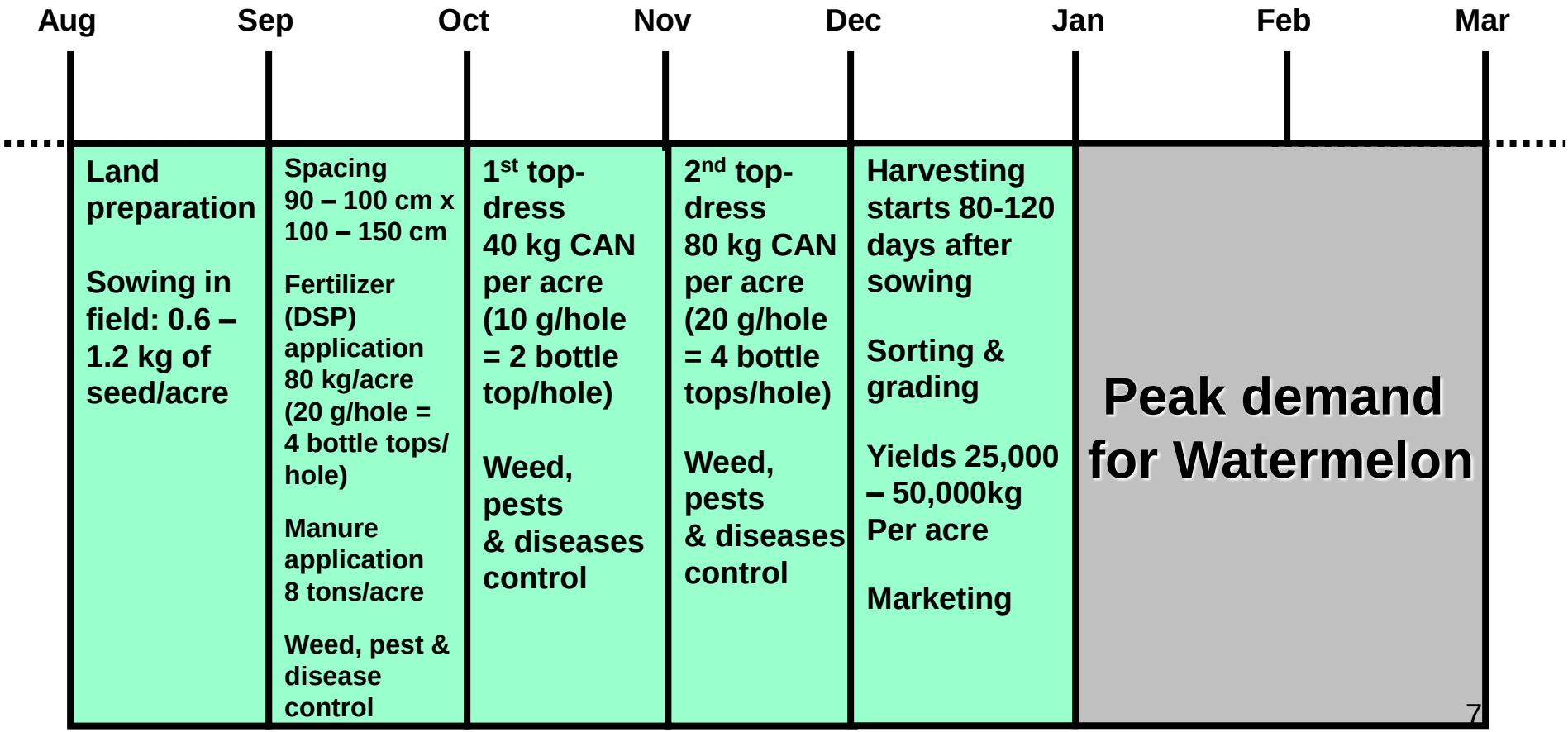
Altitude	**0 – 1,500 metres above sea level**
Rainfall	**400 – 600 mm of rainfall annually**
Growing Temperature	**22 – 28 ^{0}C (day)**
Soils	**•Sandy loam** **•Well drained and slightly acidic** **•pH range 6.0 – 6.8**

2. Pre-Cultivation Preparation:
2.1 Market Survey

Conducting a market survey on Watermelon

2.2 Crop Planting Calendar

A Sample of a Watermelon Planting Calendar



Other Pre-Cultivation Preparation Techniques

2.3 Soil sampling & analysis

2.4 Composting

2.5 Quality seed/planting materials

3.0 Cultural Practices

3.1 Land preparation

3.2 Incorporation of crops residues

3.3 Basal application

3.4 Planting

Photo: SHEP PLUS

Young watermelon plants

Seed Rate:

- About **0.6 – 1.2 kg per acre** depending on variety and spacing
- Soak seeds overnight to hasten germination

3.4.1 Recommended Spacing (GHCP&PHHT20: Q10):

- **100 – 150 cm** between rows
- **90 – 100 cm** between plants
- Plant population: 2,666-4,444 plants per acre

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

- **80 kg** per acre of TSP or DSP

3.5 Water Requirement

Drip Irrigation

(GHCP&PHHT20: Q12)

- Water deficit during flowering and fruit development causes serious yield reduction
- Irrigation is important to ensure consistent moisture availability e.g. 4-day interval
- Excessive irrigation causes splitting / cracking, tasteless and watery fruits

3.6 Management of Weeds

3-6

3-7

Photos: SHEP PLUS

A watermelon field with good weed management (left) and field with weeds (right)

3.7 Top-dressing

Top-dressing using the placement method

(GHCP&PHHT20: Q14)

- **CAN** top dressing fertilizer is applied in **2 splits**:
  - **1st split application:** when the plants start to run (**40 kg per acre**)
  - **2nd split application:** when plants are about to flower (**80 kg per acre**)

3.8 Crop Management:
3.8.1 Mulching

Photo: © Victor Omari, HCD 2019

Mulching underneath fruit using organic materials

3.8 Crop Management:
3.8.1 Mulching

Mulching underneath fruit using organic materials

- Mulching could be done using straw or dry leaves
- Its advantages include:
  - **Moisture conservation**
  - **Weeds suppression**
  - **Prevents fruits** from being in contact with soil and hence pest & disease attack
  - The fruits need to be turned regularly to ensure uniform fruit color development

3.8.2 Pruning

Photo: Howard F. Schwartz, Colorado State University, Bugwood.org (CC BY 3.0 US)

Control the number of fruits per plant if market demands larger fruits

- Remove any d**ead**, **diseased**, **yellowing**, **infested** leaves or shoots at the joint where they are connect to the main stem
- Remove **deformed** and **blossom-end rot fruits**
- Maintain 2-3 vines and remove extra vines
- If market demands larger melons leave 3-4 well shaped melons per plant
- **Do not** prune when vines are wet

3.9.3 Major Pests

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

A. Melon Flies
B. Aphids
C. Spider Mites
D. White Flies
E. Epilachna Beetles
F. Root-knot Nematodes

3.9.3.A: Melon Flies

Photo: SHEP PLUS

Identification:

- Adult has a yellow stripe in the middle of the thorax between the wings
- A black (often incomplete) T-shaped marking on the abdomen (the rear body section)
- Additional dark patches towards the outer edge of the wings
- Head yellowish with black spots

3.9.3.A: Melon Flies (1/2)

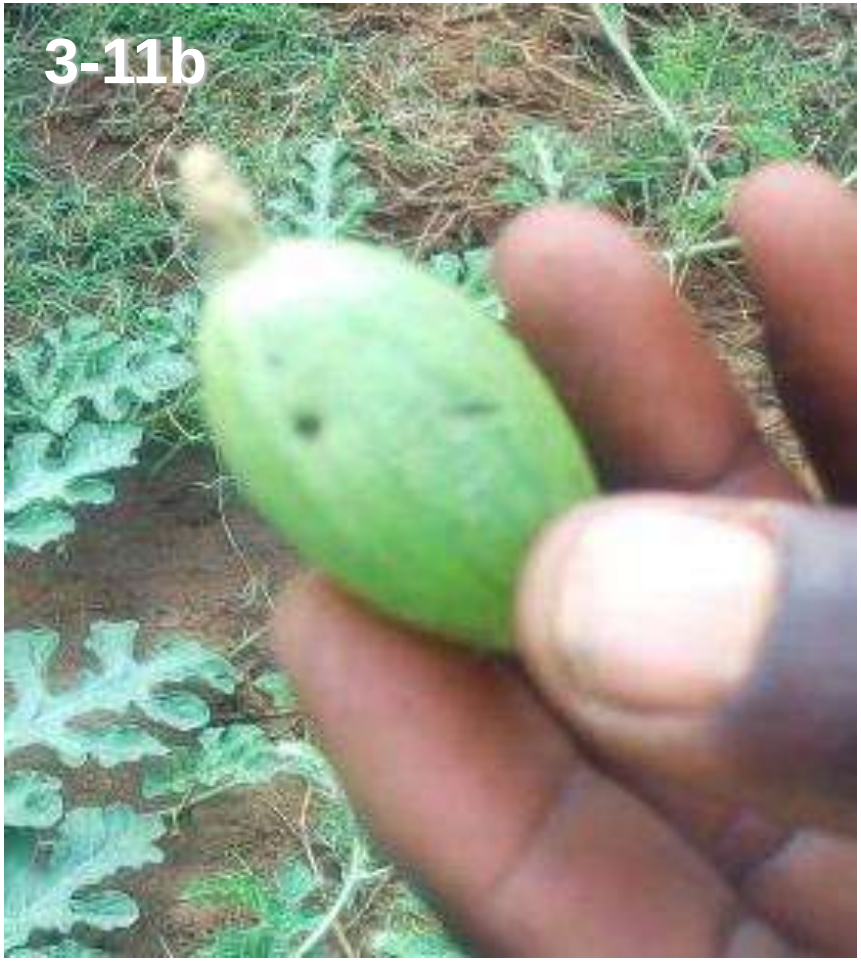


Photo: SHEP PLUS

Damages:

- Larvae usually tunnel into the fruit causing a watery ooze to form on the surface that can later turn brown and **resinous**
- Exit holes by the larvae (**2 – 3 holes**) are visible on fruit surface
- Affected fruit will rot and often fall from the plant prematurely
- Larvae can also feed on flowers and plant stems

3.9.3.A: Melon Flies (2/2)

Control:

- **Field Monitoring/ Biological control:**
  - Use of pheromone traps e.g.) **cue lure** baited traps, and **Bactrolure L®** (a.i. **Methyl Eugenol**) used together with **Malathion**
- **Cultural Control:**
  - Wrap fruits with a eco-bags
  - Remove fruits with dimples and oozing clear sap
  - Kill the maggots by burning, burying or tying collected fruits in black plastic bags
- **Chemical Control:**
  - Difficult since larvae feed inside the fruit
  - **Use of pesticides**, such as
    - **Deltamethrin (Decis 2.5 EC®)**
    - **Trichlofon (Dipterex 95 SP®)**

3.9.3.B: Aphids

Photo: Mississippi State University , Mississippi State University, Bugwood.org (CC BY 3.0 US)

Aphids on a leaf

Identification:

- Colonies of **green to blackish** aphids are found on tender shoots
- **Excretion of honeydew**

Damages:

- Attacked leaves are **curled** and **twisted**
- Sooty mould

Control:

- Ensure plants are not water stressed
- **Use of pesticides**, such as
  - **Azadirachtin (Nimbecidine®)**
  - **deltamethrin (Decis 2.5EC®)**
  - **Abamectine + Diomethosam (Summit ®)**

3.9.3.C: Spider Mites

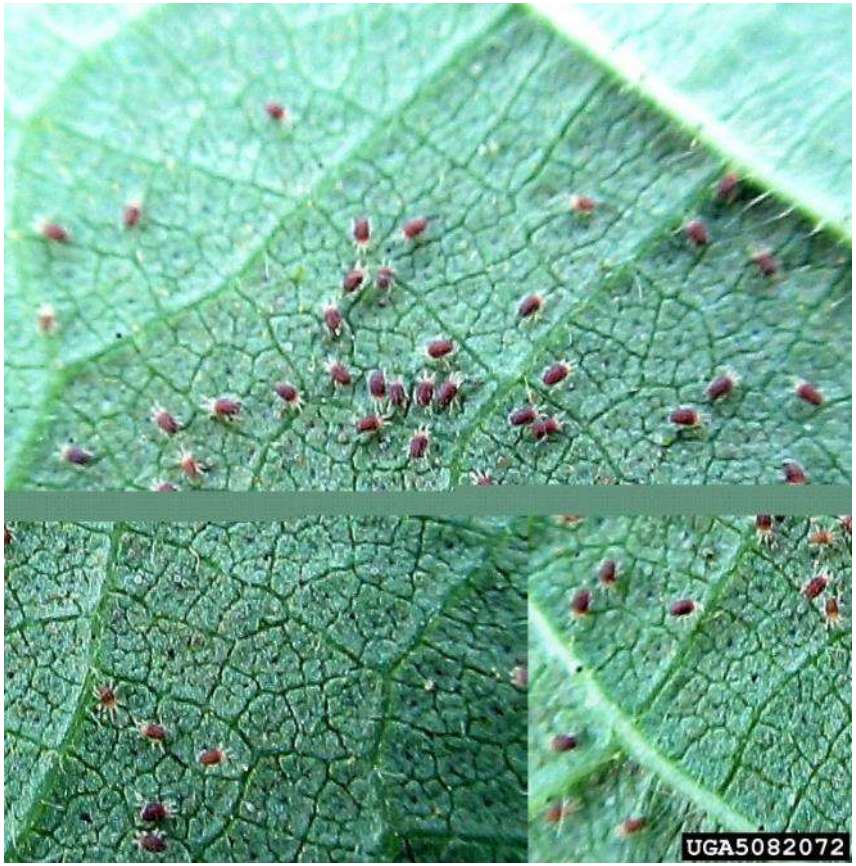


Photo: O.P. Sharma, Bugwood.org (CC BY 3.0 US)

Spider mites on a leaf

Identification:

- Mites are tiny spider like pests which spin silk threads for anchoring to the plant
- Their bodies are **yellow-green** to **reddish brown color**
- They flourish at **low humidity** and **high temperature** (**hot dry conditions**)

3.9.3.C: Spider Mites Cont'

Damage:

- Attacked leaves show **white to yellow speckling**
- Where there is high infestation, plant is covered with **orange cloud of mites** and **webs**

Control:

- **Adequate irrigation**
- **Mulching** to conserve water
- **Predatory mite (Phytotech®)**
- Spray with **miticides**, such as: **Bifenthrin (Brigade 25EC®)**

3.9.3.D: White Flies

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

White Fly adults on a leaf

Identification:

- Small soft bodied insects with wings covered with white powdery wax
- Presence of honeydew and sooty mould

Damage:

- Sucking sap
- Vector of viral diseases (Cucurbit Yellow Stunting Disorder)

Control:

- Use of pesticides such as:
  - **Lamba-Cyhalothrin (Karate 2.5WG®)**
  - **Thiamethoxam (Actara 25WG®)**

3.9.3.E: Epilachna Beetles

Photo: © A. M. Varela, icipe (CC BY-NC-SA 3.0)
http://www.infonet-biovision.org/PlantHealth/Crops/Watermelon#simple-table-of-contents-2

An Epilachna Beetle

Identification:

- Adults resemble lady bird beetles

Damages:

- Feed on leaves leaving fine net of leaves
- Damaged leaves **shrivel** and **dry up**

Control:

- **Spray with insecticides**, such as
  - **Deltamethrin (Decis 2.5EC®)**
  - **Lambda-cyhalothrin (Duduthrin Super EC®)**

3.9.3.F: Root-knot Nematode

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

Root-knot Nematode (Meloidogyne sp.) induced galling of Watermelon roots

General Description:

- Most cucurbits are extremely susceptible to Root-knot Nematodes

Symptoms:

- Stunting, weak/ unhealthy, premature wilting, and slow recovery to improved soil moisture conditions

3.9.3.F: Root-knot Nematode Cont'

Symptoms Cont':

- Root symptoms cause swollen areas (galls) on the roots of infected plants which result from exposure to multiple and repeated infections
- Leaf chlorosis (yellowing)

Control:

- **Cultural Control:**
  - Crop rotation of less susceptible crops or resistant varieties
  - Use of adequate amount of manure
  - Use of resistant varieties e.g.) Crimson Sweet
  - Use of **Ethoprophos** (MOCAP GR10®), **Azadirachtin** (NIMBECIDINE EC®)

3.9.4 Major Diseases

- The following are the major diseases of Watermelon in Kenya:

a. Powdery Mildew
b. Anthracnose
c. Downy Mildew
d. Fusarium Wilt
e. Gummy Stem Blight (Black Rot)
f. Watermelon Mosaic Virus (WMV)

3.9.4.a: Powdery Mildew

Photo: Jason Brock, University of Georgia, Bugwood.org (CC BY 3.0 US)

Symptom of

“Powdery Mildew”

General Descriptions:

- It is a fungal disease which is favoured by dry condition

Symptoms:

- White powdery growth start on lower leaf surface and later on the upper surface
- At advanced stage necrotic areas develop on the leaves

Control:

- **Use of fungicides**, such as
  - **Sulphur (COSAVET DF®)**
  - **Famoxadime+Cymoxanil (EQUATION PRO®)**
  - Azoxystrobin + Difenoconazole (AZOXY TOP 325 SC®)

3.9.4.b: Anthracnose

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

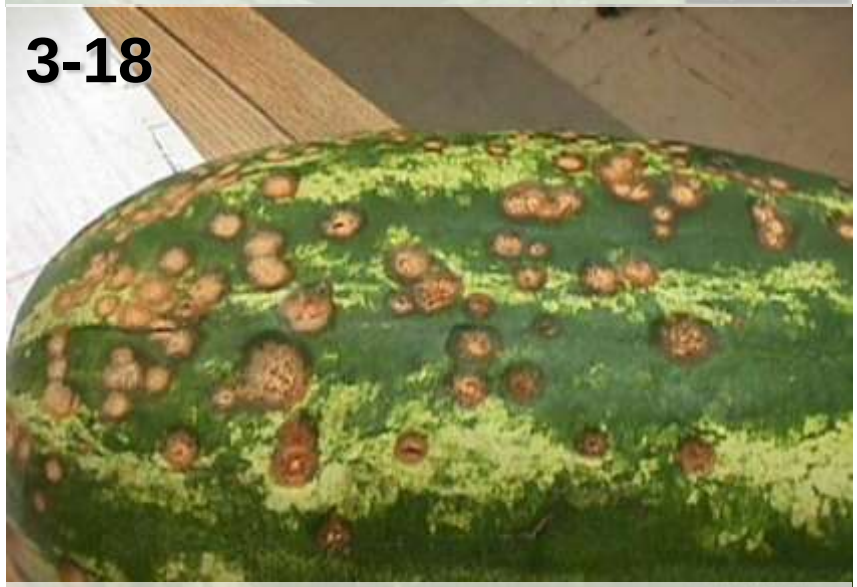


Photo: Jason Brock, University of Georgia, Bugwood.org (CC BY 3.0 US)

General Descriptions:

- This disease is caused by **fungus** and affects **leaves**, **vines** and **fruits**
- Plants can be infected at **any stage**

Symptoms:

- **Round to angular reddish brown spots** on older leaves
- Spots may **dry**, **turn black** and **tear out**
- **Sunken spots** on the rind of fruits which may produce pinkish colored ooze

3.9.4.b: Anthracnose Cont’

Control:

- **Cultural Control:**
  - Crop rotation
  - Plant clean seeds
- **Chemical Control:**
  - Use of fungicides, such as
    - **Copper Oxychloride (Samaya Kop 50WP®)** when vines start to run
    - **Mancozeb (Dithane M45®)**
    - **Azoxystrobin + Difenoconazole (AZOXY TOP 325 SC®)**

3.9.4.c: Downy Mildew

Photo: SHEP PLUS

Downy Mildew on upper leaf surface

General Descriptions:

- Fungal disease which attacks leaves of Watermelon
- The pathogen is air borne

3.9.4.c: Downy Mildew Cont'

Symptoms:

- Small, irregular, chlorotic spots on upper leaf surface becoming brown and necrotic; entire leaf may become blighted
- Infected leaves tend to curl upward from the margins
- Gray to purple downy growth may be visible on underside

Control:

- **Cultural Control:**
  - Reduce canopy density
- **Chemical Control:**
  - **Mancozeb (Milthane Super®, Penncozeb WP®)**
  - **Propineb + Cymoxanil (Milraz WP®)**
  - **Dimethomorph + Mancozeb (MILLIONAIRE 69% WDG®)**

3.9.4.d: Fusarium Wilt

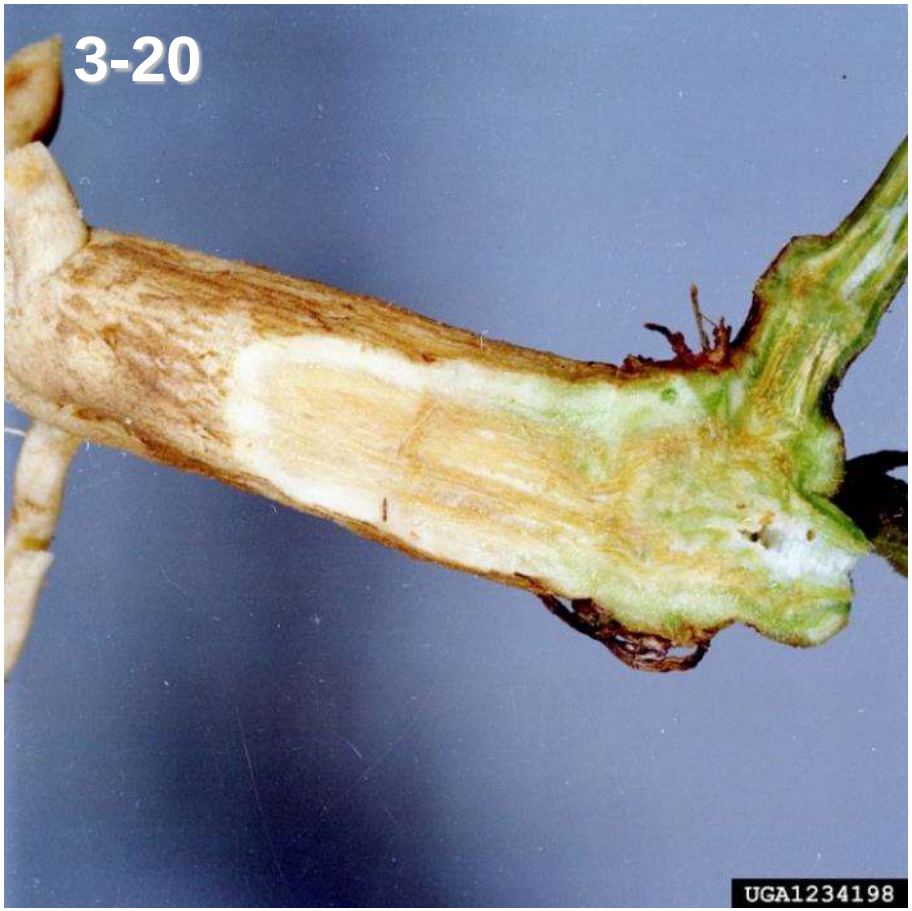


Photo: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org (CC BY 3.0 US)

Cross section of a stem affected by Fusarium Wilt

General Descriptions:

- It is **a fungal disease** which can infect crop at any stage of growth
- Pathogen can be spread by **seed**, **soil** or **drainage water**

Symptoms:

- Wilt symptoms develop from **one** or **few runners**
- Vascular tissue of lower stem and roots show **brown coloration**

3.9.4.d: Fusarium Wilt Cont'

Photo: Howard F. Schwartz, Colorado State University, Bugwood.org (CC BY 3.0 US)

Stems and leaves affected by Fusarium Wilt

Control:

- **Crop rotation**
- Rouging/removal and destruction of diseased plants
- Plant in well drained soils and avoid water logging
- **Use of certified seed**
- Use of **well decomposed manure** and **compost**

3.9.4.e: Gummy Stem Blight (Black Rot)

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

Brown irregular lesion on leaf

Photo: Rebecca A. Melanson, Mississippi State University Extension, Bugwood.org (CC BY 3.0 US)

A stem showing the gummy exudate symptoms

General Description:

- The disease affects **leaves**, **stem** and **fruits**

Symptoms:

- **Brown round** or **irregular lesions** on leaves
- Lesions on stem are **brown** and later **turn white**
- Gum oozes from stem cracks
- Affected fruits are **soft** and **discolored**

Control:

Use of chemical, such as **Copper Oxychloride** (SAMAYA KOP 50WP®, COBOX 50WP®, ISACOP®)

3.9.4.f: Watermelon Mosaic Virus (WMV)

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

WMV symptoms on the leaf

Photo: By Source (WP:NFCC#4), Fair use, https://en.wikipedia.org/w/index.php?curid=37441924

Fruit affected by WMV

General Descriptions:

- This disease is transmitted by **aphids**
- It infects **only cucurbit crops**

Symptoms:

- **Mottling of leaves**
- Stunted growth, shortened internodes with bushy erect growth for some runner tips
- **Mottled appearance** on fruit surface

Control:

- **Field sanitation:** removal of weeds (they are potential hosts)
- Control aphids

4. Harvest

Photo: SHEP PLUS

A farmer and his harvested watermelon

4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

- **Tendrils** near **fruit stem** have changed color from green to **brown**
- **Ground spot** on the **belly** of the melon has changed from white to **yellow**
- The fruits when **thumped** with the hand produce muffled **dull tone** (immature fruits produce clear metallic ringing tone)
- Cut and leave the stalk attached to the fruit
- Mature fruits have sweet taste, flavor, crisp texture and deep red color
- **Sugar content** (measured as soluble solids by use of hand held refractometer) of **10 %** or more in the flesh near the center of the melon

Main harvesting stages:

- Mature but before full ripeness for distant markets
- Mature and ripe for nearby markets

4. Harvest Cont'

Notes:

- Watermelons don't ripen after they are picked so harvest time is important (non climacteric)
- If harvested immature, red color will develop but sugar content does not increase after harvest
- Harvesting should be done by cutting the vine and NOT pulling, twisting or breaking off the vines

Yields: 25,000 – 50,000kg per acre (Depending on varieties)

5. Post-Harvest Handling

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

Photo: SHEP PLUS

Choose appropriate post harvest handling methods

5. Post-Harvest Handling Cont’

Sorting and Grading

- Watermelons are sorted to remove insect-damaged, **blossom-end rot**, cracked, discolored, without stalk
- Watermelons are graded according to size (small, medium & large) for each variety

5. Post-Harvest Handling Cont'

Packaging, Storage & Transportation

- Graded watermelons are packed in large containers or cartons
- Watermelon can be stored for two (2) weeks.
- But prolonged storage leads to lose of crispness and color
- Vehicles for transportation should be straw or paper-padded to reduce damage through bruising

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
- http://www.infonet-biovision.org/PlantHealth/Crops/Watermelon
- http://www.greenlife.co.ke

THANK YOU

ASANTE SANA

DOMO ARIGATO GOZAIMASU

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