Chapter 7

Main protected vegetables

Cucumbers

Family – Cucurbitaceae
Specie - Cucumis sativus Linnaeus
Type – Parthinocarp, pollinated

Varieties
Short
Long

Varieties
Short smooth
Short with spines

Pathinocarp = Development of female flowers to fruits without Need for pollination.

Cucumbers Cultivation

1. Required conditions for the crop.
2. Soil preparation: Fertilizers, Plowing, Fumigation
3. Distances between plants
4. Vertical growth and pruning
5. Fertilization
6. Irrigation
7. Cultivation season & verities
8. Plant protection: Foliage diseases, Soil born diseases , Insects, Viruses

Required Conditions for crop

1. Soil temperature: > 18 c.

2. Radiation: 900-1500 Micro E.

3. Humidity: 70-85%

Type of Soil and Characteristics

Desirable soil for Cucumbers growing are:

Well drained, Fairly deep 50 -70 cm, fertile & good proper PH, good soil structure, permit penetration of roots well penetration of water (not compact soil)and air maximum nutrient availability and enhancement of water holding capacity, low soil salinity.

Soils with good organic matter generally are the most satisfactory soils for vegetables and Cucumbers.

Types of Flowers

Female flowers, Cucurbits

Male flowers, Cucurbits

Parthinocarp (No need for pollination), Cucumbers

Basic Information for open fields

Distance between bids - 40-50 Cm.

Distance between plants 40 Cm

Growing period (Palestine), Spring/Summer (warm) 21 -30 days.

Winter harvest: 30-40 days

Length of harvesting period 45 days

Interval of harvesting 2-3 days

Harvesting Intervals

- In order to get suitable product for canning the intervals between harvests must be very short 2-3 days.

- product with high quality must be small, short and thin,

Winter varieties,
Less flowers on node

Soil preparation

1. Removing residues of last crop.
2. Soil preparation, plowing by sub-soiler 40-45 cm depth.

3. Compost application: 4-5 m^3/du

4.Fertilizers application:
25-50 kg/du super phosphate.

5. Irrigation: 50-100 m3/du by sprinklers.

6. Using plow by rotovater 15-20 Cm. depth for mixing
7. Before planting irrigation 50 m^3/du.

Distances

Single row – 140 Cm. Between rows, between plants 40 Cm.

Double rows – 180 Cm. Between rows, between plants 40-50 Cm.

Cucumber Seedling well prepared, the root system covers the substrate and white color (young).

IRRIGATION

(According to Evapotranspiration ET)

Plant age in days	Irrigation coefficient
0-14	0.3-0.4
14-35	0.4-0.6
35 or more	0.8-0.9

The total amount of water (3-10 m3/du/day) divided to 3-8 times a day in soil less culture

Fertilizing cucumbers in medium and heavy soils

N:P:K
N:P2O5:K2O

Fertilizing cucumbers in light and heavy soil soils

Plant age/days	Gram/1m^3 water irrigated		
	Pure nitrogen N	Phosphorus $P_2 0_5$	Potassium K_2O
0 - 14	60	60	60
14 - 35	100 - 120	60	100 - 120
35 - crop end	120 - 150	60	150 - 180

Pests of Cucumbers in greenhouses

1. Soil Born Diseases:
   - Nematods spp
   - Fusarium, Pythium
   - Rhizoctonia
2. Foliage diseases:
   - Powdery Mildew
   - Downy Mildew
   - Angular leaf spot (Lachrymans)
   - Botrytis
   - Sclerotinia

Pests of Cucumbers in greenhouses

3. Insects: Red mites, Thrips, Bemisia Tabaci, Leaf miner, Spodoptera,

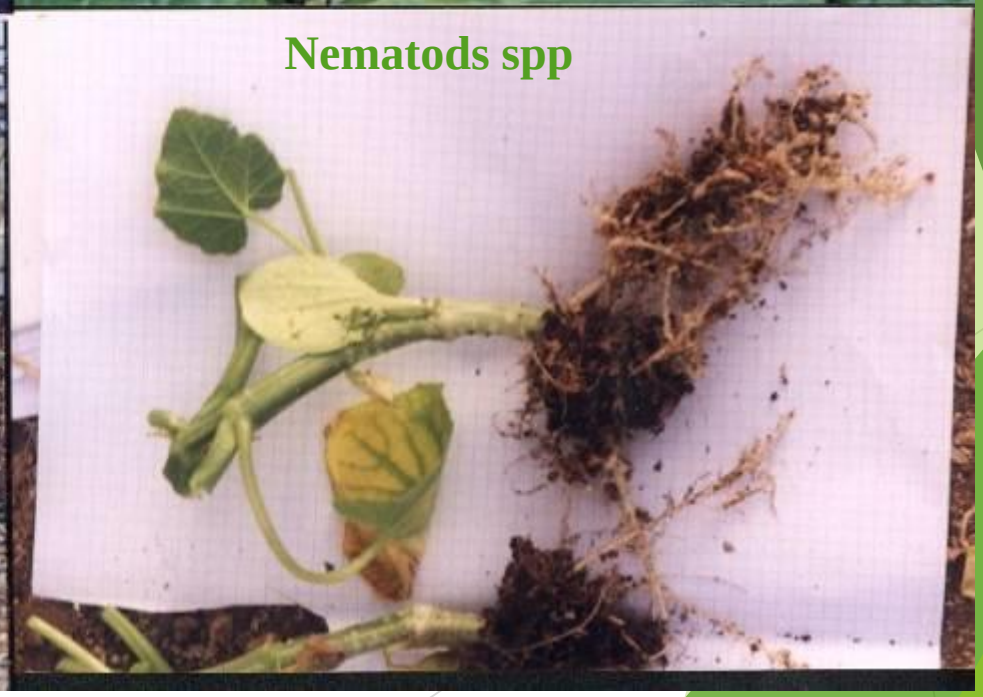
4. Viruses: CMV, CVYV, CYV, ZYMV, CGMMV

Nematodes Infection

Fusarium

Pythium

Test of Rootstocks



Nematods spp

2. Foliage diseases

- **Powdery Mildew** ***(Sphaerotheca fuligina)***
- **Downy Mildew** (***Pseudopernospora cubensis***)
- **Angular leaf spot (*Pseudomonas Lachrymans)***
- **Gray Mold** ***(Botrytis cinerea)***
- **Sclerotinia sclerotiorum**
- **Dedimela Gummy stem** ***(Mycosphaerella melonsis)***

Strong infection with Downy Mildew

Powdery Mildew

Downy Mildew

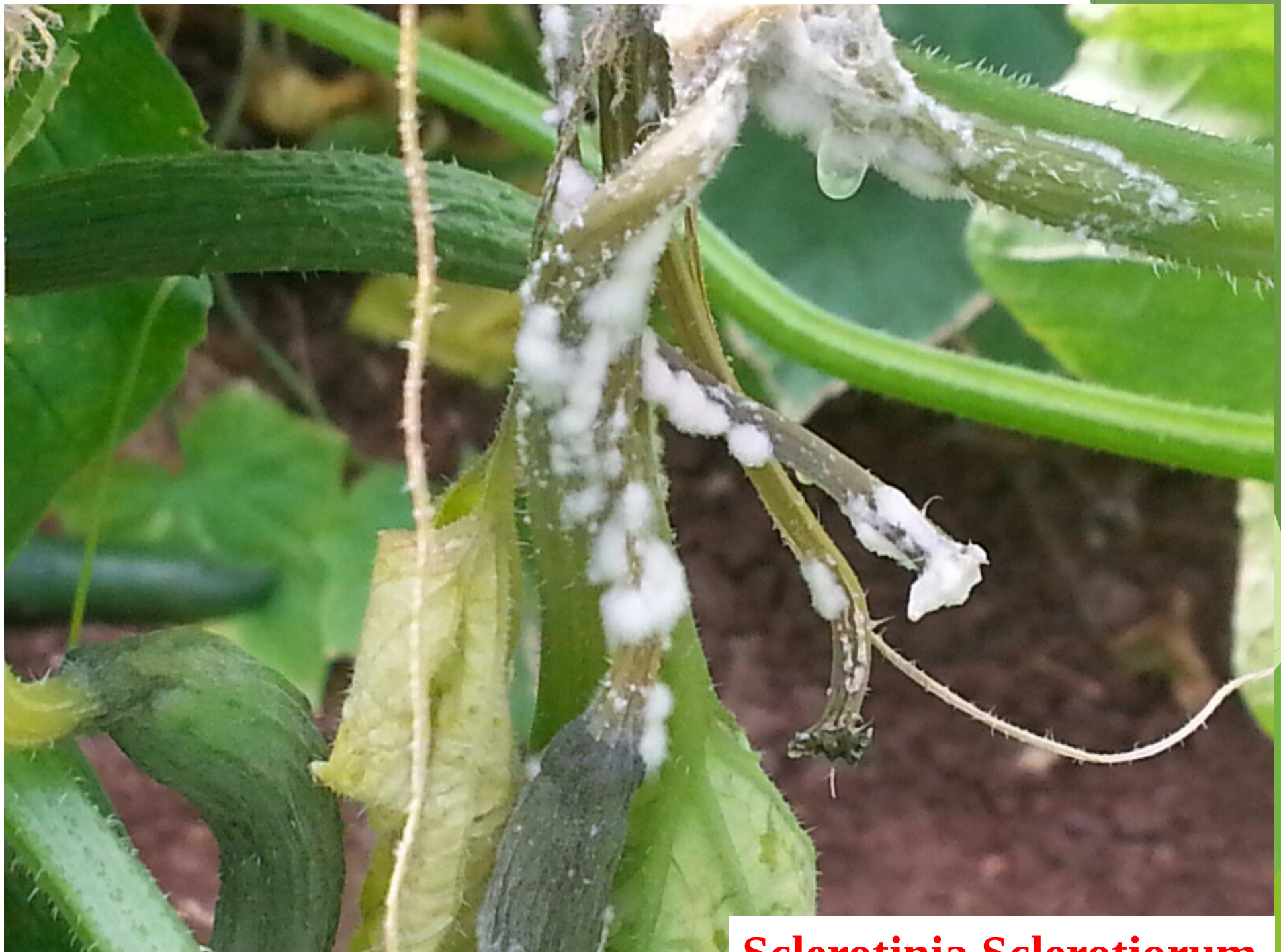
Down side

Downy Mildew

Upper side

Botrytis

Infection by Botrytis and Healthy plants



Sclerotinia Sclerotiorum

Sclerotinia

Pests of Cucumbers in greenhouses

3. Insects:

Red mites, Thrips, Bemisia Tabaci, Leaf miner, Spodoptera,

Red mites

(and their natural enemies)

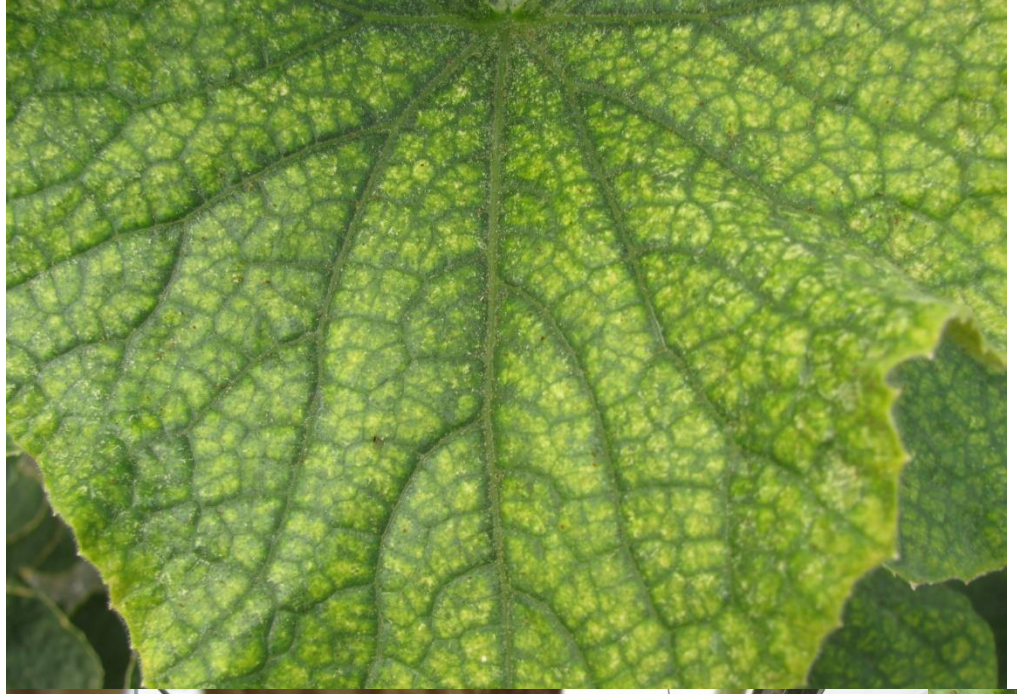
אקרית הפרסימיליס, נקבה בוגרת.
גודל אמיתי: 1 מ"מ אורך.

זוג אקריות פרסימיליס ולידן גוויה מצוצה
של אקרית צהובה.

מושבה אופייניות של האקרית הצהובה.

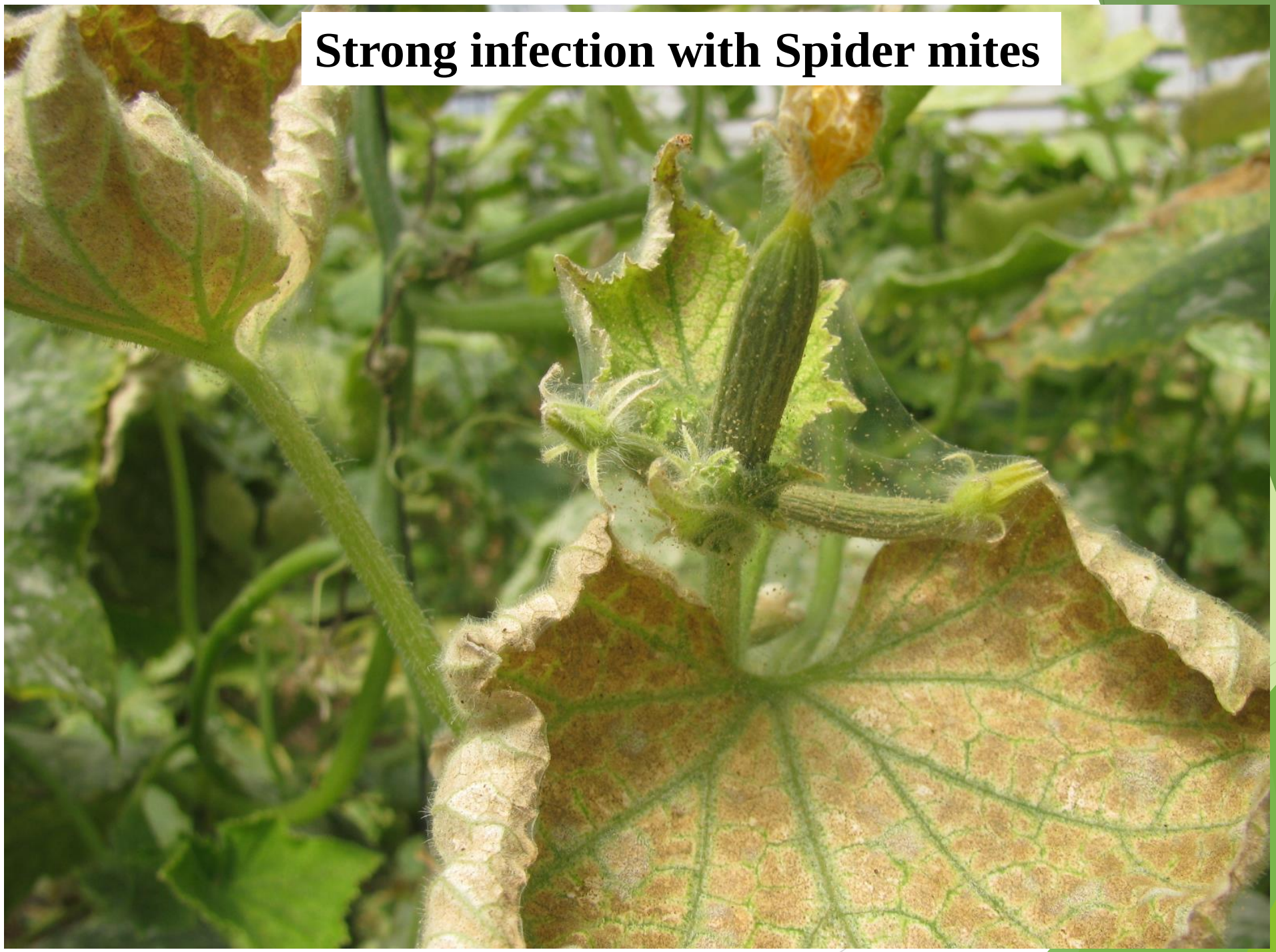
אקרית הפרסימיליס (מימין) תוקפת אקרית צהובה.

Damaging of mites



Strong infection by Spider mites

Strong infection with Spider mites



בוגר וביצים של כימת עש הטבק.
גודל אמיתי של הבוגר: 1.2 - 0.85 מ"מ אורך.

עורות גולם ריקים של כימת עש הטבק.
משמאל, חור גיחה של צירעת המונדוס.
מימין חור גיחה של כימת עש הטבק.

זחלים מדרגה שניה, שלישית ורביעית
של כימת עש הטבק

Bemisia Tabaci

זבוב מנהרות, בוגר. גודל אמיתי: 2-2.5 מ"מ אורך

שני זחלים של צירעת הדיגליפוס ניזונים מרימה משותקת של זבוב המנהרות.

Leaf miner

Thrips

Thrips cause direct Damages to leaves & Fruits, sucking and Small spots on fruits

בוגר של תריפס קליפורני. גודל אמיתי: 1.2 מ"מ אורך.

שלוש נימפות דרגה רביעית של פשפש האוריוס

Nymphs Orius the predator of thrips

Damages of Thrips up, damages of low tem. Down, healthy fruits right

Infection by Aphids
Cause deformation
of leaves & Transmit Viruses

Cucumber Green Mottle Virus CGMMV

Transmitted by Seeds and mechanical

Cucumber Vein Yellowing Virus CVYV

Transmitted by Bemisia Tabaci- (Persistent)

Cucumber Yellowing Virus
CYV

Transmitted by

Bemisia Tabaci-

(Semi-Persistent)

Grafting ?

Uniting of two living plant parts so that they grow as a single plant

- In this method, a scion of a variety which is capable of producing a quality commercial yield, is grafted onto rootstock which is capable of growing in harsh soil conditions.

- These adverse conditions include soil infested with nematodes and soil-borne diseases, lack of aeration, high salinity and other problems.
-
- In this way, a susceptible variety can be grown in soil which was previously unsuitable, achieving commercial yields

Grafting of Cucumber Seedlings

Soil mulching in Cucumbers for soil heating in low temperature

Non Pathogenic Disorders

- High salinity
- Fruit Skin creaking (cold injury)
- Herbicides damage
- Male flowers
- Misshaped fruits (temp. and Pollination)

Tomato

Taxonomy

Dicotyledon

Family: Solanaceae

Genus and species: Lycopersicon esculentum

Related species: pepper, eggplant, ground cherry, nightshade

Tomato

Domestication

Originated in the Andean region of South America

First domesticated in Mexico – very ancient

Taken to Europe around 1544

Use delayed by poisonous reputation

Cultured in the U.S. around 1830

Most worldwide production began after 1850

Tomato

World Production and Use

China now the largest producer

- Dominates production of processing exports

US and Europe major users of fresh tomatoes

- Mexico the largest exporter of fresh tomatoes
- Turkey a major exporter into Europe

CLIMATIC REQUIREMENTS

- Climate is one of the most important factors when determining planting times. The wide variation in climate in South Africa allows the planting and production of good quality fresh tomatoes in open fields in various parts of the country all year.
- Tomatoes are known to be a warm season crop.
- It can survive certain amounts of cold units, but are intolerant of very low temperatures.
- A tomato crop requires very stable temperature ranges with minimums and maximums not being too wide apart. Temperature variation might result in poor fruit quality or reduced yields.
- The minimum temperature is around 10°C with the maximum being 34°C. Optimum temperatures are around 26 - 29°C.

Developmental Stage	Temperatures (˚C)		
	Minimum	Optimum	Maximum
Germination	11	16 - 29	34
Vegetative Growth	18	21 - 24	32
Fruit set – night	10	14 - 17	20
- day	18	19 - 24	30
Red Colouring	10	20 - 24	30
Yellow Colouring	10	21 - 32	40
Cold Damage		under 6	
Frost Damage		under 1	
Terminal Damage		-2	

Required temperature ranges per development stage for optimum tomato production.

CULTIVATION PRACTICES

SOIL PREPARATION

Soil preparation improves the potential for profitable production of tomatoes.

Any primary soil preparation must be aimed at creating growing conditions plants to develop the optimal root system in a specific soil profile.

Although the root structure of a tomato plant can penetrate various soil types up to depths of 2 meters, the highest percentage roots

The advantages of soil preparation are:

- No restrictions on root development. Less chance of compaction.
- More oxygen in the soil creating better root development.
- Higher yield.
- Reduction in production costs.
- More vegetative growth.
- More tolerance to drought and stress.
- Less root disease prevalence.
- Horizontal and vertical compaction layers broken.
- Better water retention.
- Increased uptake of moisture and nutrients.

The choice of preparation systems should be determined by the plant requirements and the soil type.

Soil preparation should be done to depths varying between 200 – 400mm. Ridging is highly recommended.

The main advantage of ridging a tomato crop is to keep excess water away from the plant, improved oxygenation of the root zone, increased soil depth in the growing bed, to promote root development.

Due to the effect of certain factors being prevalent at specific locations, within each of these areas the planting times may be earlier or later than the times given below.

Establishment periods for the main production areas will then be:

1. Simi costal areas: Feb to May

2. Algore ares: Sept to May

3.Cold areas: May to Nov

4. Middle high lands: Oct to Dec

PLANT POPULATION AND SPACING

- Plant populations differ hugely from area to area and region to region.
- The lowest commercial plant population is around 2000 to 2200 plants per du.
- The single most important factor when making a decision around plant population is the type of chemical spraying system- or method that the grower is going to use for the duration of the crop.
- Everything should be designed around this implement so as to get in between rows to effectively control pests and diseases. It is highly recommended to try and keep the between row spacing at 1.8 to 2.5 meters.
- Tomatoes grown on the ground for informal and fresh markets should have enough inter row spacing (minimum 1.8m)

- Plants with vigorous growing habits are recommended with in row spacing of not closer than 35 – 40cm.
- Plant population under protection is usually up to two times higher than open field production. With varieties that have a determinate habit the yield per plant will stay relatively constant to different plant populations, but too high populations will make a difference.
- Looking at marketable yields as well as the yields of large fruit, it was clear that the trend on the determinate types was towards yielding the best at the highest plant population. The indeterminate types had no significant effect.
- Farming in general requires producing the highest yield of saleable product. The best yield of saleable product was generally achieved at the higher plant populations.

These recommendations are followed:
Open land: 1200 – 1800 plants /du.
Under protection: 2000 – 2400 plants/du.

FERTILIZATION GUIDELINE

Requirement stages:

0 – 5 weeks:	Vegetative growth occurs with high Nitrogen requirements.
6 – 12 weeks:	The flowering stage with high Potassium requirements.
12 – 20 weeks:	The fruit set and fill stage with high Calcium, Magnesium requirements.

Ideal fertilization levels:

N:	18 – 20 Kg/du
P:	6 – 10 Kg/du
K:	30 – 40 Kg/du
Ca:	25 – 30 Kg/du
Mg:	5 – 6 Kg/du

Above quantities are calculated over a 17 – 22 week application cycle and soil analyses not taken into consideration.

IRRIGATION

The supply of adequate water to the roots of a tomato plant is critical. Under- or over irrigation can have a devastating effect on the outcome of the crop. It is therefore very important to apply water at optimal times.

Too little water might lead to:
Sub-optimum yields.
•Decrease in the photosynthetic rate.
•Plants developing stunted growth.
•No production of flowers.
•Low percentage fruit set.
•Slow fruit development.
•Small fruit sizes.
•Poor quality. Flower abortion.

Too much water might lead to:
•Not enough oxygen in the soil.
•Plants becoming wilted.
•Root diseases becoming prevalent.
•No plant development.

- When scheduling irrigation, the size of the root system at the time of irrigation needs to be taken into account.
- In general, the root system can be compared to the aerial growth of the plant.
- The roots spread into the soil at a similar rate to which the aerial growth develops. Most tomato roots occur in the top 500 – 600 mm of soil level, even at maturity. For this reason irrigation should be monitored at this level with irrometers.
- Deep, thorough irrigations are preferable to light and regular watering intervals. Drip or flood irrigation is preferable to overhead irrigation, due to susceptibility to foliar diseases.
- The amounts of water used will vary depending on the climatic conditions.
- During the cooler months tomatoes require about 0.5 M3 per day and this might increase to 3-4 M3 under very hot, windy and dry conditions.

PRUNING

To maximize photosynthetic efficiency and minimize risk of disease, the suckers that form in the axils between the leaves and the main stem of indeterminate tomato types may be pruned.

A strong main stem is encouraged by removing all suckers below the first flower cluster. It is recommended to remove side shoots before they are 5 cm in length. More stems will however result in more, smaller fruit, produced increasingly later in the season. The indeterminate tomatoes can have one to many stems (commonly not more than four).

Fewer stems will produce fewer, though larger, fruit, and the plant will take less space. For a multi-stemmed indeterminate plant, allow the second stem to grow from the first node above the first fruit.

A third stem can be allowed to develop from the second node

Fresh Tomato

Variety Selection

Market garden opportunities

- Heirloom varieties
- Unusual colors
- Unique culinary

Fresh Tomato

Harvest

Harvested at various stages

Mature green or breaker for shipping

Pink or turning red for local markets

Full red for home use

Tomato

Disease Problems

Fungal

- Late blight
- Early blight
- Pithium damping off
- Fusarium wilt

Bacterial

- Bacterial wilt

Tomato

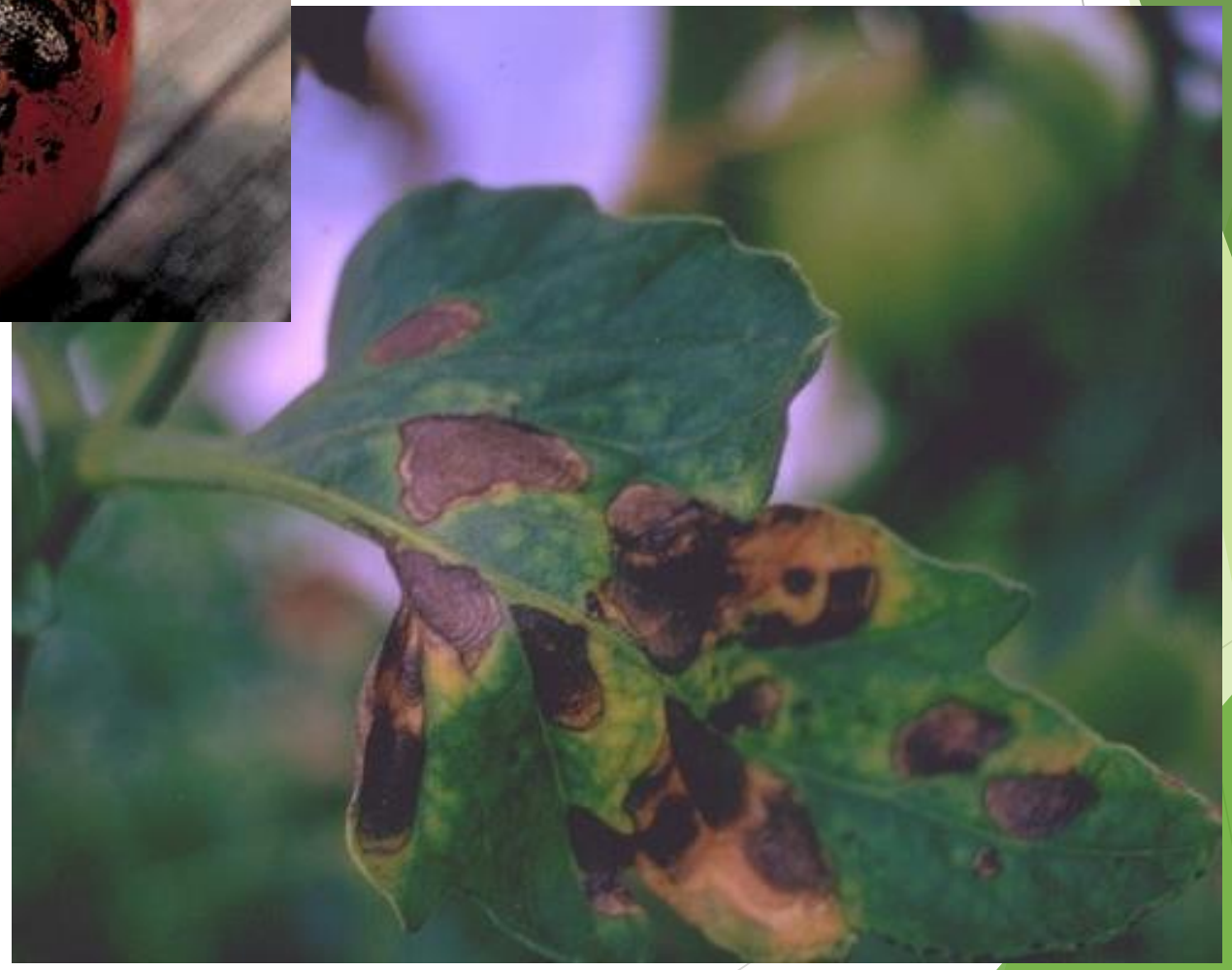
Disease Problems

Viral
- Tobacco mosaic
- Tomato spotted wilt
- Tomato leaf curl
- Cucumber mosaic virus

Physiological
- Blossom—end rot

Nematode
- northern/southern root-knot

Late blight

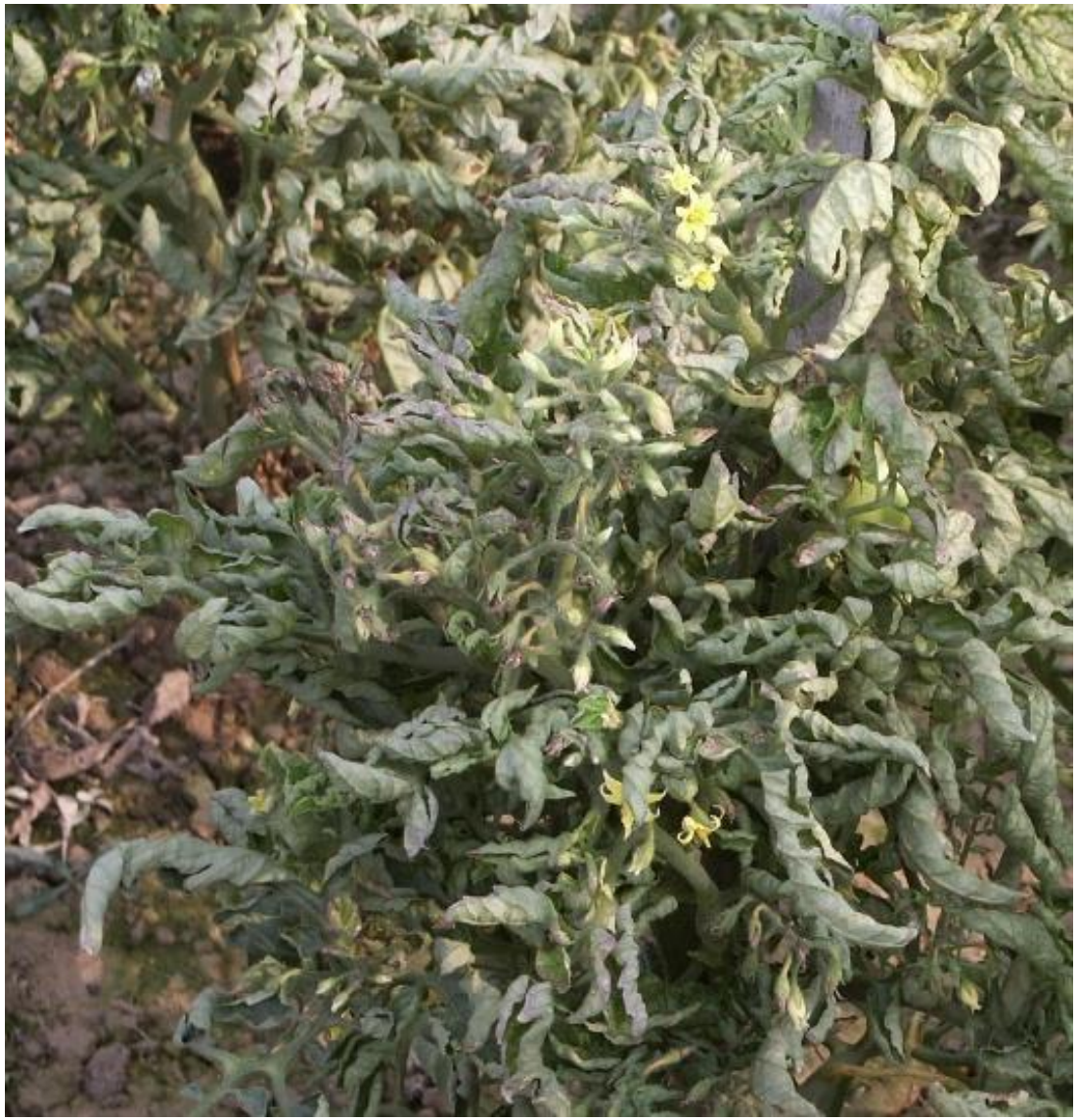


Early blight

Damping off

Fusarium wilt

Tomato spotted wilt



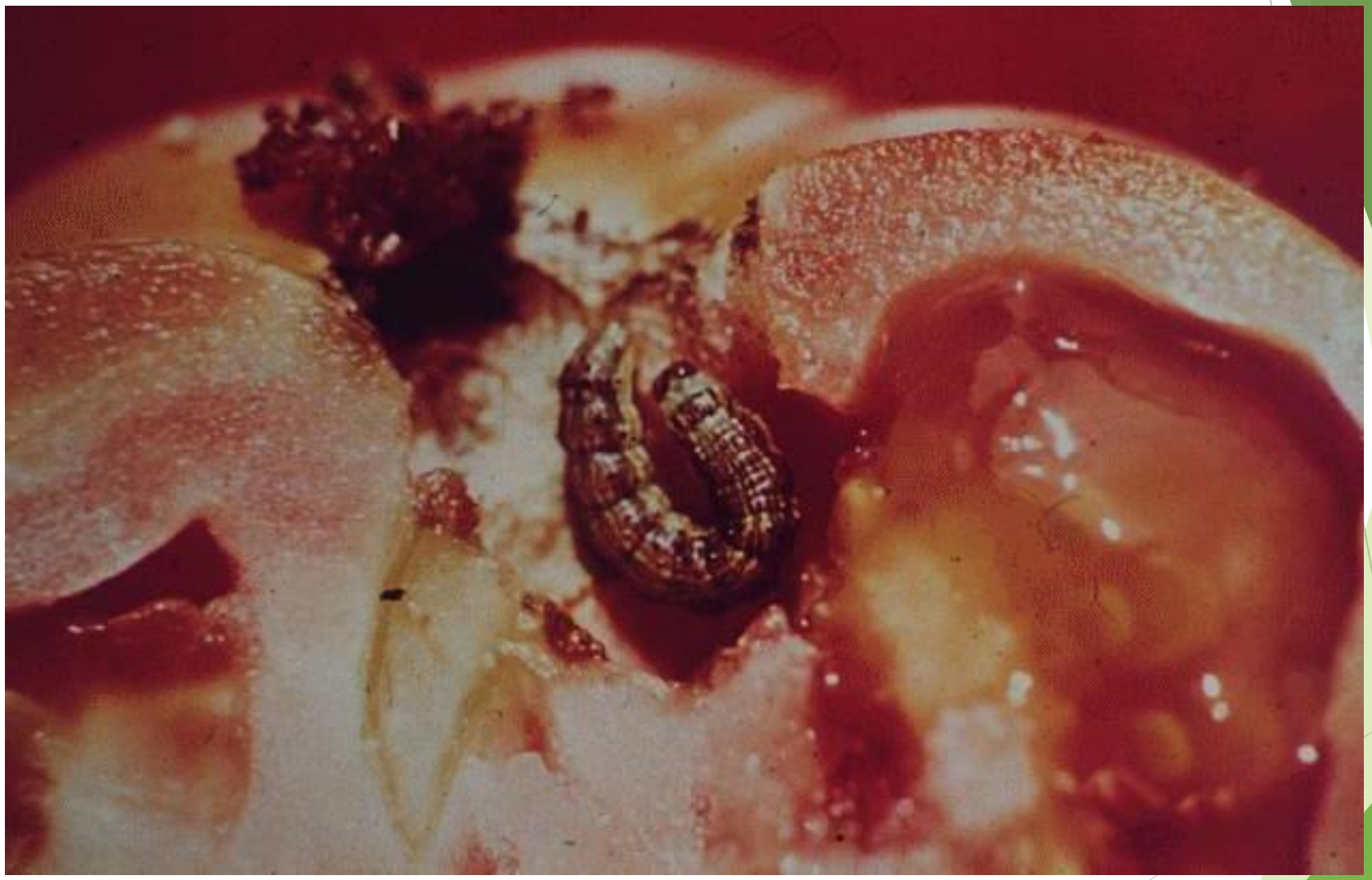
Tomato curl leaf virus

Cucumber mosaic virus

Root-knot nematodes

Blossom-end rot

Tomato hornworm



Tomato fruit worm

Breeding by genetic methods

Resistance for Soil-borne diseases.

Resistance for Foliage diseases.

Tolerant varieties for Nematodes.

Resistance and tolerant for Viruses.

Use of root stock for grafting.

Overcome: Nematode Tolerance-Breeding

Overcome: Breeding Tomato varieties Tolerant To TYLCV

saline water, nematode, number of plants:
Grafted Seedlings With 1 Or 2 Stems Per Plant

Grafted tomato plants in green-houses

Grafted plants have vigorous vegetative growth, and produce higher yield than non grafted plants.

Fusarium Crown Rot

The Problem Spidermites. Two-spotted spidermite and red spidermite

Two-spotted spidermite - adult, nymphs and egg

A female predator

Predator in action

Results of predation

Commercial package

Leaf miner damages

- A well ventilated cardboard outer box and a hard plastic inner box
- A standard hive initially contains a single queen, ca. 50 workers and the same number of larvae/pupae
- In tomato, the colony lasts 6-8 weeks while pollinating a surface of 2000-2500 m^2

Pollination of tomato flowers

Bumblebees for Natural Pollination
An Important Factor in IPM
in Greenhouse Vegetables

Thank you