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Insect pests of Major Vegetable Crops

(Tomato, Hot and Sweet Pepper, Eggplant, Vegetable Legumes, Vegetable Brassicas, Okra and Cucurbits)

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Welcome To the Wonderful World Of Insects

- Man originated about a million years ago, but insects at least 500 million years ago
- Insects are the largest Class of the animal kingdom
- Insects constitute about 72% of all known animal species
- Over 1 million insect species on the planet

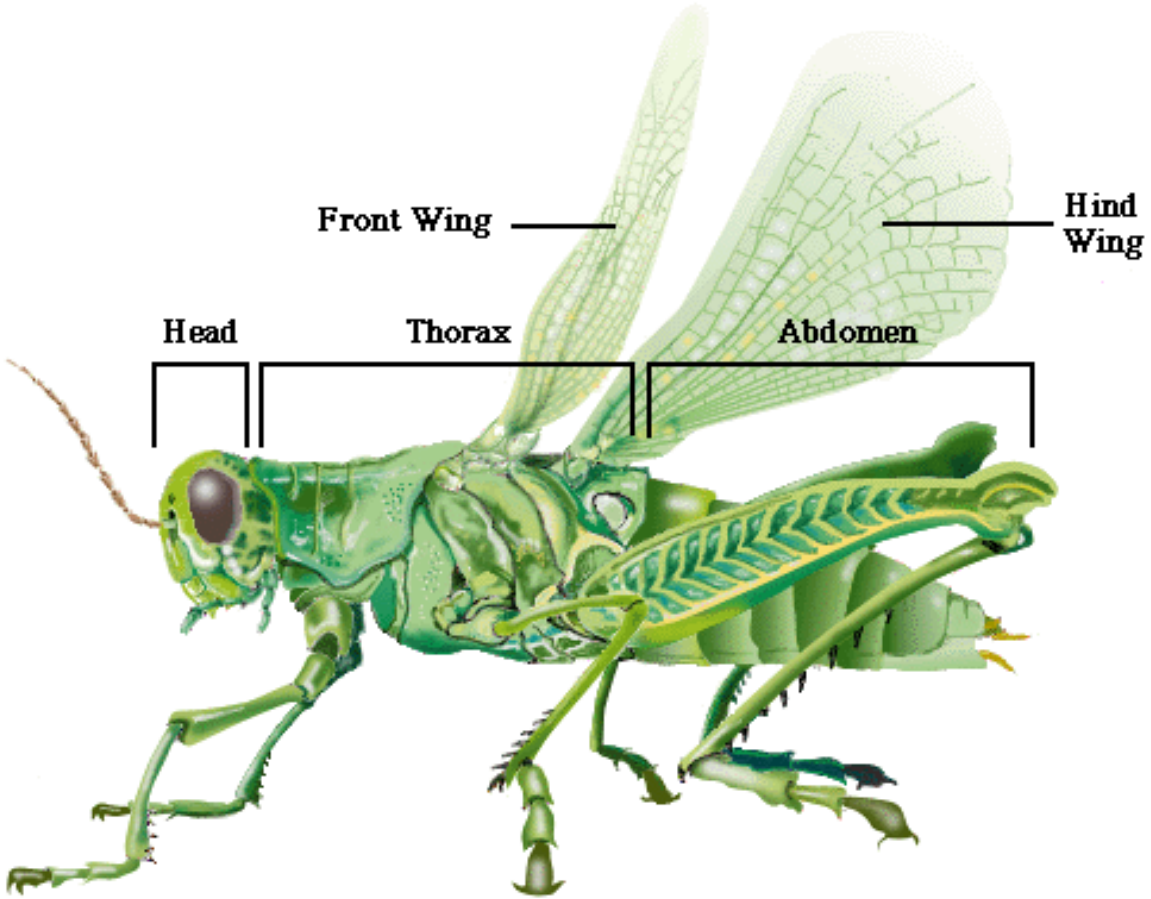


Photo courtesy: http://wings.avkids.com/Book/Animals/Images/grasshopper.gif

Insect moulting (Metamorphosis)

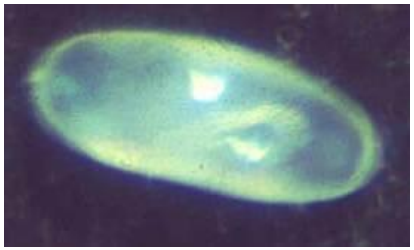
Photo courtesy: http://www.rps.org/images/portfolios/343/Dragonfly___larvae.jpg

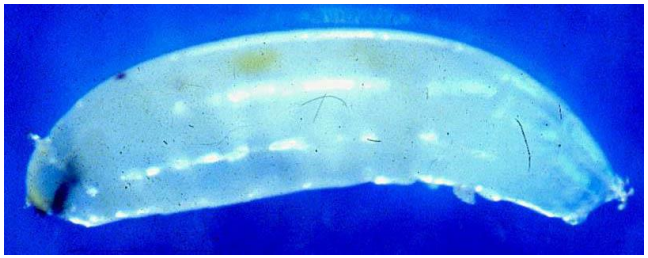
Complete metamorphosis - moth

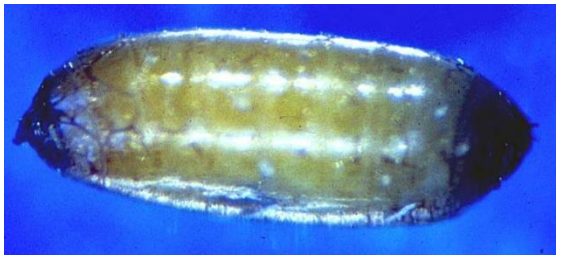





Complete metamorphosis - Fly







Complete metamorphosis - beetle

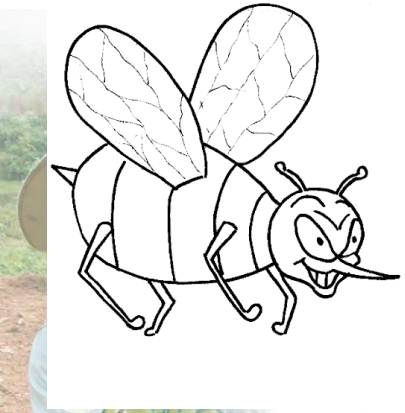
Incomplete metamorphosis - bug

Insect Mouth-parts and crop damages

- Biting and chewing (Defoliators, Borers, etc.)

Insect Mouth-parts and crop damages

- **Piercing and sucking (Hoppers, aphid, whitefly, etc)**

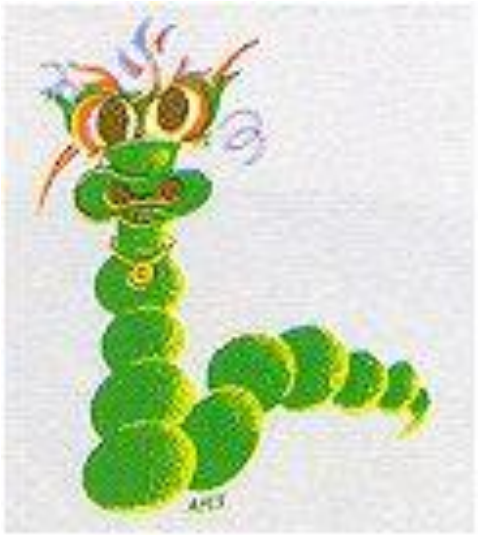


Pest: Any organism which causes damage to man and his belongings

e.g. Insect, Pathogen, Nematode, Snail, Slug, Weed, Bird, Rodents, etc

Pest from the French word 'Peste' and Latin term 'Pestis' which means Plague or a contagious disease

Insects: Major group of pests on humans, animals and plants. One sixth of world agricultural produce is consumed by insect pests every day!



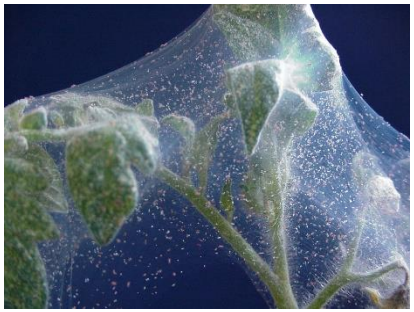
Categories of pests

1. **Regular pest** – close association with the crop
   e.g. Diamondback moth on cabbage

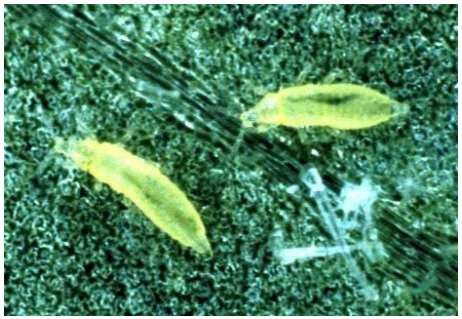
2. **Occasional pest** – no close association with the crop *e.g.* Tomato fruitworm in cabbage

Categories of pests

3. Seasonal pest – occurs in a particular season every year
   e.g. Spider-mites during hot and dry season



4. Persistent pest – occurs on the crop throughout the year *e.g.* Onion thrips



5. Sporadic pest – occurs in isolated areas in certain periods
   e.g. Cabbage webworm

Categories of pests

6. Epidemic pest – sudden and severe outbreak of a pest in a region at a time *e.g.* Locusts

7. Endemic pest - low level occurrence of a pest in few places regularly, but confined to those places only *e.g.*, Eggplant stem borer in few places in Indian subcontinent

Tomato (*Solanum lycopersicum*)

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Tomato Fruit Worm, *Helicoverpa armigera*

Host plants

1. Vegetables
   (Tomato, Sweet pepper, Chillies, Okra, Cabbage, etc)
   - Fruit worm or Fruit borer
2. Legumes (Chickpea, Pigeonpea, etc)
   - Pod borer
3. Oil seeds (Peanut/Groundnut, Sunflower, etc)
   -Defoliator/Head borer
4. Cereals (Corn/Maize, other coarse cereals, etc)
   -Cob borer
5. Fiber crops (Cotton)
   -Bollworm

>180 cultivated and wild plant species in 67 plant families

Symptoms of damage

Eggs laid on leaf surfaces

Early stage larva feeds on leaves

Then moves to flower buds

Damage to the fruits: feed by thrusting part of its body inside the fruits, make bore holes surrounded by faecal pellets

Life-cycle

TFW-Eggs

- “large” 0.5mm
- laid singly
- 10-23 days oviposition
- 500-2300
- hairy plant surface
- flowering initiation
- 4-5 days incubation

The four stages of TFW egg development. Freshly laid TFW eggs are white, turning a light brown colour over the next 1–2 days. Close to hatching, the black head capsule of the developing larva is visible through the eggshell

Source:
http://www. dpi.qld.gov.au/fieldcrops/17696.html

TFW-Larvae

- initially on foliage
- large larvae-fruits
- 5-7 instars (6)
- duration-temp. dependent (<35ºC)
- 15-25 days
- mature larva – large
- pale green – brownish black
- light-dark lateral stripes

Larval stage (instar)	Length (mm)	Age (days)
First	1 – 3	1 – 2
Second	4 – 7	2 – 4
Third	8 – 13	4 – 8
Fourth	14 – 23	8 – 11
Fifth	24 – 28	11 – 14
Sixth	29 – 30+	14

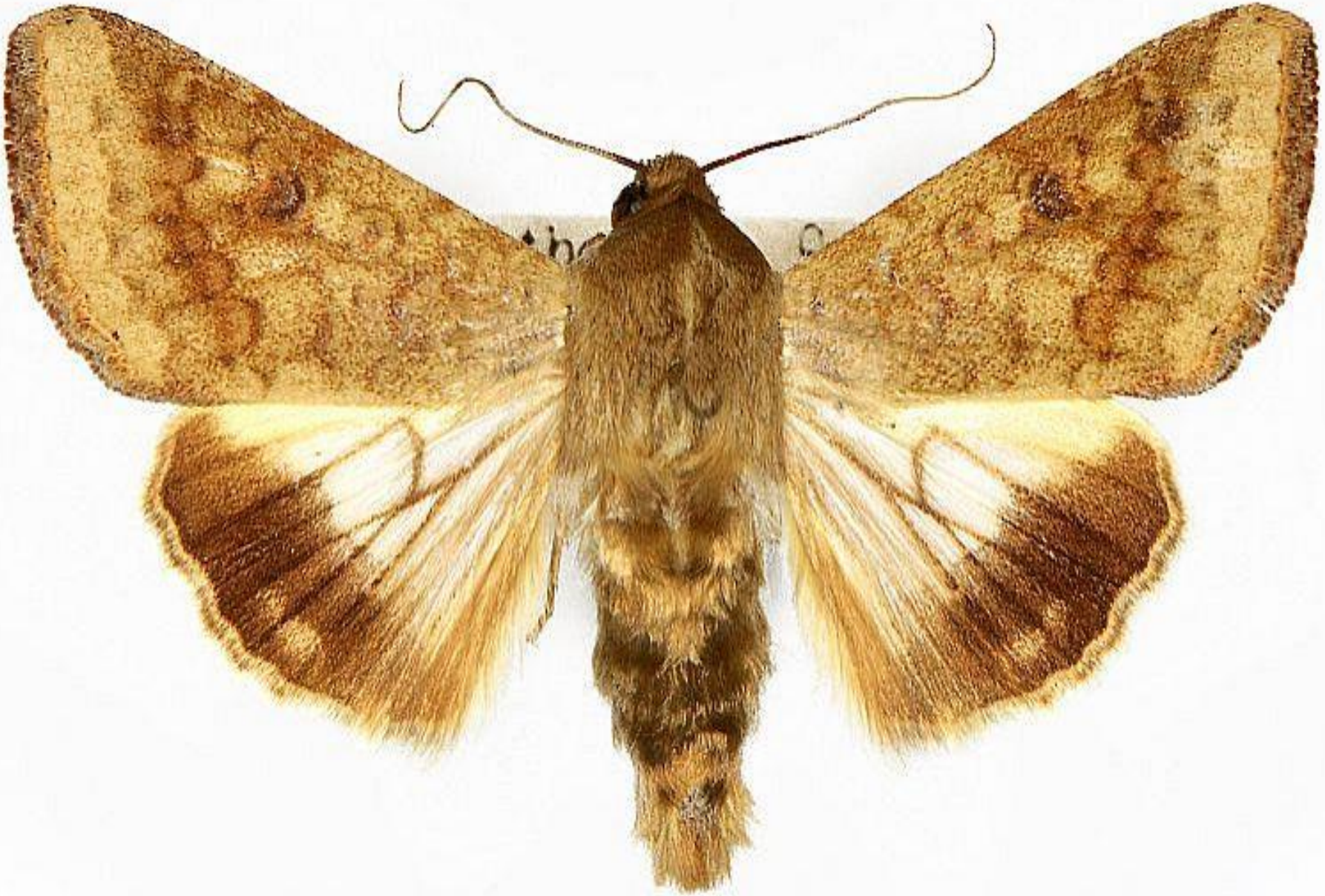
Source:
http://www2.dpi.qld.gov.au/fieldcrops/17696.html

TFW-Pupation

- in soil
  - 2.5 to 17.5 cm depth
  - ~ surface litter
- hard coat, chestnut brown
- duration-temp. dependent
- 6-30 days at 15-35ºC
- field 10-14 days
- low & high temp diapause

TFW-Adult

- emergence at night
- 40 mm (wing expanse)
- scales on forewing
- white hind wings, brown border
- nocturnal
- 1-23 days male longevity
- 5-28 days female longevity
- influenced by temperature + pupal weight
- pre-mating period, 4 days



Source: http://www.ento.csiro.au/gallery/moths/albums/Helicoverpaarmigera/helicoverpa_armigera_01.jpg

Common Army Worm (CAW), *Spodoptera litura*

Host plants

1. Vegetables (Tomato, Capsicum, Cabbage, etc.)
2. Legumes (Soybean)
3. Oil seeds (Peanut/Groundnut, Castor, etc.)
4. Alliums (Onion)
5. Fiber crops (Cotton)

>120 cultivated and wild plant species

Symptoms of damage

Eggs laid on leaf surfaces in a mass covered by hairs

Larva feeds on Leaves (Defoliation)

Larva also feeds on stems

Damage to the fruits: enters fully inside the fruits, feed inside and hollow-out the fruits

Life-cycle

Egg

Early larva

Grown-up larva

Adult

Pupa

Whitefly, *Bemisia tabaci*

Host plants

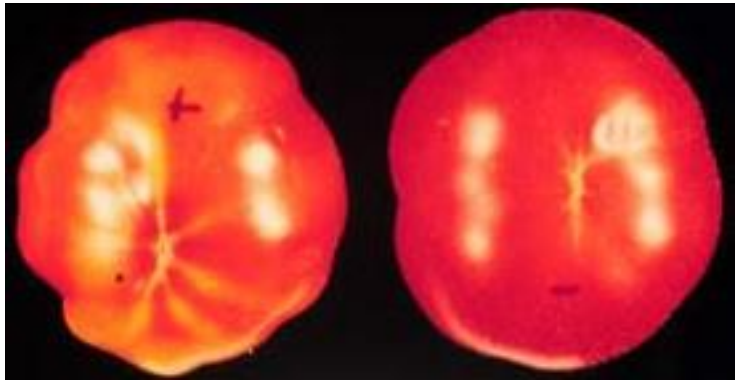
1. Vegetables (Tomato, Capsicum, Cabbage, Eggplant, Okra, Melons, etc.)
2. Legumes (Mungbean, Soybean, Yard-long bean, etc.)
3. Fiber crops (Cotton)
4. Weeds

>900 cultivated and wild plant species

Symptoms of damage

- foliar feeders, spots
- chlorotic leaf surface
- progressive yellowing of whole leaves
- honey-dew, black sooty mold
- reduced photosynthesis
- retarded growth, reduced yield

- biotypes to putative species
- nymphs cause phytotoxicity
- silvering of leaves
- uneven ripening of tomato



(Photo source:Shahab Hanif-Khan, Univ. Florida)

Irregular ripening

- Vectors of 60 viruses
- TYLCV

TYLCV disease

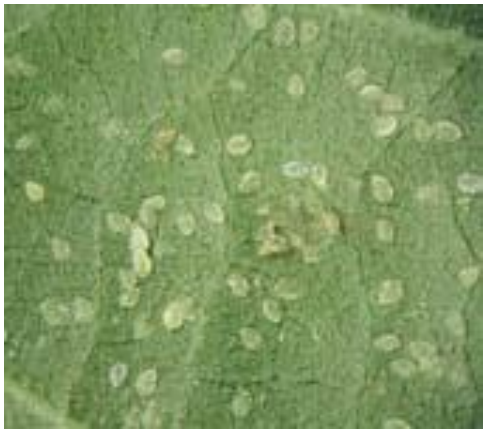
Life-cycle

Eggs

- circular
- underside of foliate
- ~160 eggs
- oviposition on only alive plants
- egg incubation ~5-9 days
- influenced by temp.

Larvae (Nymphs)

- neonate, oval, scale-like
  - 3 instars
  - 4th instar puparium
- adult emergence
  - 12-15 days



Nymphs

Puparium

Adults

- neonate covers with white wax
- from ventral wax glands
- mating numerous times
- longevity
  - female ~ 60 days
  - males 9 - 17 days
- 11-15 generations/season
- movement air-borne, long distances

Pests of Capsicum/Chillies

1. Tomato Fruit Worm
2. Common Army Worm

Fruit borer

3. Thrips
4. Aphids
5. Yellow mite (Broad mite)

Fruit borers, *Helicoverpa armigera* and *Spodoptera litura*

Thrips

Major thrips species

Scirtothrips dorsalis - South Asia
Thrips palmi - Southeast Asia
Thrips parvispinus - Indonesia, Thailand

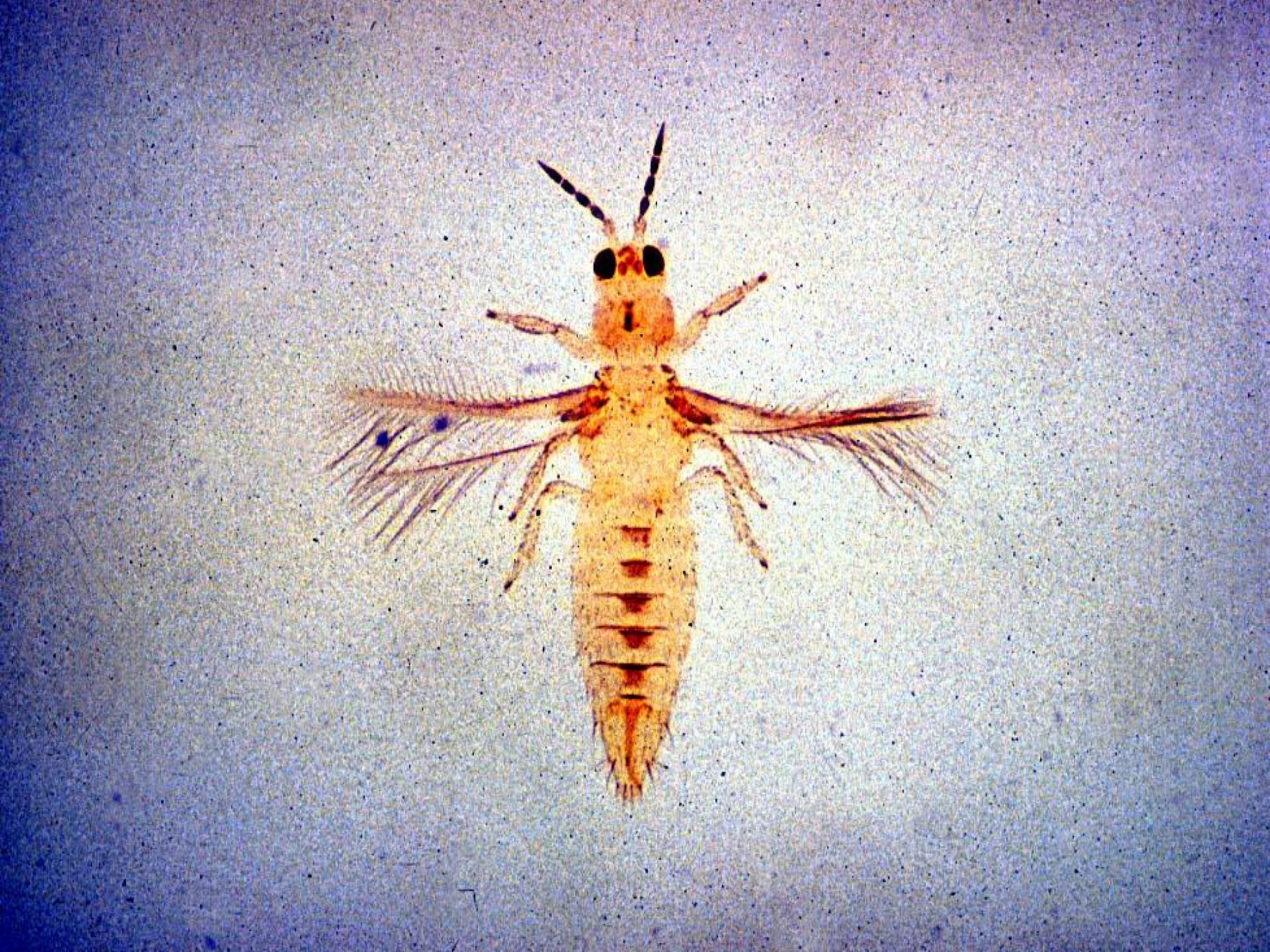
Highly polyphagous

Nature of damage

- feed on soft parts
- shoot, leaves, flowers
- rasping surface, sucking sap
- growing tips + axillary buds - most damage
- leaf curl symptoms* (also by broad mites)
- leaves deformed, shed
- buds brittle, shed
- stunted plants
- TOSPO virus vector in Chilies

Symptoms of damage

1. near the mid-vein brown and dried up
2. Silvery shining appears on the undersurface
3. leaves shrivel and have ragged edges
4. leaves tend to curl upward like the shell of a boat



Life-cycle

Eggs

- inside leaf or shoot tissue
- 2-4 eggs/day, 30-32 days

Larvae

- 2 instars
- 7-8 days

Pupae

- in axils, leaf curls
- 2-4 days

Aphids, *Aphis gossypii* and *Myzus persicae*

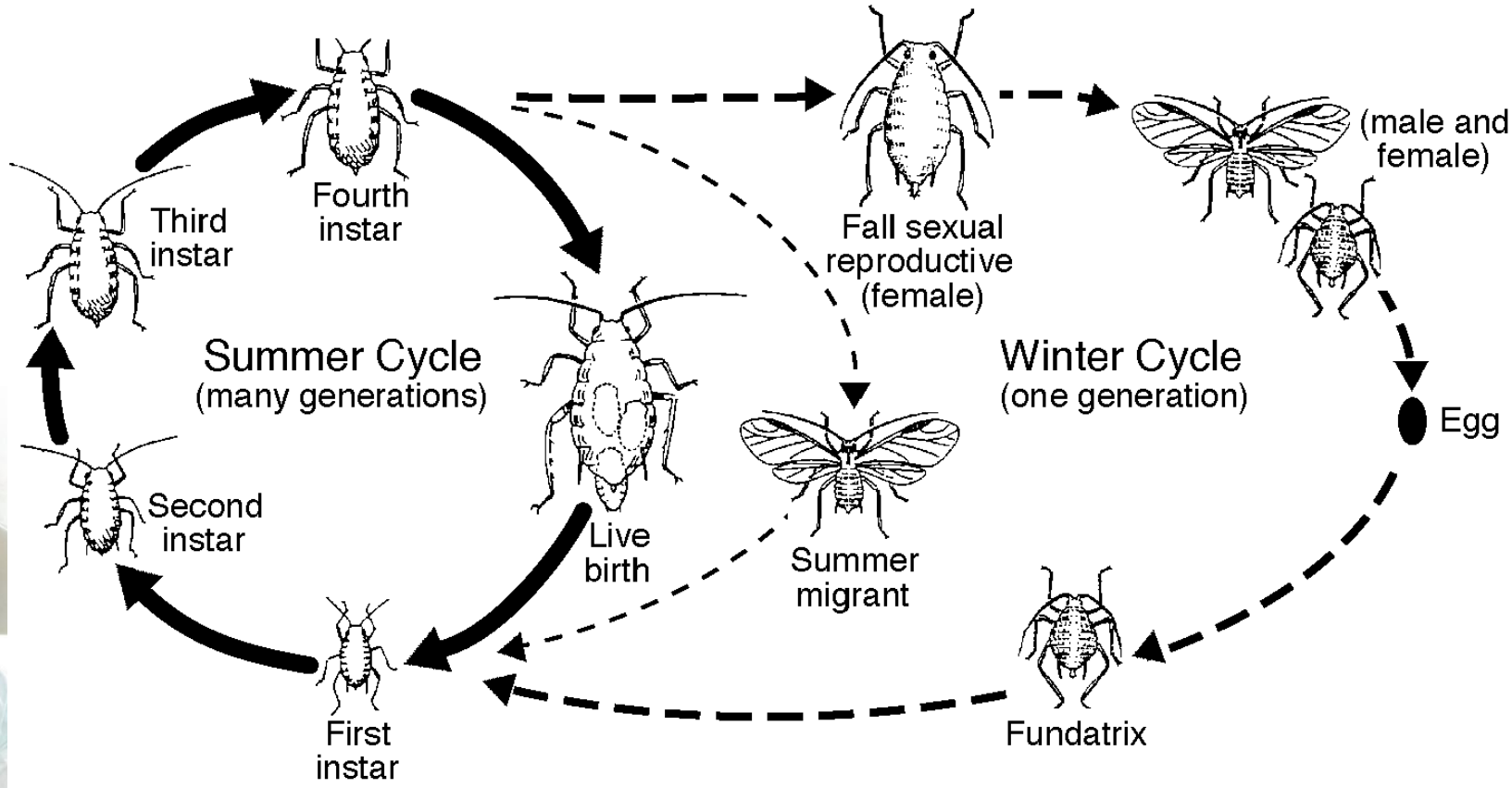
A. gossypii

M. persicae

Symptoms of damage

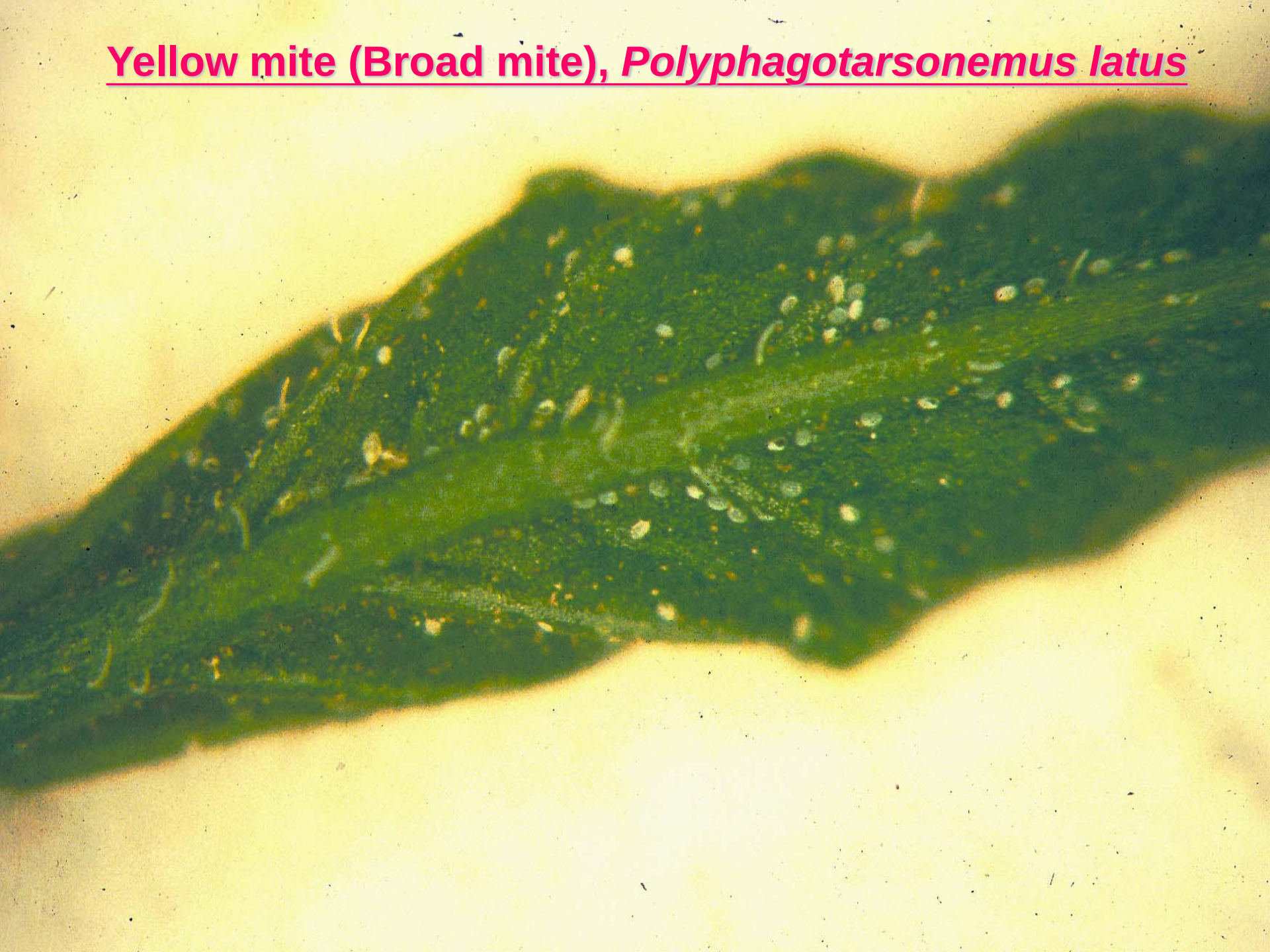
1. Leaf distortion and curling
2. Honey dew-sooty mould

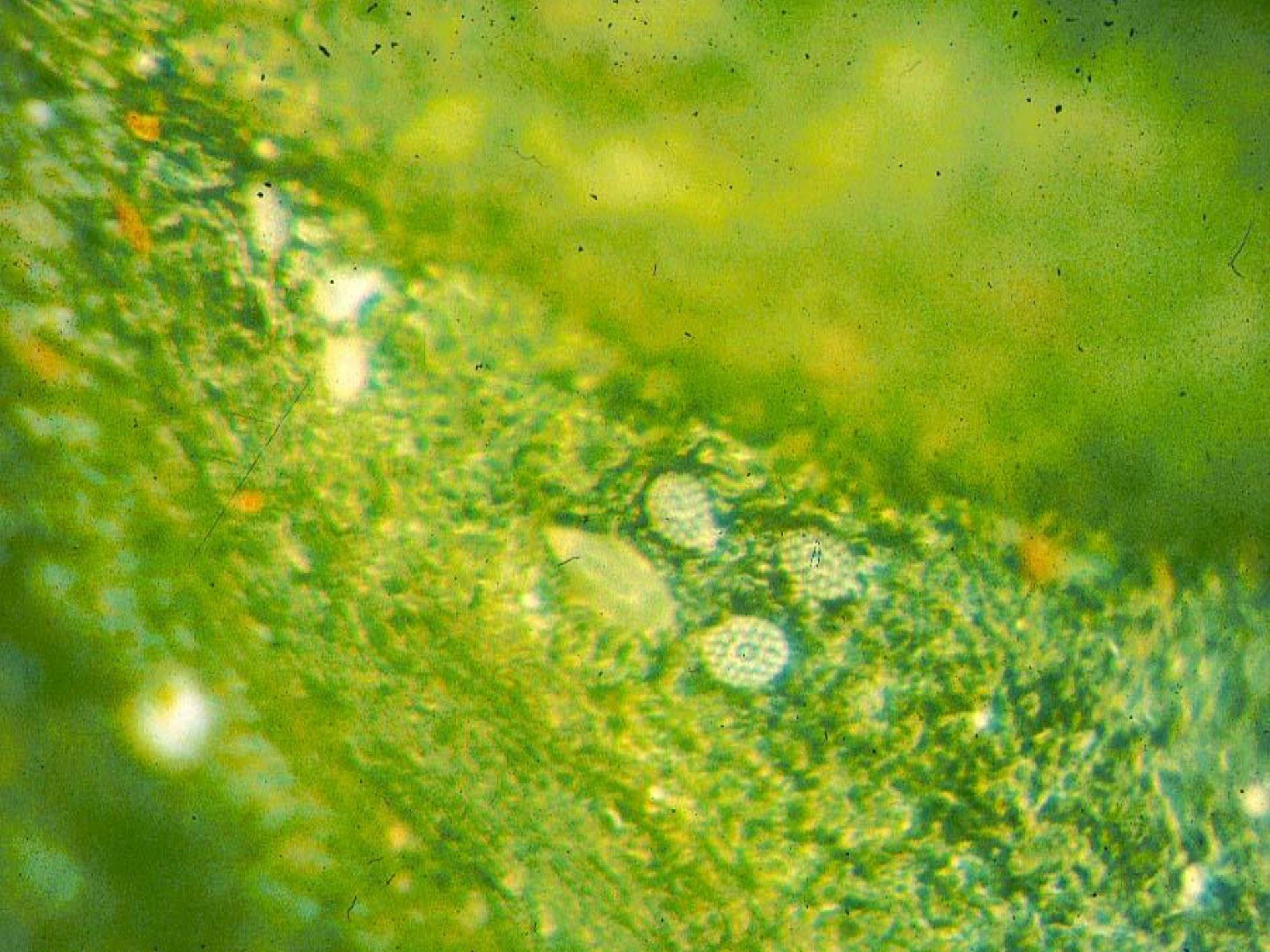
Life-cycle

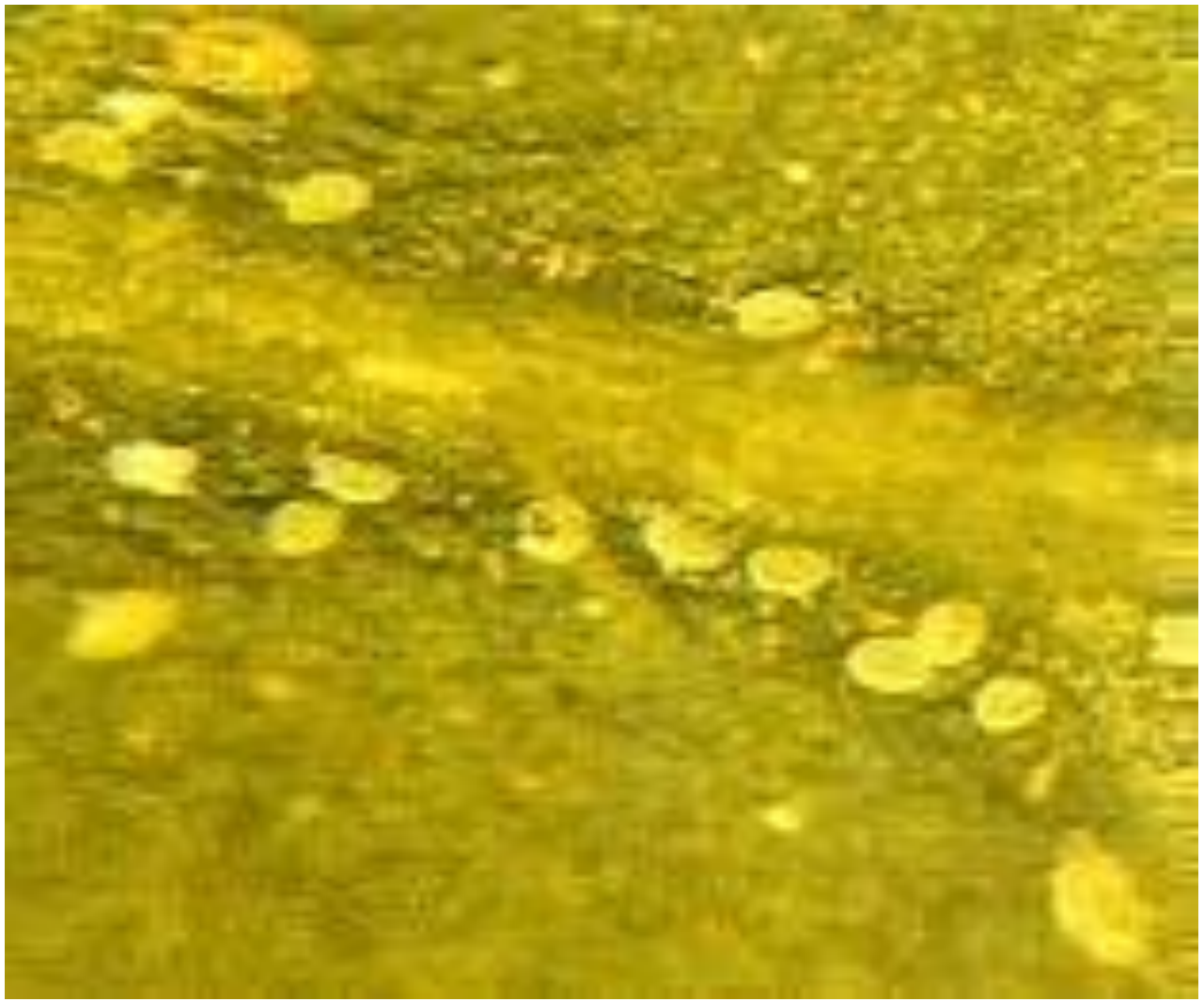


Source
http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7404.html

Yellow mite (Broad mite), *Polyphagotarsonemus latus*



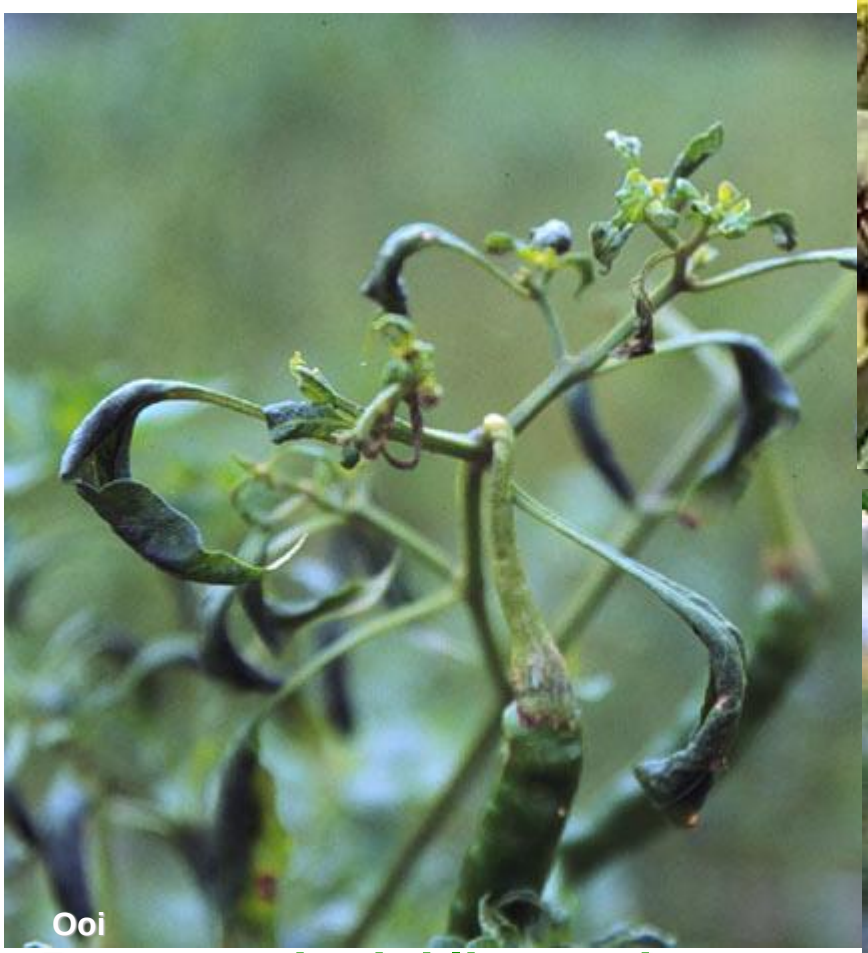




Host plants

1. Vegetables (Tomato, Sweet pepper, Chillies, etc.)
2. Legumes (Cowpea, *Phaseolus vulgaris*, etc.)
3. Fruits (Mango, Citrus, Guava, etc.)
4. Flowers (Marigold)
5. Fiber crops (Cotton, Jute, etc.)

Symptoms of damage



1. Downward crinkling and narrower leaves
2. Brittle leaves
3. Blister patches on fruits

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Life-cycle

4-6 days

Eggs: oval, slightly flattened

Larva: pear shaped with three pairs of legs
female: yellowish green or dark green
male: yellowish brown

Pupa: resting stage
female: 4th pair of legs reduced and whip like
male: 4th pair of legs enlarged

Adult: elliptical, but slightly wider at the front than the rear. Females are long and males are slightly shorter and more broad

Eggplant (*Solanum melongena*)

Major insect and mite pests of eggplant worldwide

Pest species	Plant parts attacked
Leucinodes orbonalis	Shoots, fruits
Amrasca devastans	Leaves
Epilachna vigintioctopunctata	Leaves
Euzophora perticella	Stem
Thrips palmi	Leaves, Fruits
Aphis gossypii	Leaves
Myzus persicae	Leaves
Tetranychus telarius	Leaves
Tetranychus urticae	Leaves
Phthorimaea operculella	Leaves
Leptinotarsa decemlineata	Leaves

Eggplant fruit and shoot borer

Leucinodes orbonalis

(Lepidoptera: Crambidae)

Distribution of *Leucinodes orbonalis*

Nature of damage

- within 1 h neonate enters
  - shoot, flower or fruit
- plug entrance hole with excreta
- wilting of shoot (dead heart)
- reduced plant growth
  - reduced fruit size as well as number
- development of new shoot that delays maturity
  - new shoot also get damaged

Nature of damage

- feeding in flower
  - no fruit
- fruit damage
  - destruction of plant tissue
  - feeding tunnel with frass
  - fruit unfit for marketing
  - up to 20 larvae/fruit
  - yield loss varies
  - serious damage in autumn
  - reduction in vitamin C content

Egg

-Oviposition on leaves, green stems, flower buds, developing fruits and calyces of fruits
-about 250 eggs
-laid singly
-0.75 mm in length and 0.53 mm in width (Singh and Singh, 2001)
-hatching in 3-5 days
-creamy white and turns to red

Larvae

- Neonate bores into tender shoot, fruit and flower buds
- During vegetative stage, it feeds inside the growing shoots
- Fruit preferred over shoot
- Usually five instars
- Six in some cases (PhilRice, 2007)
- 9 to 14 days; sometimes up to 28 days
- 16 to 23 mm long when full-grown

Larval stage	Body color	Head color
Neonate	Creamy or dirty white	Prominent dark brown or light black
First instar	Dirty white or pinkish	Predominant dark brown to blackish
Second instar	Creamy white to pinkish	Dark brown
Third and fourth instar	Pinkish brown with small dark spots	Dark brown
Fifth instar	Pinkish	Dark brown

(Singh and Singh, 2001; PhilRice, 2007)

Pupae

- Tough grayish silken cocoon
- Pupates on fallen leaves, debris and soil surface
- 1 to 3 cm deep in soil (rare)
- Dark brown colored pupa
- Usually 6 to 9 days; sometimes up to 17 days

Adult

- emergence at night
- rest on lower leaf surface
- female bigger than male
- female abdominal tip curl up
- wings white; forewing with pale black or brownish spots
- wing span 20-22 mm; body 13 mm long
- longevity 6 to 8 days; sometimes short lived for 2 to 4 days

Cotton Leafhopper

(*Amrasca devastans*); also known as *Amrasca biguttula biguttula*

Distribution: South- and Southeast Asia

Hosts: cotton, okra, eggplant, potato, sunflower, etc

Nature of damage

- nymphs & adults suck sap
- underside of leaves
- inject toxin (phytotoxicity) → Hopper burn
- yellowing – curling – bronzing – drying
- reduced photosynthesis
- reduced vigor
- not a vector

Egg

- Active year round
- Oviposition
  - underside leaf lamina
  - mainly in veins
  - 15 to 38 yellowish white eggs
  - 4 to 11 days incubation

Nymphs

- 5-6 instars
- green wedge shaped
- resembles the adults, but wingless
- 1 to 3 weeks

Adults

- Greenish yellow or pale green
- 2 black dots on posterior part of forewings
- pre-oviposition period is 2-4 days
- oviposition duration 4-9 days
- 5 to 7 generations/season
- walk diagonally in relation to their body

Epilachna beetle
(Spotted leaf beetle)

Epilachna vigintioctopunctata

E. dodecastigma

Nature of damage

- grubs and adults scrap chlorophyll from leaf surfaces
- forms ladder-like windows
- windows coalesce together leading to skeletonization
- leaf dries and drops-off

Egg

- Oviposition on under surface of leaves
- about 180 eggs, in groups of 10-35
- elongate spindle or cigar shaped, yellowish eggs
- hatching in 2-4 days

Grub and Pupa

- yellowish spiny grub
- 10 to 35 days
- pupate on the leaf or stem
- yellowish pupa with spines on the posterior part, and anterior part being devoid of spines

Adults

- brownish hemispherical beetle
- wing has distinct black spots
  - *E. dodecastigma* (12 spots)
  - *E. vigintioctopunctata* (28 spots)
- Life cycle: 17 to 50 days

Spider mites

Tetranychus urticae Koch (Acari: Tetranychidae)

Economic Importance

- polyphagous
- *T. urticae*, worldwide distribution
- *T. evansi*, predominant in Africa

Symptoms of damage

- nymph and adult feeding
- lower leaf surface
- large chlorotic spots
- leaf curling
- extensive browning
- webbing damaged area
    - affects chemical control
    - affects biological control
- retarded growth

Life-cycle

- orange eggs, lower leaf surface
- turn dark red before hatch
- nymphs creamy, turn greenish yellow
- 3 instars, 6-7 days
- adults 25 days
- egg to adult 9-10 days

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Pests of Vegetable Legumes

Bean/Legume thrips

- ***Megalurothrips dorsalis*** **S. Asia**
- ***Megalurothrips usitatus*** **SE Asia**
- ***Megalurothrips sjostedti*** **Africa**

Nature of damage

- feed on pollen
- suck sap from flower parts
- distortion and discoloration of flower
- flower drop, red scar
- regeneration of flowers
- attacked again
- absence of flower -> vegetable buds
  - crinkled, distorted leaves
  - rainy season, less damage

Aphids

- *Aphis craccivora* cowpea aphid
- *A. fabae* bean aphid
- *A. glycine* soybean aphid
- *Acyrthosiphon pisum* pea aphid

A. craccivora: **widespread & destructive**

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Legume Podborer

Maruca vitrata

Worldwide

Biology – Oviposition

- flower buds, flowers
- terminal shoots
- rarely on pods
- fecundity 8-140*
- tiny, translucent yellowish
- incubation 2-3 days

Larvae

- 5 instars
- 9-14 days
- dull white, spot on each segment
- mature larva 16 mm

Pupae

- greenish pale yellow
- in soil, rarely in pod
- 6-8 days

Adults

- large moth
- distinct marking forewings
- longevity
  - 8-10 days females
  - 6 days males

Generation

- 18-35 days

Nature of damage

- young larvae in bud and flowers
- older larvae in pods
- damaged flower contain frass
- in pod, small hole at proximal end
- developing seeds devoured
- sticking of 2-3 pods together
- sticking of leaf and pod
- 10-40% yield loss