



Insect pests of Major Vegetable Crops – part 1

**(Tomato, Hot and Sweet Pepper, Eggplant,
Vegetable Legumes)**

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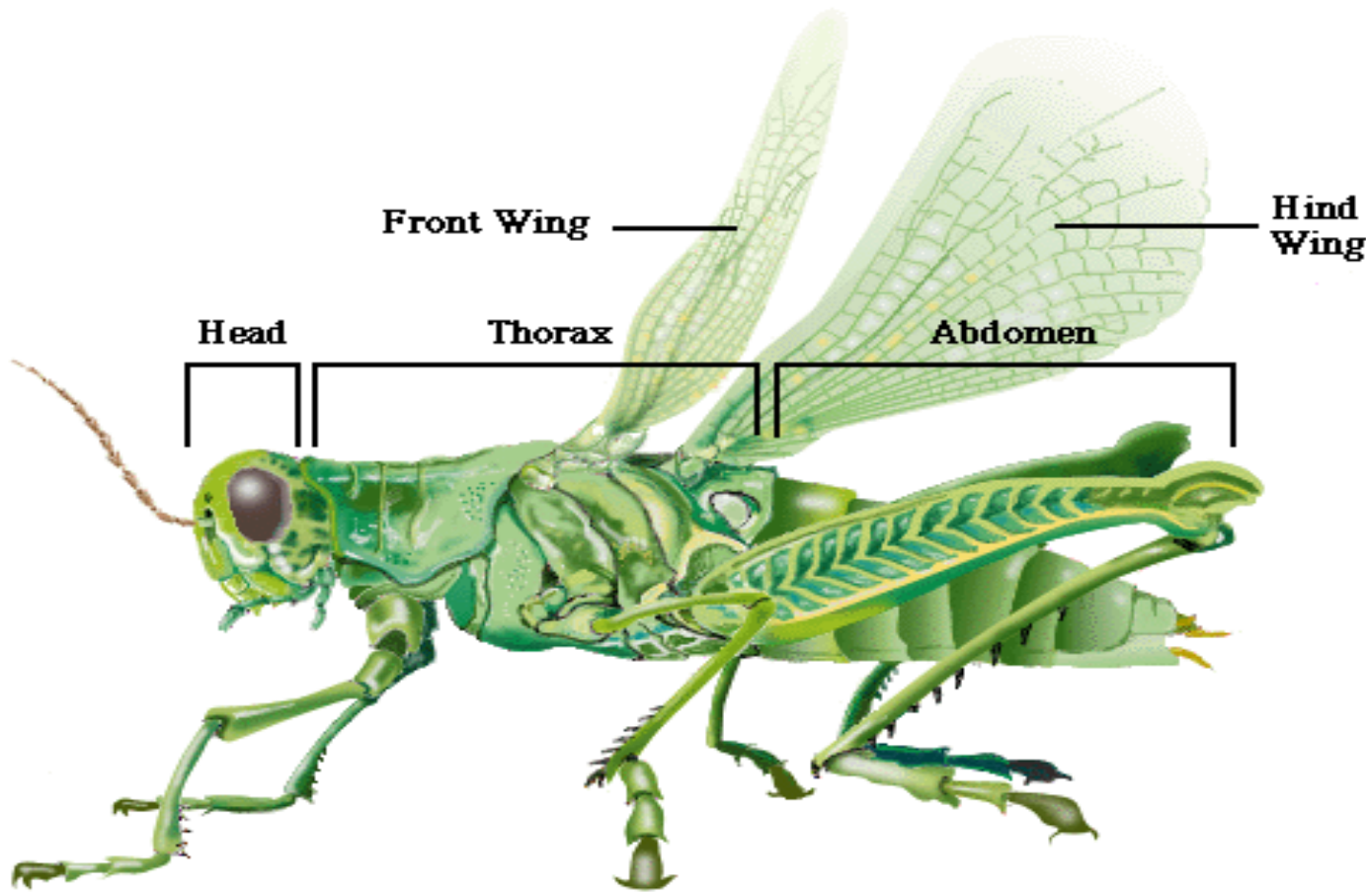
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- **Man originated about a million years ago, but insects at least 500 million years ago**
- **Insects are the largest Class of the animal kingdom**
- **Insects constitute about 72% of all known animal species**
- **Over 1 million insect species on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







Insect moulting (Metamorphosis)



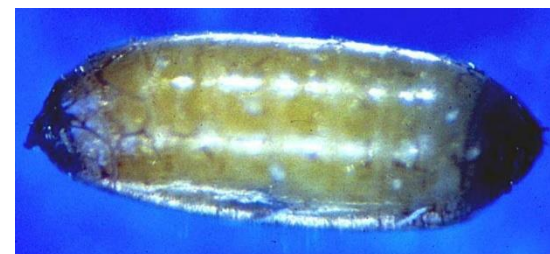
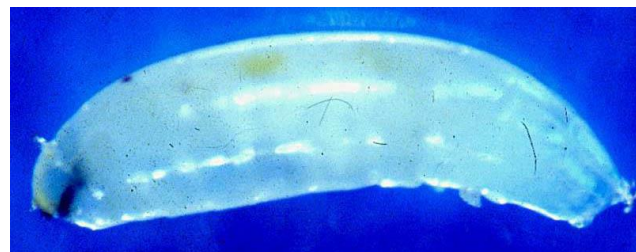
Photo courtesy: http://www.rps.org/images/portfolios/343/Dragonfly__larvae.jpg



Complete metamorphosis - moth



Complete metamorphosis - Fly



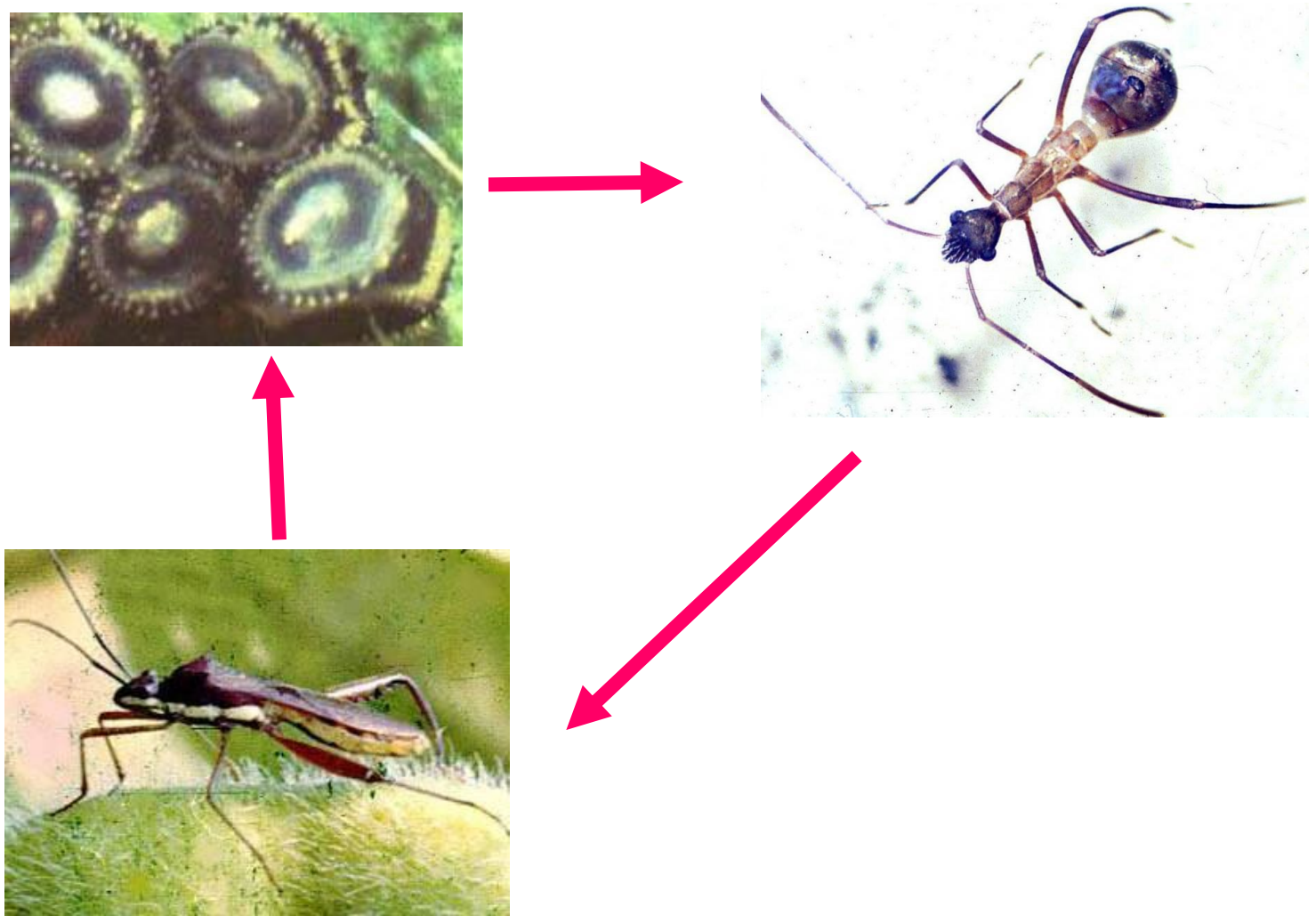


Complete metamorphosis - beetle





Incomplete metamorphosis - bug





Insect Mouth-parts and crop damages

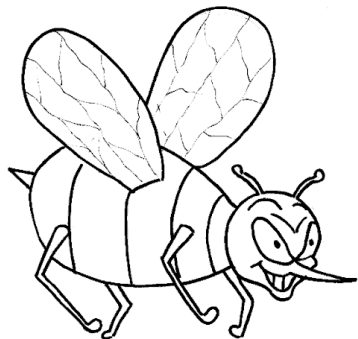
- **Biting and chewing (Defoliators, Borers, etc.)**





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*)



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

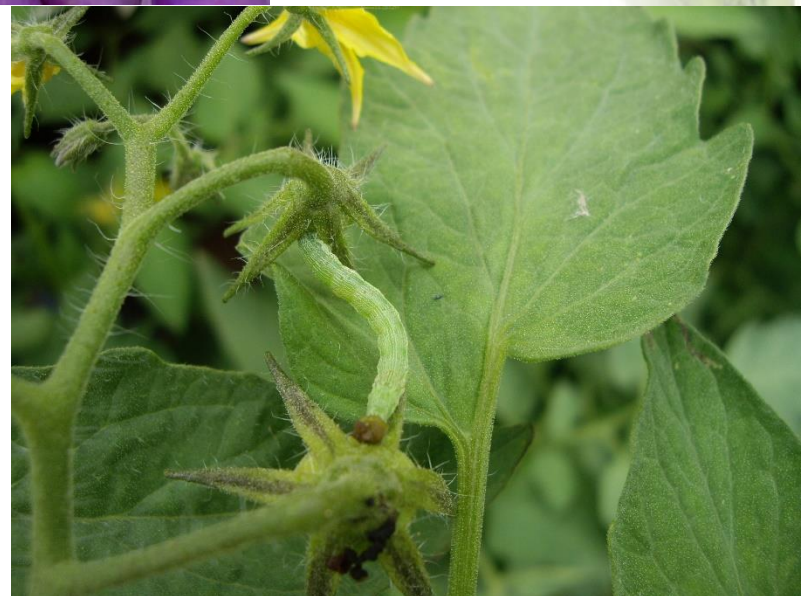
Source:

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



TFW-Larvae

- initially on foliage
- large larvae-fruits
- 5-7 instars (6)
- duration-temp. dependent ($<35^{\circ}\text{C}$)
- 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 15-35°C
- 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



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



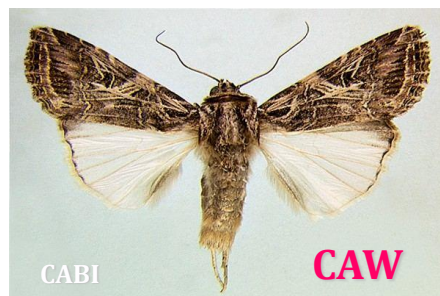
Early larva



Grown-up larva



Pupa



Adult



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





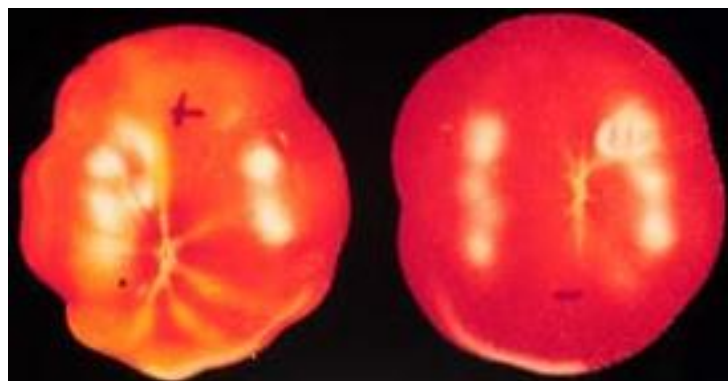
Symptoms of damage

- 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
- Tomato Yellow Leaf Curl Virus (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





South American leaf miner, *Tuta absoluta*





Damage symptoms















Recorded host plants





- *Solanum lycopersicum*
- *Solanum tuberosum*
- *Solanum melongena*
- *Solanum nigrum*
- *Solanum elaeagnifolium*
- *Solanum americanum*
- *Solanum bonariense*
- *Solanum sisymbriifolium*
- *Solanum saponaceum*
- *Solanum dubium*
- *Solanum muricatum*
- *Solanum woronowii*
- *Capsium annuum*
- *Nicotiana tabacum*
- *Nicotiana glauca*
- *Datura stramonium*
- *Datura ferox*
- *Datura quercifolia*
- *Physalis peruviana*
- *Physalis angulata*
- *Lycium sp.*
- *Phaseolus vulgaris*
- *Malva sp.*
- *Amaranthus viridis*
- *Sorghum halepense*
- *Xanthium strumarium*

(USDA-APHIS, 2011; Muniappan, 2014; CABI, 2015)



Solanum tuberosum



Solanum viarum



Solanum nigrum



Solanum melongena





Life stages of *T. absoluta* : Egg

- Small (0.35 mm long), cylindrical
- Creamy white to yellow
- Laid mostly on the under surface of leaves, but also on stem, floral buds and calyx of unripe fruits





Life stages of *T. absoluta* :

- Cream in color with characteristic dark head
- Later it turns as green or pink
- Four larval instars



Life stages of *T. absoluta* :

Pupa

- Pupation may take place
 - in the soil
 - Or on the leaf surface in the cocoon built by last instar larva
 - Or within mines
- Brownish pupae
- About 6 mm long



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Life stages of *T. absoluta* : Adult

- Small adults with a body length of 5-7 mm, and a wing span of 8-10 mm
- Filiform antennae (thread like antennae), the most important characteristic
- Grey scales with characteristic black spots present in anterior wing





- 30-40 days
- Multivoltine
- Up to 12 generations per year

Life-cycle of *T. absoluta*

4-7 days



12-20 days



overwinter as eggs,
pupae or adults
depending on
environmental
conditions



10-11 days (F)
11-13 days
(M)





Pests of Capsicum/Chillies

1. **Tomato Fruit Worm**
 2. **Common Army Worm**
 3. **Thrips**
 4. **Aphids**
 5. **Yellow mite (Broad mite)**
- Fruit borer**
- 





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

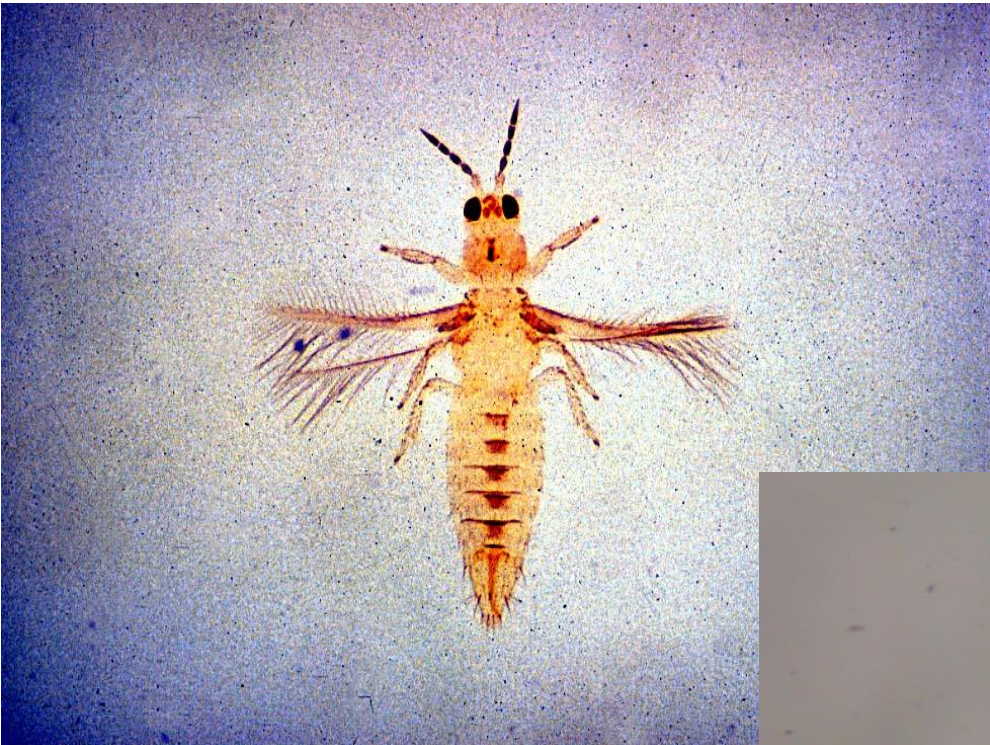




Symptoms of damage

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







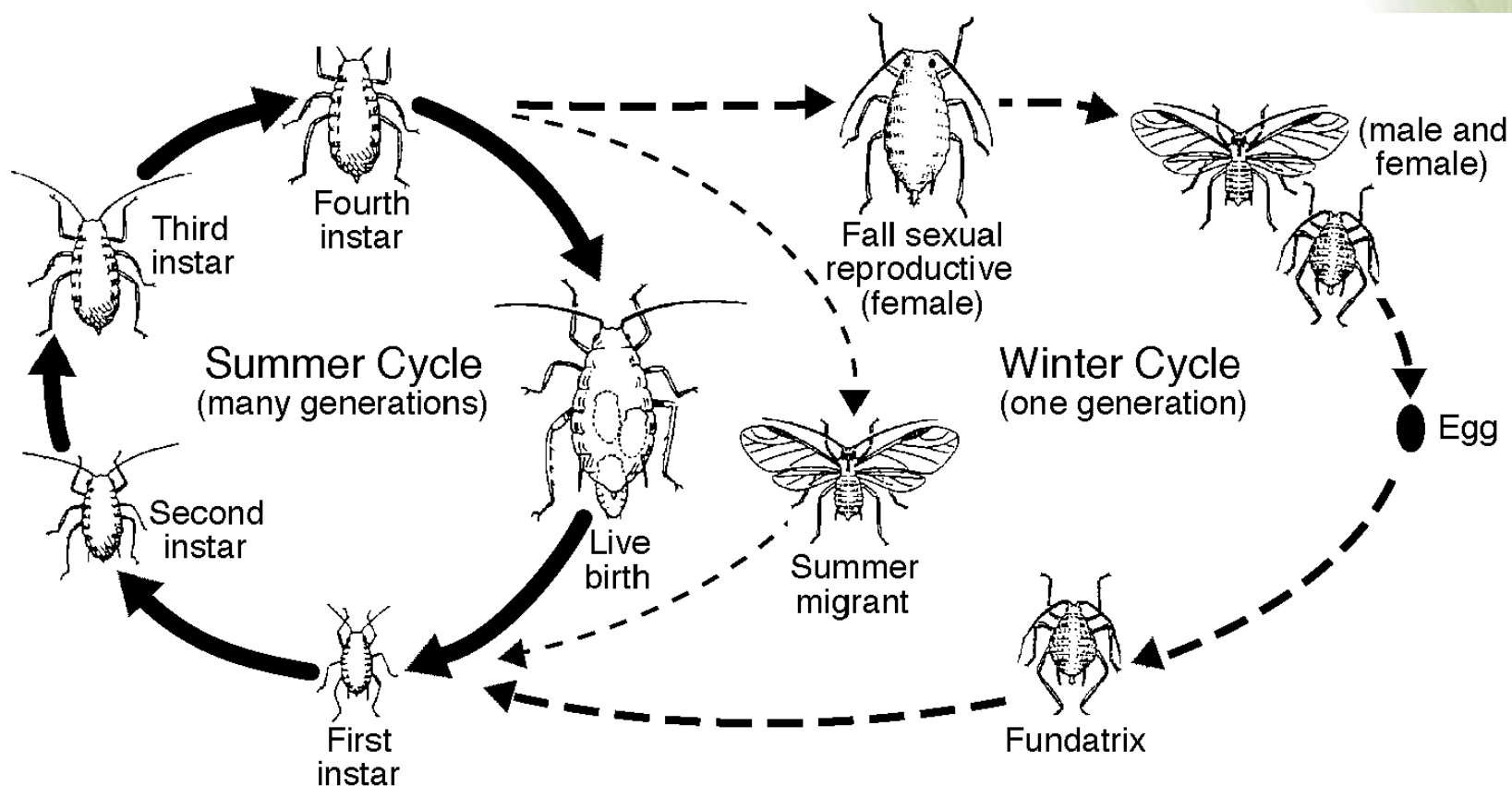
Symptoms of damage



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



Life-cycle

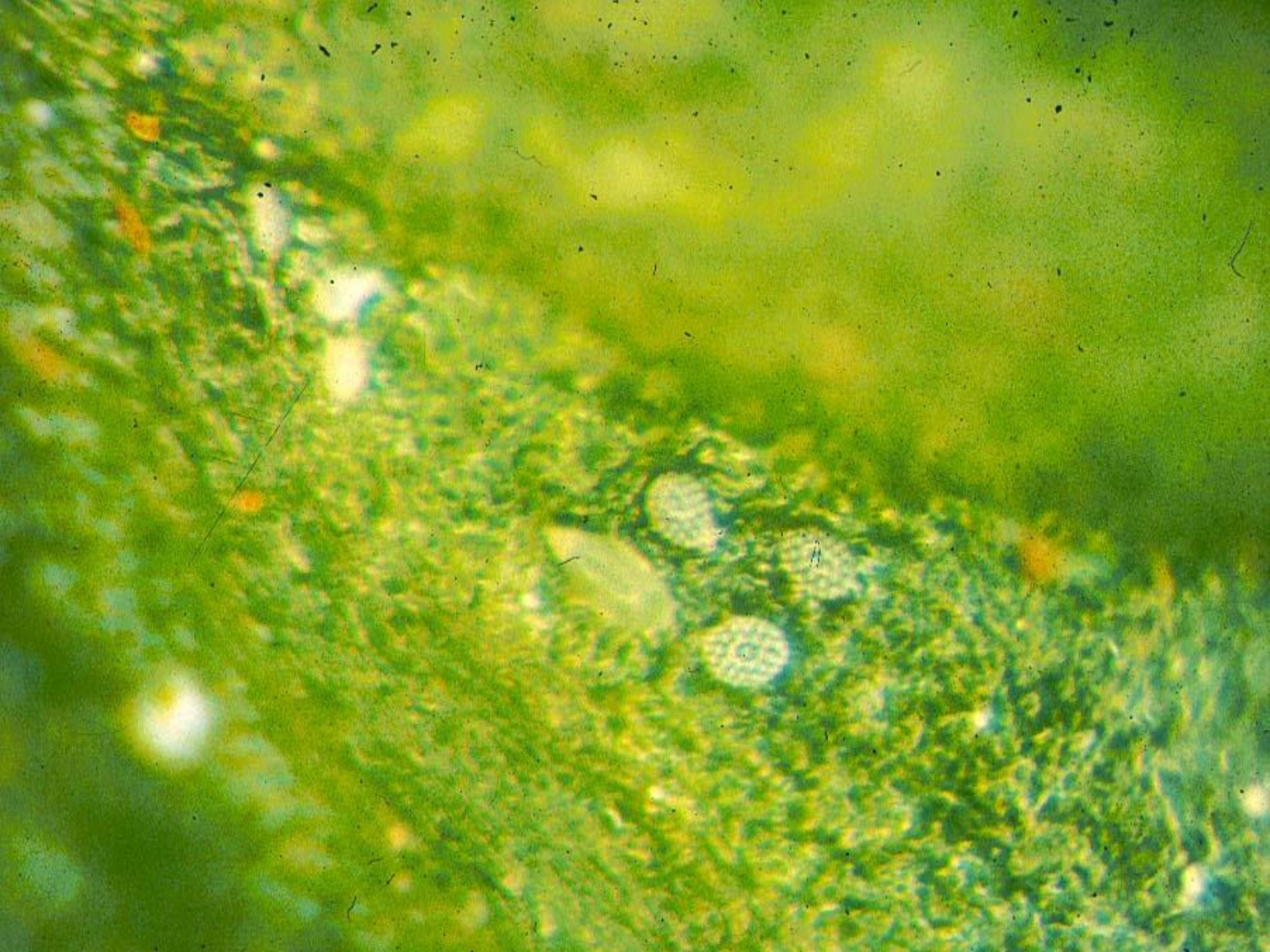


Source

<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







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*)



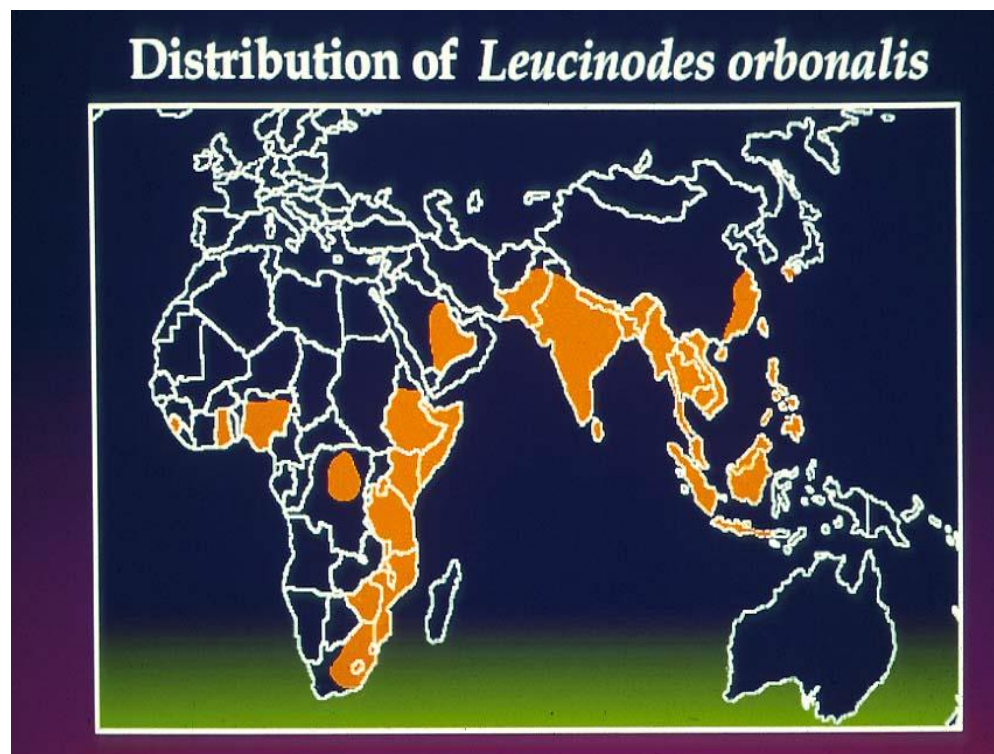
Major insect and mite pests of eggplant worldwide

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



Eggplant fruit and shoot borer

Leucinodes orbonalis
(Lepidoptera: Crambidae)





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



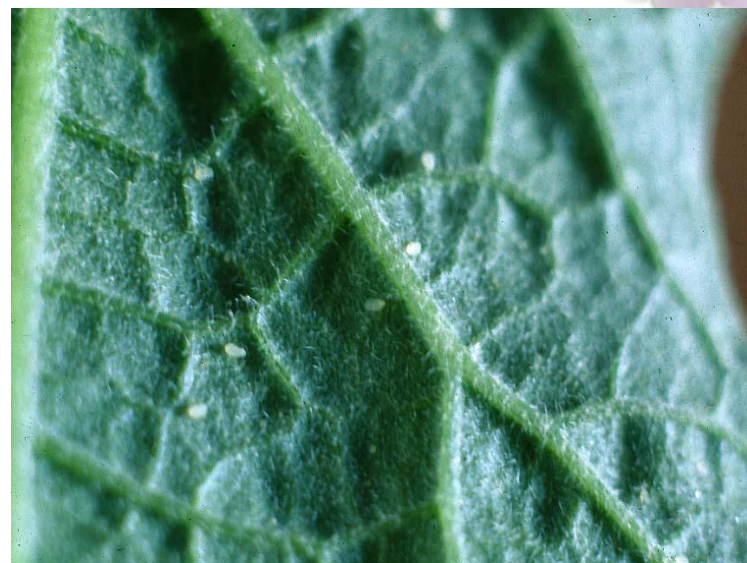






Egg

- 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* spp. **(Acari: Tetranychidae)**

- **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









Pests of Vegetable Legumes





Bean flies, *Ophiomyia* spp.





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
- *Acyrtosiphon pisum* pea aphid

***A. craccivora*: widespread & destructive**









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











Other minor pests of Vegetable Legumes





Leaf beetles, *Monolepta* spp.





Stink bug, *Nezara viridula*





Pod sucking bugs



**Shriveling of
pods and seeds**





Bean leaf roller, *Omiodes indicata*





Blue butterfly, *Lampides boeticus*





Red spider mite



Storage beetles, *Callosobruchus* spp. & *Acanthoscelides obtectus*

