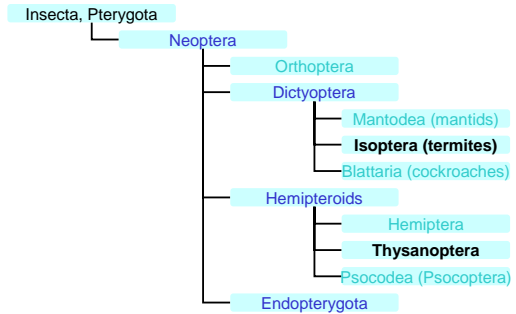


Thysanoptera

Thrips

RPB 2009; thysanoptera v. 2.4

Today ...



Major features of Thysanoptera

- Name comes from the Greek for fringed wings. Also known as 'thunderflies' or 'stormflies'
- Adults 0.5-15mm but temperate species rarely >2mm
- About 5,000 described species.
- Widely distributed in Latitudes between 60N and 45S.
- Usually both genders, but females predominate. Males are haploid. Some species are wholly parthenogenetic (or the males are unknown).



More basic facts about thrips:

- Piercing/sucking mouthparts. Most feed on vascular plants, but some on fungi or mosses. Often seen on flower heads. Some species are predatory.
- Some thrips are pests of a wide range of crops e.g. cereals, vegetables, flowers, cotton, citrus etc. Damage is direct to flowers, fruit and leaves, also indirect by virus transmission e.g. Tomato spotted wilt virus (TSWV)
- Some thrips are beneficial as pollinators and as natural enemies of mites, scales and pest thrips. Some are also useful for weed control.

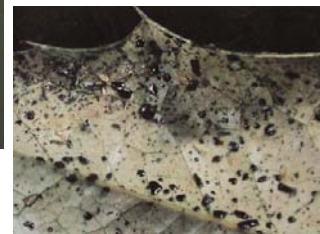
Thrips damage: primarily cosmetic



225 Western flower thrips damage to petals of *Chrysanthemum*.

... with flowers this matters!

Thrips damage

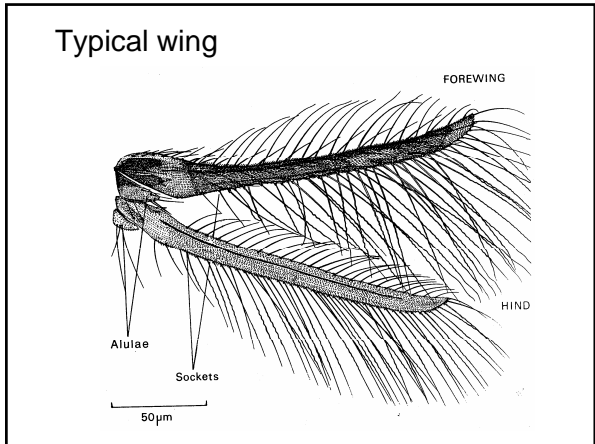


excrement/frass

Courtesy: www.realipm.com

Principal features of an adult thrips

- unique asymmetrical mouthparts;
- tarsi with apical eversible bladders;
- wings (if present) hair fringed and narrow;
- ... but adults may be: macropterous, brachypterous or apterous.



Taxonomy of thrips: 2 suborders

| Terebrantia | Tubulifera |
|---|--|
| Seven families, two are of economic importance - the Aeolothripidae and Thripidae | One family, the Phlaeothripidae (includes pest and natural enemy spp.) |

Sub-order: Terebrantia

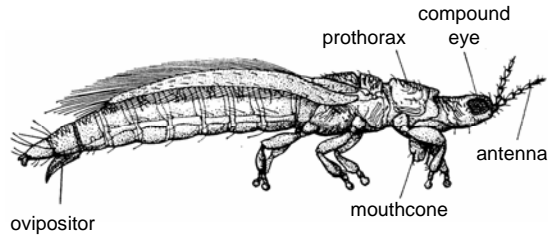
- Forewings veined
- Wings at rest parallel to each other
- Rear abdomen conical
- In female, single pupal stage
- Saw-like ovipositor

Sub-order: Tubulifera

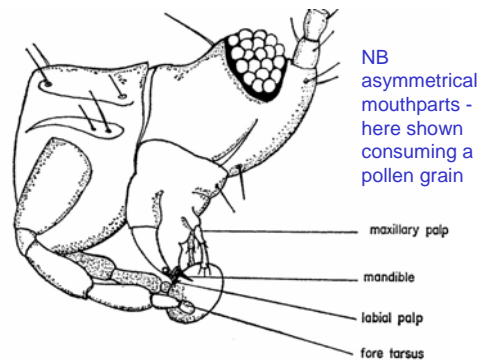
- Forewings lack veination
- Wings at rest overlap
- Two pupal stages separated by a moult
- Rear abdomen tubular
- No ovipositor

| Sub order | family | No of species | (UK) | Comment |
|-------------|--------------------|---------------|------|---|
| Terebrantia | Uzelothripidae | 1 | 0 | |
| | Merothripidae | 15 | 0 | Neotropical fungal feeders |
| | Aeolothripidae | 260 | 13 | Mainly temperate, flower-living predators |
| | Adiheterothripidae | 5 | 0 | |
| Tubulifera | Fauriellidae | 4 | 0 | |
| | Heterothripidae | 70 | 0 | New World |
| | Thripidae | 1700 | 107 | |
| | Phlaeothripidae | 3000 | 39 | |

Side view of adult thrips showing mouthcone



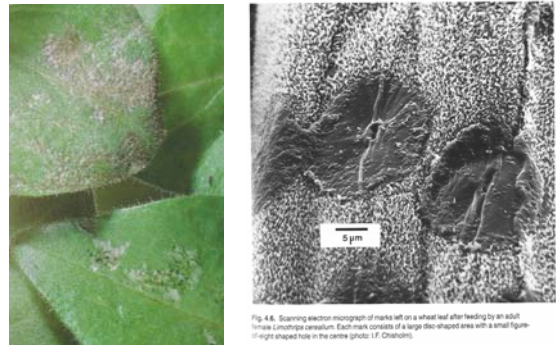
The mouthcone and mouthparts



Feeding by thrips

- Mouthparts form a cone attached to underside of head and directed downwards beneath the first thoracic segment. Uniquely asymmetrical with a single piercing mandible and two maxillary stylets forming feeding tube.
- Cell contents (including pollen & chloroplasts) ingested whole, thrips can consume 12% of their body weight per hour.
- Feeding sites on plants: leaves, flowers, florets and seeds.
- Direct damage: probing and feeding removes surface waxes, epidermal cells collapse and mesophyll cells are destroyed. Tissues then develop a silvery sheen and areas coalesce and wrinkle.

Feeding scars



Indirect damage

- Virus transmission of tomato spotted wilt virus (TSWV) and peanut yellow spot (PYS).
- To become infective the thrips must feed on an infected plant during its larval stage.



Photo: Paul Bachi, www.bugwood.org

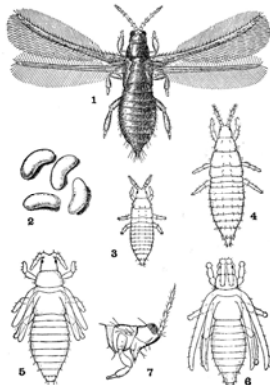
(Transmitted by 9 spp. in USA)

Biology and Ecology

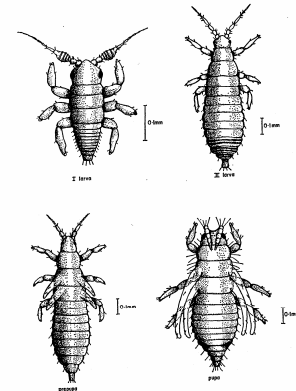
- Haploid males develop from unfertilised eggs. Females predominate especially in glasshouses where populations may be entirely parthenogenetic.
- Females produce 30-300 eggs, which are either surface deposited or embedded in plant tissue
- Life cycle can last from 10 days to 1 year depending on the temperature. In temperate regions 1-2 generations per year. Over-wintering life stage (egg, pupa, adult) depends on species. 12-15 generations per year in warmer climates where the peak populations can exceed 10 Million individuals per Hectare.
- Weak fliers (10-50 cm/s) but can be windblown to disperse > 100km.

**Thysanoptera:
Hemimetabolous
development**

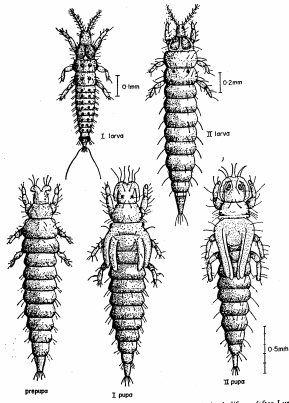
- **Life cycle evolution:** intermediate between incomplete & complete metamorphosis: egg, 2 actively feeding 'larval' instars, pre-pupa, pupa, adult.
- Hemimetabolous nymphs, but the term 'larva' is used.
- Many terebrantians move to soil to pupate, many tubuliferans remain on host plant.



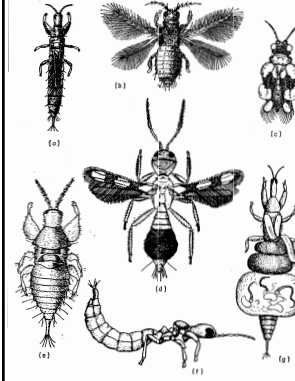
Immature life stage of *Caliothrips fasciatus*, the bean thrips, a typical **terebrantian**



Immature life stages of *Haplothrips leucanthemi*, a typical tubuliferan



Adaptive forms in thrips



- Podothrips* grass dweller
- Selenothrips* foliage feeder
- Arachisothrips* peanut-winged thrips
- Franklinothrips* fast-running predator
- Hoplothrips* flattened crevice dweller
- Leptogastrothrips* ant mimic
- Kladothrips* bubble leaf-gall thrips

Thysanopteran pests

- Piercing/scraping outer plant cells
- Especially cosmetic damage to high value horticultural crops
- In UK, *Kakothrips robustus* responsible for mottled silvery pea pods



Some major pest thrips

| Family | Genus | Example | Major hosts |
|----------------------|--|---|-------------|
| Thripidae | <i>Caliothrips</i> | <i>C. fasciatus</i> – bean thrips | Legumes |
| | | <i>C. sudanensis</i> – cotton leaf thrips | cotton |
| <i>Heliotothrips</i> | <i>H. haemorrhoidalis</i> – black tea or Greenhouse thrips | Polyphagous | |
| <i>Hercinothrips</i> | <i>H. bicornis</i> | Bananas & glasshouses | |
| <i>Scirtothrips</i> | <i>S. citri</i> , <i>S. dorsalis</i> | Citrus | |
| <i>Limothrips</i> | <i>L. cerealium</i> – grain thrips | Cereals & grasses | |

Some more major pest thrips

| Family | Genus | Example | Major hosts | |
|-----------------|----------------------|------------------------|--|--|
| Thripidae | <i>Frankliniella</i> | <i>F. occidentalis</i> | Both v. polyphagous – western flower thrips | |
| | | <i>F. schulzei</i> | - cotton bud thrips | |
| | <i>Thrips</i> | <i>T. tabaci</i> | onion thrips | v. polyphagous, onions, tomatoes |
| | | <i>T. angusticeps</i> | - cabbage thrips | polyphagous, apple, pear, brassicas |
| Phlaeothripidae | <i>Gigantothrips</i> | <i>G. elegans</i> | Leaf curl on figs | |
| | | | | |

Controlling thrips - Cultural methods:

- Irrigate to avoid water stressed plants. NB watering can also physically remove thrips
- Cultivation and burning regimes, crop rotation
- Planting and harvesting times
- Increase plant spacing: when there is a need to reduce virus incidence
- Control alternative hosts – crop and weed

Cultural controls in practice



Thrips lay eggs in flowers

Remove open or unwanted flowers

Bins for reject flowers – with lids



Trap crops

Courtesy: www.realipm.com

Controlling thrips - Chemical

- Difficult as they hide in confined spaces
- 'Thripstick' – sticky polybutene + deltamethrin (sprayed onto plastic surfaces under cucumber plants against *T. tabaci*)
- Synthetic pyrethroids & neo-nicotinoids may interfere with IPM
- Application ...

... at very high volume rates



Thrips: Biological controls

- Predatory mites: *Amblyseius (Neoseiulus) cucumeris*
- *Orius* spp. (pirate bugs)
- Lacewing larvae
- Predatory thrips ...

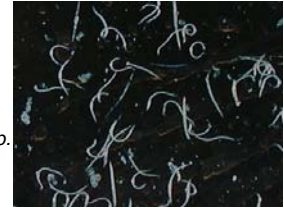


Beneficial thrips

- NATURAL ENEMIES OF PESTS
- Aeolothripidae:
 - Aeolothrips – thrips, mites, moth eggs
 - Franklinothrips – thrips, mites, whitefly
- Thripidae
 - Scolothrips – tertranychid mites
- Phlaeothripidae
 - Aleurodothrips)
 - Karnyothrips) coccids, scales
 - Leptotherips) mites etc
 - Podothrips)

Microbial agents

- Entomopathogenic nematodes: *Steinernema feltiae* & *Heterorhabditis* spp.
- *Lecanicillium* (*Verticillium*) *lecanii*



Monitoring thrips



Yellow traps work as well as blue

Used for monitoring to initiate sprays – spot treatment or overall?

Risk of large traps for mass trapping – may encourage invasions from outside

'Thripline': synthetic version of a sexual aggregation pheromone for Western Flower Thrips, (natural pheromone produced by males and attracts both males and females into mating aggregations)

Pest example: Western Flower thrips, *Frankliniella occidentalis* (Pergande)

- Adults <2mm long, yellow-brown in colour, but several colour forms occur which vary in abundance according to season
- Highly polyphagous species - 244 recorded hosts including flowers of apricots, plums, peas, tomatoes, roses, cucurbitaceae, chrysanthemums
- Feeding causes discoloration and scarring of blooms and petals and deformed buds; one of the transmitters tomato spotted wilt virus (TSWV)
- Easily dispersed on wind, clothes, equipment, plants & cut flowers

Western Flower thrips (ctd.)

- In USA glasshouses 12-15 generations per year.
 - Eggs inserted into parenchyma cells of leaves, flowers & buds, hatch 4 days at 27°C,
 - 2 larval stages, pre-pupal & pupal stage. Pupates in soil.
 - >50 eggs per female. 80% female
- Control: phytosanitary measures, quarantine, biocontrols. Chemical control difficult because of cryptic habits & insecticide resistance.



Frankliniella occidentalis



Thrips palmi

- Invasive species - spreading rapidly in tropics and sub-tropics
- Polyphagous pest of Cucurbitaceae and Solanaceae ("melon thrips")
- Kept out of Europe despite a number of outbreaks (UK infestation imported on cut flowers) - all successfully eradicated
- Mix of IPM measures:
 - Space treatments with OP/pyrethroids
 - Imidacloprid (a neo-nicotinoid) - NL
 - Sanitation with winter break in glasshouses (UK)



See: Cannon *et al.* (2007) *Crop Protection* 26 1089-1098

<http://www.insectimages.org> DEFRA

Beneficial thrips

- REDUCING FITNESS OF WEEDS
- *Liothrips urichi* to control *Clidemia*
- *Amynothrips andersoni* to control alligator weed in southern USA



- POLLINATION – useful when large insects such as bees are rare

Summary : Thysanoptera

- “Fringed wings” - coupled by tiny hooks on hind wings - sometimes called “thunder flies”
- Two sub-orders:
 - Terebrantia: 7 families including Thripidae
 - Tubulifera: 1 family the Phlaeothripidae
- Small, slender, usually dark insects, commonly associated with flowers
- Piercing asymmetrical mouthparts
- Pest species - often significant cosmetic damage; may transmit viruses
- Beneficial spp. - especially pollinators and predators of thrips mites and Sternorrhyncha

Further Reading

Trevor Lewis (1973) *Thrips*. Academic Press

