Mechanisms of insecticide resistance in Western Flower Thrips, *Frankliniella occidentalis* (Pergande)

Insecticide Resistance Action Committee

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Introduction and biological background

The Western Flower Thrips, *Frankliniella occidentalis* (Pergande) (WFT) is a cosmopolitan and polyphagous pest. Both adults and larvae show a preference to feed on and in flowers, making them particularly difficult to control. Adults may migrate between crops depending on availability of flowers. In addition to direct plant damage, WFT is a highly efficient vector of different plant tospoviruses like TSWV. [1]

Originating in W. USA in the 1960, it spread east in the 1970's, then appeared in Europe in 1983, Japan 1990, Australia 1993, spreading mainly in horticultural crops.[1]

The insect completes its lifecycle in around 2-3 weeks. Three factors may contribute to the development of resistance in WFT: short generation time, high fecundity and haploid males in which resistance genes are directly exposed to selection by insecticide treatment.

Resistance mechanisms

First reports of insecticide resistance in WFT date to the 1990's.

Studies using piperonyl butoxide synergist revealed that enhanced detoxification, mediated by cytochrome P-450 monooxygenases, is the major mechanism imparting resistance to pyrethroids, OP's and carbamates in WFT.[8]

Cross-resistance among these insecticide classes is present.

Research with spinosad-resistant WFT showed that no standard synergists could break the resistance, suggesting a mechanism other than the metabolic pathway. Also, spinosad-resistant WFT showed no cross-resistance to acrinathrin, formetanate or methiocarb in laboratory strains selected for resistance towards each insecticide.[10]

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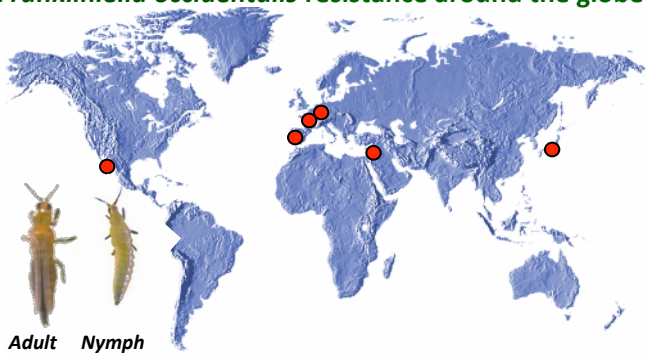
Frankliniella occidentalis resistance around the globe



Adult ***Nymph***

Resistance management guidelines

- ✓Use each compound according to the label recommendation
- ✓Alternate products from different chemical MOA groups
- ✓Use as many different MOA groups as possible
- ✓Avoid treating subsequent generations with the same MOA group
- ✓We recommend no more than 3 sprays per crop cycle of any AI
- ✓Avoid spraying acrinathrin before formetanate or spinosad
- ✓Avoid spraying formetanate before methiocarb

MOA Group	Primary Site of Action	Chemical Subgroup or Exemplifying Active Ingredient
1A	Acetylcholinesterase (AChE) inhibitors	Carbamates eg methiocarb, formetanate
1B	Acetylcholinesterase (AChE) inhibitors	Organophosphates eg acephate, methamidophos, chlorpyrifos-methyl
2A	GABA-gated chloride channel antagonists	Cyclodiene organochlorines eg endosufan
2B	GABA-gated chloride channel antagonists	Phenylpyrazoles (Fiproles) eg fipronil
3A	Sodium channel modulators	Pyrethroids eg fenpropathrin, acrinathrin, *tau*-fluvalinate
5	Nicotinic acetylcholine receptor (nAChR) allosteric activators	Spinosyns eg spinosad, spinetoram
6	Chloride channel activators	Avermectins eg abamectin, emamectin benzoate
13	Uncouplers of oxidative phosphorylation via disruption of the proton gradient	chlorfenapyr
15	Inhibitors of chitin biosynthesis, type 0	Benzoylureas eg lufenuron
UN	Compounds of unknown or uncertain MoA	azadirachtin

IPM for Western Flower Thrips control

WFT is a typical pest of greenhouse and covered crops, which opens up many opportunities for alternative ways to control the pest:

- Blue sticky roller traps can be employed to catch flying adult thrips
  - Performance can be enhanced with pheromones / kairomones
- Anti-thrips screens reduce thrips inmigration into the greenhouses
- Predators can be released onto leaves to hunt and kill larval thrips
  - *Amblyseius cucumeris, swirski, degenerans,*
  - *Orius sp.*

Orius laevigatus predatory bug nymph

Amblyseius cucumeris predatory mites

- Entomopathogenic nematodes and fungi (EPNs, EPFs) can be used as foliar sprays in flowering crops to attack and infest adult thrips, if humidity conditions are high enough. *Eg Steinernema, Beauveria, Paecilimyces sp.*
- Methods to control WFT may include treating substrates with insecticides (eg IGRs) or predatory mites (eg *Hypoaspis miles*) to target the nymph stage which falls to the ground from the plant.
- Use beneficial-compatible compounds or those with low foliar residual effect to limit long term effects on predators and parasites (for example potassium salts of fatty acids, maltodextrin. Use chemical clean up sprays at the beginning and end of the season where appropriate.
- Improved insecticide formulations and the use of adjuvants may be a key factor for successful control.

Identification of *F. occidentalis*

Photo courtesy of CSIRO

- Female body colour yellowish with darker abdominal segments.
- Male smaller and paler.
- Antennae with 8 segments, the first paler than the second.
- Pronotum with 2 large setae on each posterior angle, 1 on each anterior angle, and 2 on anterior margin.
- Ocellar setae between anterior ocellus and each of posterior ocelli (not between posterior ocelli).
- Main post-ocular setae much larger and darker than the others.
- Two complete rows of 20-22 setae on main vein of fore hind wing and 15-17 on secondary vein.

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