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

**Introduction and biological background**

The Western Flower Thrip, *Frankliniella occidentalis* (Pergande) 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, *F. occidentalis* is a highly efficient vector of different plant tospoviruses like TSWV.

Originating in E. 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. The insect completes its lifecycle over 2 weeks. The developmental time from egg to adult on the cucumber, cabbage, bean, capsicum and tomato leaf was 9.2, 10.2, 10.4, 12.2 and 12.9 days, respectively.

**1. Resistance mechanisms**

First reports of insecticide resistance in *F. occidentalis* 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, OPs and carbamates in *F. occidentalis*. However, endosulfan was not synergized.

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

**2. Resistance management guidelines**

- Use each compound according to the label recommendation
- Alternate products from different chemical MOA groups
- Avoid treating subsequent generations with the same MOA group
- Max 3 sprays per crop cycle of any active ingredient
- Avoid spraying acrinathrin before formetanate or spinosad
- Avoid spraying formetanate before methiocarb

<table>
<thead>
<tr>
<th>MOA Group</th>
<th>Primary Site of Action</th>
<th>Chemical Subgroup or exemplifying active ingredient</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Acetylcholinesterase inhibitors</td>
<td>1A Carbamates methiocarb, formetanate</td>
</tr>
<tr>
<td>1</td>
<td>Acetylcholinesterase inhibitors</td>
<td>1B Organophosphates, eg acephate, methamidophos, chlorpyrifos-methyl</td>
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<tr>
<td>3</td>
<td>Sodium channel modulators</td>
<td>2A Organophospho endosulfan</td>
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<td>5</td>
<td>Nicotinic acetylcholine receptor activators</td>
<td>3A Pyrethroids, eg fenpropathrin, acrinathrin, deltamethrin, taufluvalinate</td>
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<tr>
<td>6</td>
<td>Chloride channel activators</td>
<td>6A Avermectins abamectin, emenemactin benzoate</td>
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<td>13</td>
<td>Uncouplers of oxidative phosphorylation</td>
<td>13 Chlorfenapyr</td>
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<td>15</td>
<td>Inhibitors of chitin biosynthesis</td>
<td>15 Benzoylureas lufenuron</td>
</tr>
<tr>
<td>UN</td>
<td>Unknown mode of action</td>
<td>Azadirachtin</td>
</tr>
</tbody>
</table>

**References**

12. Zhang, J & et al. Life history of western flower thrips, Frankliniella occidentalis (Thysan., Thripidae), on five different vegetable leaves. J App Ent.131 (June 2007)

**3. IPM for Western Flower Thrip control**

Western Flower Thrips are typical pests of greenhouse and covered crops, which opens up many opportunities for alternative strategies to control them:

- Blue sticky roller traps can be employed to catch flying adult thrips
- Performance can be enhanced with pheromones
- Predators can be released onto leaves to hunt and kill larval thrips
- Amblyseius cucumeris, swirsks, degenerans, and Orius laevigatus
- Entomopathogenic nematodes (EPNs) can be used as follar sprays in flowering crops to attack and infest adult thrips, if humidity conditions are high enough. *Eg Steineremema feltiae*.
- Cultural methods to control Western Flower Thrips involve treating substrates with insecticides (eg IGRs) or predatory mites (eg *Hypoaspis* or *Amblyseius*) to target the nymphose stage which falls to the ground from the plant.
- Sprays may be targeted only to flowers to control thrips avoiding side effects on predators released in a crop
- Clean up sprays with abamectin or spinosad leave low residues allowing short intervals between spray and release of predators

**4. Monitoring Methods, other info?**

- For adults, use Method 10a published on the IRAC website

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