# Insecticide resistance overview of the tobacco whitefly (*Bemisia tabaci)*

Insecticide Resistance Action Committee

www.irac-online.org

## Introduction and background

*Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae) is one of the most critical invasive pests worldwide, and also known for its high potential of resistance development. It is a vector of serious plant diseases such as Tomato Yellow Leaf Curl Virus and Cucurbit Chlorotic Yellow Virus. In order to sustainably control *Bemisia tabaci*, it is important to implement resistance management programs.

The two most important sub-species of *Bemisia tabaci* are Middle East – Asia Minor 1 (MEAM1, also known as biotype B) and Mediterranean (MED, also known as biotype Q).

| IRAC Group | Mode of Action | Sub-group | Chemical class / Compounds | Resistance: Juvenile stages | Resistance: Adults |
|---|---|---|---|---|---|
| 1 | Acetylcholinesterase inhibitors | A | Carbamates | Globally Widespread | |
| | | B | Organophosphates | Globally Widespread | |
| 3 | Sodium channel modulators | A | Pyrethroids | Globally Widespread | |
| 4 | nAChR competitive modulators | A | Neonicotinoids | No reported cases | Several locations |
| | | C | Sulfoxaflor | Rare cases | |
| | | D | Flupyradifurone | Rare cases | |
| 7 | Juvenile hormone mimics | C | Pyriproxyfen | Several locations | No active at this life stage |
| 9 | Effectors of chordotonal organs | B | Pymetrozine Pyrifluquinqzon | No reported cases | Several locations |
| | | D | Afidopyropen | No reported cases | |
| 12 | Inhibitors of mitochondrial ATP synthase | A | Diafenthiuron | Rare cases | |
| 15 | Inhibitors of chitin biosynthesis affecting CHS1 | - | Benzoylureas | No reported cases | |
| 16 | Inhibitors of chitin biosynthesis, type 1 | - | Buprofezin | Isolated cases | |
| 21 | Mitochondrial complex I inhibitors | A | METI's | Isolated cases | |
| 23 | Inhibitors of acetyl CoA carboxylase | - | Spiromesifen / Spirotetramat | Isolated cases | Not active at this life stage |
| 28 | Ryanodine receptor modulators | - | Cyantraniliprole | No reported cases | |
| 29 | Chord. organ modulators, undefined | - | Flonicamid | No reported cases | |
| UN | Compounds of unknown or uncertain MoA | - | Azadirachtin | No reported cases | |
| UNB | Bacterial agents (non-BT) of Unknown MoA | - | e.g. Chromobacterium spp. | No reported cases | |
| UNE | Biological essences of Unknown MoA | - | e.g. Fatty acid monoesters | No reported cases | |
| UNF | Fungal agents of Unknown MoA | - | e.g. Beauveria bassiana | No reported cases | |
| UNM | Non-specific mechanical disrupters | - | Diatomaceus earth | No reported cases | |

**No reported cases mean no published or unpublished data is available to suggest a case of resistance.**

## Latest resistance status of major insecticide IRAC groups (2020)

### Group 1: Carbamates & Organophosphates

Resistance has been observed since 1980's and is globally widespread. Resistance has been linked to elevated levels of esterases and insensitive acetylcholinesterase.

### Group 3A: Pyrethroids

Resistance has been observed since 1980's and is globally widespread. Resistance has been linked to target site mutations in the sodium channel (e.g. L925I,T929V)

### Group 4: Neonicotinoids, Sulfoximines, Butenolides

Resistance to neonicotinoids (4A) has been documented in Europe since the late 1990's. Subsequently resistance has spread to several locations globally, including North and South America, Europe, Asia and Africa. Resistance is particularly conferred by elevated levels of CYP6CM1, a P450 enzyme elevated in adults, but much less in nymphs. Sulfoximines (4C) and butenolides (4D) are described to be unaffected by this mechanism of resistance.

### Group 7C: Pyriproxyfen

Resistance has been reported in South Europe, USA and Israel since the 2000's and more recently in some regions of Brazil. Potential involvement of cytochrome P450s in pyriproxyfen resistance has been suggested.

### Group 9B: Pymetrozine & Pyrifluquinazon

The elevated level of enzymes which are known to confer resistance to neonicotinoids are also known to affect pymetrozine and to a lesser extent pyrifluquinazon. As with neonicotinoids, resistance occurs in adult whiteflies whereas nymphs are much less affected.

### Group 23: Spiromesifen/Spirotetramat

Recently isolated cases of resistance to spiromesifen and spirotetramat were described in Spanish and Australian populations of MED- and MEAM1-type *B. tabaci,* respectively. Resistance is conferred by a target-site mutation (A2083V) in acetyl-CoA carboxylase.

### Other modes of action

There are no or very limited documented cases of resistance to the other IRAC mode of action groups registered for the control of *Bemisia tabaci*.

Before the implementation of resistance management strategies, it is recommended to consult local experts for latest updates on the resistance situation within your region. Insecticide susceptibility can vary between locations and at different times.

## Resistance Management *(See the IRAC Bemisia tabaci Pest Page for more information at www.irac-online.org/pests/bemisia-tabaci/ )*

IRAC highly recommends monitoring the level of resistance carefully in order to allow appropriate recommendations for insecticide resistance management (IRM). The most widely followed approach in IRM is based on defined 'MoA treatment windows', where a treatment window is defined by the life-cycle of the pest. The basic aim of the strategy is to avoid treating consecutive generations with insecticides of the same MoA. For more information and advice regarding *B. tabaci* and IRM approaches, please visit IRAC web page: www.irac-online.org



Designed & produced by IRAC Sucking Pest Working Group Team, Poster Ver. 2.1, Based on Mode of Action Classification Ver. 9.4
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