

# Sustainable control of the greenhouse whitefly: combining solutions

## Problem

The greenhouse whitefly, *Trialeurodes vaporariorum* causes direct damage to plants by piercing their tissues, as well as indirect damage, by transmitting viruses. Mineral oils are usually applied to control the greenhouse whitefly but should be replaced with more sustainable solutions.

## Solution

The combined use of disruptive vibrations, orange essential oils (EO) and other plant extracts (PE) significantly reduces the greenhouse whitefly fitness and infestation rates.

## Outcome

Synergistic effects of vibrations and plant-derived products (EO+PE) reduce greenhouse whitefly infestations more effectively than separate application of plant-derived products and vibrations. This synergetic approach also allows to reduce the total number of EO+PE treatments per year and even has a stronger effect than that of a pyrethroid insecticide used as a positive control.

## Applicability box

### Input used

- |                                      |  |
|--------------------------------------|--|
| <input type="checkbox"/> Copper      | <input type="checkbox"/> Anthelmintics |
| × Mineral oil                        | <input type="checkbox"/> Antibiotics   |
| <input type="checkbox"/> Fertilisers | <input type="checkbox"/> Vitamins      |

### Geographical coverage

Global

### Application time

Throughout the entire cropping season

### Period of impact

Current crop

### Equipment

Vibro-plates, Orange Essential Oil, *Clitoria ternatea* extract

### Best in

Tomato and other greenhouse crops

## Practical recommendations

### Characteristics of the vibration device

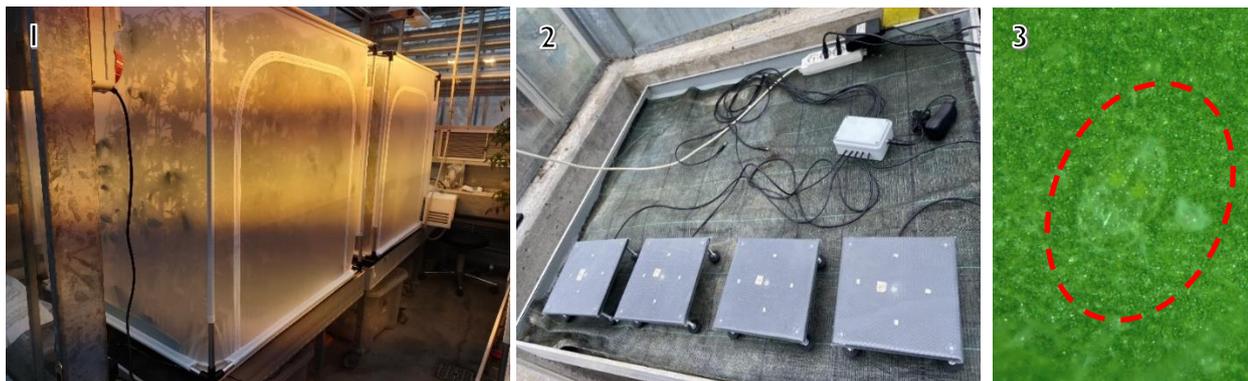
- Vibro-plates consist of square wooden plates (length: 20 cm, thickness: 1 cm) paired to mini-shakers (12 V) associated with a microchip.
- Vibro-plates can work individually or in groups, thus supporting more potted plants.
- The disruptive vibration amplitude, measured from the plants, must reach a velocity of at least 30  $\mu\text{m/s}$  (optimal range: 40-300  $\mu\text{m/s}$ ), which is considered sufficient to disrupt the vibrational signals emitted by the whitefly.
- Cables are required to power the device. Models with built-in solar panels are currently under development for outdoor applications.

### Characteristics of the plant-based products

- The orange essential oil is formulated as a micro-emulsion, diluted in water, and applied to the crop with standard spray devices used for conventional pesticides.
- BPA044I, a plant extract of *Clitoria ternatea*, is highly soluble in water. The product can be easily diluted and sprayed on the crops with all the standard devices used for conventional pesticides (e.g., back sprayers or atomizers).

### Combined use of the alternatives

- Vibro-plates must be turned on 24 hours per day and for the entire period when crop protection is needed to be effective. The system is particularly effective at low population densities of greenhouse whitefly. Therefore, it should be activated as soon as the plants are placed in the greenhouse.
- The concentrations of orange essential oil and extracts of *Clitoria ternatea* are, respectively, 4 and 20 mL/L in the final solution. Tap water is used to dilute the products, and application can be performed with a pressurised hand sprayer. The first treatment must be done at the appearance of the first whitefly adults in the crop and repeated after 7-10 days.



**Picture 1: Greenhouse experimental set-up: Bugdorm cages (volume: 1 m<sup>3</sup>) with 36 potted tomato plants** (Photo: Valerio Mazzoni, FEM).

**Picture 2: A set of 4 vibro-plates, each one actioned by a mini-shaker** (Photo: Valerio Mazzoni, FEM).

**Picture 3: A whitefly nymph in its first instar on a tomato leaf - the nymph is transparent, elliptical, and attached to the surface of the leaf (in the red dotted circle on the picture). Nymphs are the most susceptible stage to plant extract treatments** (Photo: Valeria Fattoruso, UNITN).

## On-farm application

### System approach

Vibrational signals used in synergy with orange essential oil and *C. ternatea* extracts can be considered a suitable strategy for sustainable control of the greenhouse whitefly in organic farming. The method is free of synthetic chemicals and does not release harmful residues into the environment. Farming practices enhancing biodiversity also constitute an integral part of any mineral oil reduction strategy.

### Availability

The vibro-plate device can accommodate different cropping systems and is easily installed. However, the prototype is still under development at this stage, while experimentations are under way. The device should be available for farmers in 2023. Orange essential oil is already available on the market. *Clitoria ternatea* extracts must go through a registration process at the EU level and will therefore not be available before 2025).

## Further information

### Further readings

RELACS News Story “Behavioural manipulation as an alternative to the use of paraffin oil in greenhouse whitefly control”, available at: [https://relacs-project.eu/wp-content/uploads/2020/01/ifoameu\\_projects\\_relacs\\_news\\_story\\_fem\\_japan\\_final.pdf](https://relacs-project.eu/wp-content/uploads/2020/01/ifoameu_projects_relacs_news_story_fem_japan_final.pdf).

RELACS Practice Abstract “Vibrational signals to control the whitefly in organic greenhouse production”, available at: [https://relacs-project.eu/wp-content/uploads/2022/04/RELACS\\_PA\\_09\\_Vibrations\\_CIHEAM\\_FEM\\_final.pdf](https://relacs-project.eu/wp-content/uploads/2022/04/RELACS_PA_09_Vibrations_CIHEAM_FEM_final.pdf)

### Weblinks

Check the [Farm Knowledge Platform](#) for more practical recommendations.

## About this practice abstract and RELACS

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**RELACS:** 'Replacement of Contentious Inputs in Organic Farming Systems' (RELACS) builds on results of previous research projects and takes far-advanced solutions forward. As a system approach to sustainable agriculture, organic farming aims to effectively manage ecological processes whilst lowering dependence on off-farm inputs. The RELACS partners will evaluate solutions to further reduce the use of external inputs and, if needed, develop and adopt cost-efficient and environmentally safe tools and technologies.

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RELACS has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773431. The information contained in this communication only reflects the author's view.