



Potential use of current natural enemies against invasive insect and mite species

Several insect and mite species have invaded Europe and Israel, causing significant yield losses of agricultural crops of greenhouse (GH) and outdoor cultivation and significantly increasing the costs of their management. Invasive species can become a serious problem as for the absence of natural enemies, especially during their establishment period on a crop. Especially in GHs where natural enemies are absent, insect and mite species can move into them and rapidly increase in numbers. Within the GH, good scouting and monitoring is required by examining a number of plants throughout the season, at least twice a week. A thorough examination of few plants in different positions for feeding damage signs or insect excrements or the pest itself is required.

Pepper weevil (PW), *Anthonomus eugenii*

PW (Figure 1) is mainly an insect pest of cultivated chili and sweet pepper (*Capsicum* spp.) but can also reproduce on several *Solanum* spp. It lays eggs and feeds on and develops completely inside the floral buds and fruits of the host. At 27°C, its life cycle is completed in 2 weeks. In subtropical areas on *Capsicum* spp., it has 5-8 generations/year, while multiple generations may develop in greenhouse conditions. The pepper weevil does not enter diapause, but does survive lower temperatures just above zero.



Figure 1. Adult of *Anthonomus eugenii*.

Although there are no registered biological control agents 2 external parasitoids, i.e. *Catolaccus hunteri* (Hymenoptera: Pteromalidae) and *Bracon mellitor* (Hymenoptera: Braconidae) are known for attacking 3rd PW larval instars within flower buds and small fruits, while little is known about their efficiency in *Capsicum* greenhouse.

Tomato leaf miner (TLM), *Tuta absoluta*

Tuta absoluta (Figure 2) is a very harmful leaf mining moth with a strong preference for tomatoes. It occurs on eggplants, sweet peppers, potatoes and various other cultivated plants. It can cause 50-100% yield reduction on tomato crops (GH and outdoor). Depending on temperature, life cycle ranges from 24-38d. Larvae are mining inside the leaf, stem or fruit and exit to pupate. Adults are active during night and hide between leaves during day. Larvae prefer leaves, stems, and green fruits only. Most distinctive symptoms are the blotch-shaped mines in the leaves. Damage to fruit leads to its rotting before or after harvest due to fungal development. Several natural enemies have been identified (Zappalà *et al.*, 2013).



Figure 2. Larva of *Tuta absoluta*.

Oriental spider mite (citrus brown mite), *Eutetranychus orientalis*

Citrus are the main hosts of economic importance of *E. orientalis* (Figure 3a) but this mite may also attack pepper (*Capsicum* sp.), cucurbits (*Cucurbita pepo*, *C. melo*), beans (*Phaseolus vulgaris*), eggplant (*Solanum melongena*), etc. In summer, the duration of *E. orientalis* life cycle is 10-12d and it may develop up to 25 generations/year. Mites feed on the upper side of the leaf along the lateral veins, causing the leaves to become chlorotic (pale-yellow streaks).

Little webbing is produced. The phytoseiid *Euseius scutalis* appears to regulate mite's populations.

Tomato red spider mite, *Tetranychus evansi*

Tetranychus evansi (Figure 3b) mostly prefers tomato, aubergine, pepper and beans. Damage caused by feeding punctures leads to whitening/yellowing of leaves, followed by desiccation, and eventually defoliation. In case of severe attacks, plants may die. Mites and their webbing can be seen on the underside of the leaf. Females lay up to 200 eggs. Males are smaller and orange-coloured. At 25°C, the life cycle is completed in 13.5d. Development is favoured by hot and dry conditions. The widely used phytoseiids *Neoseiulus californicus* and *Phytoseiulus persimilis* exhibit poor ability to suppress *T. evansi* populations on commercial crops, while *Phytoseiulus longipes* can be a potential natural enemy (Furtado *et al.* 2006).

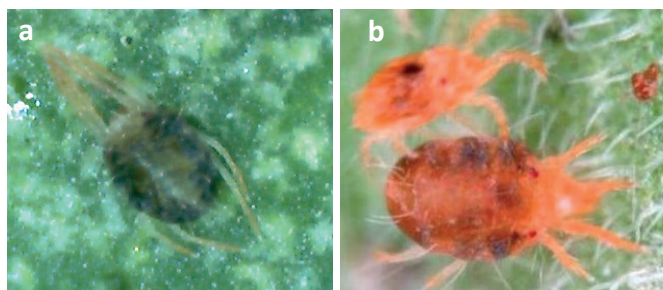


Figure 3.a- Adult of *Eutetranychus orientalis*;

Figure 3.b- Adult of *T. evansi*.

Leafminers (*Liriomyza trifolii*, *L. huidobrensis*, *L. sativa*, *L. bryoniae*)

Liriomyza spp., are leaf mining flies (Figure 4 a, b). The adults have a characteristic yellow spot on the back (the scutellum) but laboratory analysis is required to confirm the identification of each species. They cause damage by puncturing the leaf surface to feed on the leaf tissue and also to lay eggs. When the eggs hatch, the larvae tunnel within the leaf tissue forming damaging and disfiguring mines. Leaf mines and punctures reduce the quality of high value horticultural crops in addition to reducing the photosynthetic ability of the plant.

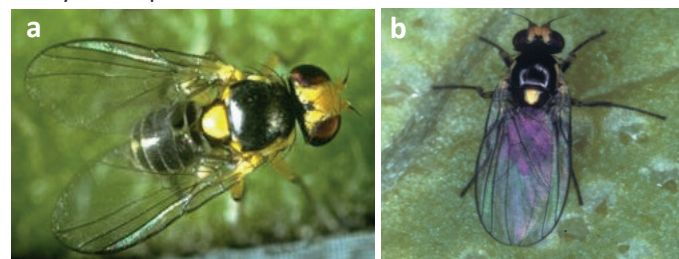


Figure 4. a- Adult of *Liryomyza Trifolii*.

Figure 4.b- Adult of *L. Huidobrensis*.

Natural enemies periodically suppress leaf miner populations. *Dacnusa sibirica*, *Opius pallipes* and *Diglyphus isaea* are under

consideration for use as natural enemies of the pest in European greenhouses.

Sweetpotato whitefly, *Bemisia tabaci*

Bemisia tabaci (Figure 5) and its biotypes are polyphagous and attack many crops. It can acquire and transmit more than 110 plant viruses. Each female lays up to 160 eggs and 11-15 generations may develop within 1 year. Natural enemies such as *Encarsia formosa*, *Eretmocerus* sp., *Macrolophus* spp., and predatory mites such as *Euseius scutalis* and *Amblyseius swirskii* can be used.



Figure 5. Adults of *Bemisia tabaci*.

Other pests of significant importance

Pests of significant concern include the tomato russet mite, *Aculops lycopersici*, the tortricid *Bactra bactrana* on sweet peppers etc.

References: CABI Invasive species Compendium. 2014. Datasheet *Bemisia tabaci*. European Plant Protection Organisation database.

Furtado IP, Moraes GJ, Kreiter S, Tixier M, Knapp M (2007) Potential of a Brazilian population of the predatory mite *Phytoseiulus longipes* as a biological control agent of *Tetranychus evansi* (Acari: Phytoseiidae, Tetranychidae). *Biological Control* 42: 139–147.

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Author: Vassilis A. Vassiliou, Eric Palevsky, Ellen Ritcher
Affiliation: Agricultural Research Institute, Nicosia, Cyprus, vassilis@ari.gov.cy

Authors of the pictures: (1) Steve Nanz, (2) Koppert Biological Systems, (3a) V. Vassiliou, (3b) A.J. (Bram) Knegt, (4) EPPO, (5) Ian Denholm

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