BioGreenhouse

Plant health

Food sprays for predatory mites

Different natural (mainly pollen) and artificial foods have been proven as suitable alternative foods supporting the survival and development of generalist phytoseiid predatory mites. Spray applications of pollen of certain plant species in greenhouse crops may support the early establishment and population build-up of phytoseiid predators, enhancing their efficiency in biological control of key pests, such as thrips and whiteflies. *Typha angustifolia* is the only commercially available pollen for greenhouse spray application, while pollen from other anemophilous species, such as corn, may also prove a suitable alternative food source for greenhouse application. Since pollen application may also support the population increase of the omnivorous thrips pest *Frankliniella occidentalis*, caution is needed when selecting the most suitable pollen for the predator, but at the same time less suitable for the pest. Herein, the most important foods currently used, or of potent use for greenhouse application are briefly presented with the aim to highlight their importance for conservation biological control.

Alternative foods for predatory mites

Natural and artificial food sources that have or may have a positive effect on the early establishment and population increase of phytoseiid predators in greenhouse crops include:

-Plant-derived foods: pollen (*Typha latifolia, T. angustifolia*, corn, pine) (Figures 1 and 3);

-Factitious foods: *Ephestia kuehniella* eggs, decapsulated *Artemia franciscana* cysts;

-Artificial foods: mixtures of sugars, yeast and pollen.

Pollen as alternative food source

Pollen of several plant species is a nutritional alternative food source supporting the survival and reproduction of generalist phytoseiid predators during periods of prey scarcity.

Figure 1. *Typha angustifolia* pollen.

Ricinus communis, a plant species producing ample quantities of highly nutritive pollen, has been successfully integrated in greenhouse crops as a 'banker plant' supporting the early introduction and establishment of phytoseiid predators (e.g. *Iphiseius degenerans*) in the absence of prey.

Corn, and more recently ornamental pepper plants, have also been documented as potentially a valuable source of fresh pollen for the early establishment of phytoseiid predators (e.g. *Amblyseius swirskii*) in greenhouse crops.

However, the provision of pollen as food supplement by spraying or dusting plants may be a more practical, less labour-intensive and more preferable approach than banker plants for the growers to enhance predatory mite conservation in greenhouse crops (Figure 2).

Figure 2. Pollen dusting in a cucurbit greenhouse.

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Commercially available pollens

Since years, pollens produced by several fruit trees, with well documented nutritional quality for a number of phytoseiid species are commercially available for pollination purposes. These pollens have never been tested as alternative food sources for phytoseiid predators in commercial greenhouses (possibly due to their relative high cost).

Figure 3. *Typha latifolia* flowering head.

Bee-collected pollen is also commercially available at a relatively low price compared to fruit tree pollens. However, this pollen has been proven as a food source of inferior nutritional quality under laboratory conditions for several phytoseiid predatory mites and thus, is considered as not suitable for application in greenhouse crops.

Typha angustifolia pollen has recently been commercially released. Growers have already started applying this product to support the early population build-up of phytoseiid predators released in their crops (e.g. *Euseius gallicus*, *A. swirskii, Amblydromalus limonicus* and *Amblyseius montdorensis*).

Other potentially important pollens

Pollens of other anemophilous plant species, such as *T. latifolia*, corn (*Zea mays*) and pine (*Pinus* sp.) have been successfully applied by spraying or dusting plants in certain ornamental and vegetable greenhouse crops with the aim to support the early establishment and population build-up of phytoseiids (e.g. *A. swirskii*). These pollens are not yet commercially available. Nevertheless, these anemophilous plants should produce pollen in huge quantities, thus making pollen collection easier and possibly, less labour-intensive.

Possible negative effects / drawbacks

In the presence of prey, the provision of pollen as a supplementary food source for predatory mites may result in reduced prey consumption (due to predator switch in food choice), therefore hampering biological control. On the other hand, mixing prey with pollen may have a positive impact on the population dynamics of generalist phytoseiid predators (such as *A. swirskii*), enhancing the efficiency of biological control of pest species, such as thrips and whiteflies.

Another risk of pollen application in greenhouse crops is related to its possible positive direct effects on the population dynamics of certain pests. Pollen consumption by the omnivorous thrips *F. occidentalis* resulted in faster development and increased oviposition. Therefore, the provision of pollen to enhance predator conservation in a greenhouse crop for which thrips is a key pest may lead to a faster increase in pest populations. To overcome this drawback, pollens of high suitability for phytoseiid predators, and of low nutritional quality for omnivore prey should be selected.

Factitious foods

Sterilized *E. kuehniella* eggs and decapsulated *A. franciscana* cysts are food sources that support the development of phytoseiid predators (e.g. *A. limonicus*) under laboratory conditions. However, the possible role of these foods for the early establishment of phytoseiids in greenhouse crops remains to be tested.

Artificial foods

New artificial diets enriched with protein exudates of moth larvae have been developed for mass-rearing phytoseiid mites. These diets have shown to be of comparable nutritional quality to the traditionally used factitious prey species used for mass-rearing phytoseiids, as well as to pollen. However, their effects on the early establishment or the conservation of predatory mites in the greenhouse have not yet been evaluated. Importantly, simple mixtures of yeast, sugar and proteins sprayed on chrysanthemum plants supported the population build-up of *A. swirskii*.

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Authors: G.D. Broufas, M.L. Pappas
Affiliation: Democritus University of Thrace, Greece
gbroufas@agro.duth.gr; mpappa@agro.duth.gr

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