BioGreenhouse

Plant health

Flowering plants for supporting hoverflies in greenhouse crops

Hoverflies (Syrphidae) belong to a large family of insects and among them are important natural enemies of aphids, such as the species *Episyrphus balteaus* and *Sphaerophoria rueppellii*. They can occur naturally both in outdoor and greenhouse crops and in in greenhouses, densities can be augmented through releases of commercially produced individuals. The larvae of these aphidophagous hoverflies are predators and eat aphids, but the adults are vegetarian and need nectar and pollen as food sources. Flowering plant can provide these required resources and thereby support populations of hoverflies and facilitate biological control of aphids. This principle is well studied for outdoor crops and flowering strips are now successfully used to support aphid control. However, the method clearly needs further development for supporting hoverfly populations in greenhouse crops.

Conservation biological control

Plants can provide nectar, pollen and plant sap as food sources for natural enemies, but the contribution of these food sources to natural enemy performance depends on the type of predator or parasitoid. Specialist natural enemies only reproduce in the presence of their (specific) prey/host species. However, most other natural enemies are temporal omnivores. They exploit or fully depend on non-prey food during a part of their life cycle, often the adult stage. For example, adults of parasitoids, hoverflies and gall midges can increase their longevity, flight activity and oviposition by feeding on nectar. Besides nectar, the adults of hoverflies also eat pollen, which is an important protein source for egg laying females.

Figure 1. Flower visiting hoverflies *Episyrphus balteatus*, an important aphid predator and pollinator.

Natural enemies may benefit from increasing vegetation diversity through the plant-provided resources such as pollen, nectar and alternative prey species.

This principle has become popular in outdoor crops where several levels of vegetation diversity are applied with flowering strips, pollen-producing plants, beetle banks or crop mixtures. The support of naturally occurring natural enemy populations through these habitat modifications is called conservation biological control.

Figure 2. Larva (left) and adult (right) of *Episyrphus balteatus*.

Suitable flowering plants for hoverflies

Not all flowering plants are suitable for hoverflies. Aphidophagous hoverflies have relatively short proboscis compared to other hymenopteran pollinators (bees and bumblebees). Recent studies of van Rijn & Wäckers (2016) showed the critical flower depth to be 16 mm, and for some plants this is even less. Thus it is important to select flowers that have accessible nectar for these hoverflies. Field studies also confirmed that densities of naturally occurring aphidophagous hoverflies in flower strips is highly correlated with the abundance of flowers that have accessible nectar. Suitable flowering plants for aphidophagous hoversflies are sweet *allyssum* (*lobularia* sp.), Coriander (*Coriandrum sativum)*, Annual Baby's-breath (*Gypsophila elegans*), buckwheat (*Fagopyrum esculentum*), German chamomile (*Matricaria recutita*) and *Crambe hispanica*.

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Figure 3. *Crambe hispanica* in an organic sweet pepper crop.

Flowering plants for greenhouse crops

Most greenhouse crops do not provide the pollen and nectar that adult hoverflies need to survive and produce eggs. Sweet pepper plants are an exception, as they continuously flower. But even in this crop, it was shown that additional flowering plants enhance the establishment of hoverflies (Pineda et al. 2008). Obviously, it is essential that the flowering period overlaps with the time that adults hoverflies are active. When hoverfies are introduced in greenhouses, the period they are active can range from early spring to late autumn. In order to support adults during this entire time period, it remains a challenge to achieve long flowering period with plants that perform well in greenhouses. In northern Europe, such long flowering periods can be achieved with by sequentially sowing *Crambe hispanica* and buckwheat (Fig. 4)

plant	sowing	flowering
Crambe hispanica	January-April	April-July
Fagopyrum esculentum	March-April	July-October

Figure 4. Possible scheme to achieve a long period of flowering plants that support hoverflies in greenhouse crop with *Crambe hispanica* (left) and buckwheat, *Fagopyrum esculentum* (right).

Future Research

Aphids are a huge problem in organic greenhouse production systems of sweet pepper, eggplant and cucumber. Supporting aphidophagous hoverfly populations with flowering plants have proven to be successful in greenhouse trials.

However, more research is needed to optimize this system in order to make it applicable for growers. We suggest focusing future research on the following issues:

1. Optimize the system of introducing plants with overlapping flowering periods for year round hoverfly support under different greenhouse climatic conditions.
2. Study to what extent the floral resources for hoverflies support other biological control agents, such as lacewings, coccinellids and mirid or anthocorid predatory bugs.
3. Assess the possible risks of introducing flowering plants for western flower thrips populations.
4. The interaction with other measures for pest and disease control.
5. Determine how efficacy of flowering plants is related to the ratio flowering plant/cropping plants

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