FresaProtect: a mix of parasitoids to control all common aphid species on protected strawberry crops. Case studies from three years of experience

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ABSTRACT

A parasitoid is a wasp able to parasitize aphids in a relatively host-specific way. These natural enemies of aphids are used in organic and/or Integrated Pest Management (IPM) strategies. Strawberry plants can be attacked by at least 15 different aphid species. To control all these different aphid species, several parasitoid species are needed. A mix of 6 different parasitoid species, FresaProtect, can control all these aphid species. Moreover, each aphid species is parasitized by at least two different species of parasitoids of the mix which increases the efficiency of the control. All parasitoids included in FresaProtect are individually efficient in the control of a large host range. However, the strength of a mix lays also in the synergy of the different parasitoid species, i.e. combination of the different research capacities, daily oviposition rates, lifespan, affinities to their hosts, behavior modification, host-feeding activity, temperature range, etc. This reinforces the action of FresaProtect. A population dynamics' model, highlighting the importance of a preventive use of FresaProtect to keep aphids level below the economic damage threshold, is shown. Here, we report case studies of FresaProtect in different European countries in strawberry crops in IPM and organic production systems. With releases, every three weeks, FresaProtect offered an excellent protection against the different aphid species attacking. With its ready-to-use unit it is easier and less time consuming than any chemical aphid control method.

Introduction

Aphid control in protected strawberries is increasingly facing different challenges. Due to multiple insecticide resistance and to the pressure of the market to reduce the level of residues in the fruits, chemical products are progressively abandoned, and biological and integrated methods meet a growing success. Viridaxis developed an innovative concept to fight against all different species of aphid attacking protected strawberries: a cocktail of six different species of parasitoids (Order: Hymenoptera, Family: Braconidae (subfamily: Aphidiinae) and Aphelinidae) called FresaProtect. Each aphid species can be attacked by several species of parasitoids, thus increasing the efficiency of the biocontrol (Table 1). When used preventively, FresaProtect is able to control all commonly appearing aphids attacking strawberry crops. It is a ready-to-use unit with integrated feeding point (honey). The tubes are installed in the crop (1 tube for 200 m²) on fixed release points (Fig. 1) which protect the tubes against predation by ants, direct sunshine and water projection. This device can be used in different cropping systems.

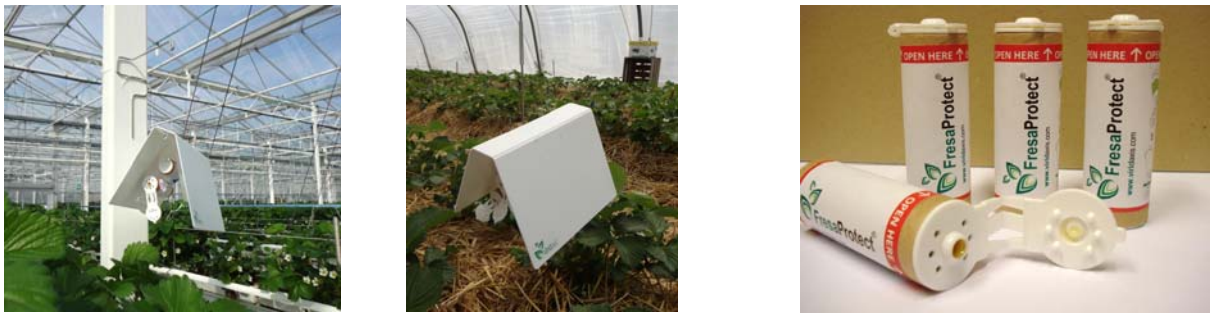

Fig. 1 Fixed release point installed on the pillars of a heated greenhouse (left) or on a metal stick planted in full ground (middle). This device protects the mummies of the parasitoids from direct sunshine and water. It is hung by a fine nylon string hindering access of ants to the tubes. On the right, close-up of the tubes showing the feeding point (honey) included in the lid.

Table 1: List of the most important aphid species attacking strawberries (left column, in bold are the most common species or those which are economically important). The parasitoids present in FresaProtect are listed in the first line. Their efficacy in the control of the different aphids is indicated by '+' for proven control under field conditions (+++: very high efficacy, ++: high efficacy, +: good efficacy) or 'X' for control under laboratory and semi field conditions.

Aphid/Parasitoid	*Aphidius ervi*	*Aphidius matricariae*	*Ephedrus cerasicola*	*Praon volucre*	*Aphidius colemani*	*Aphelinus abdominalis*
Acyrtosiphon malvae	++			+++		
Aphis craccivora		++		+	+++	x
Aphis fabae		+		+	x	x
Aphis forbesi		x			x	
Aphis gossypii		++	x	+	+++	x
Aphis nasturtii		++		+		
Aphis ruborum		++			++	
Aulacorthum solani	++	x	+++	++	x	++
Chaetosiphon fragaefolii			x	x		x
Macrosiphum euphorbiae	+++			+++	x	+++
Macrosiphum rosae	++			+++	x	++
Myzus ascalonicus		x	x	x		x
Myzus persicae	+	++	++	++	+++	++
Rhodobium porosum	++		x	x		+++

1 Material and Methods

FresaProtect is used commercially since 2011 in many European countries, including Belgium, France, Germany and United Kingdom, in different cropping systems (heated glasshouses or unheated tunnels, full ground or table top) and on different varieties (Elsanta, Clery, Sonata, Candiss, Amesti, Darselect, Lambada, Charlotte, Mara des bois, Gariguette and many other varieties). Releases are done every three weeks starting at planting, and using fixed release points. As parasitoids are most efficient when used in a preventive way (Thielemans et al. 2011) (Fig. 2), releases start on a clean crop (in the absence of aphids) just after planting or covering of the tunnels (eventually after a cleaning treatment if necessary).

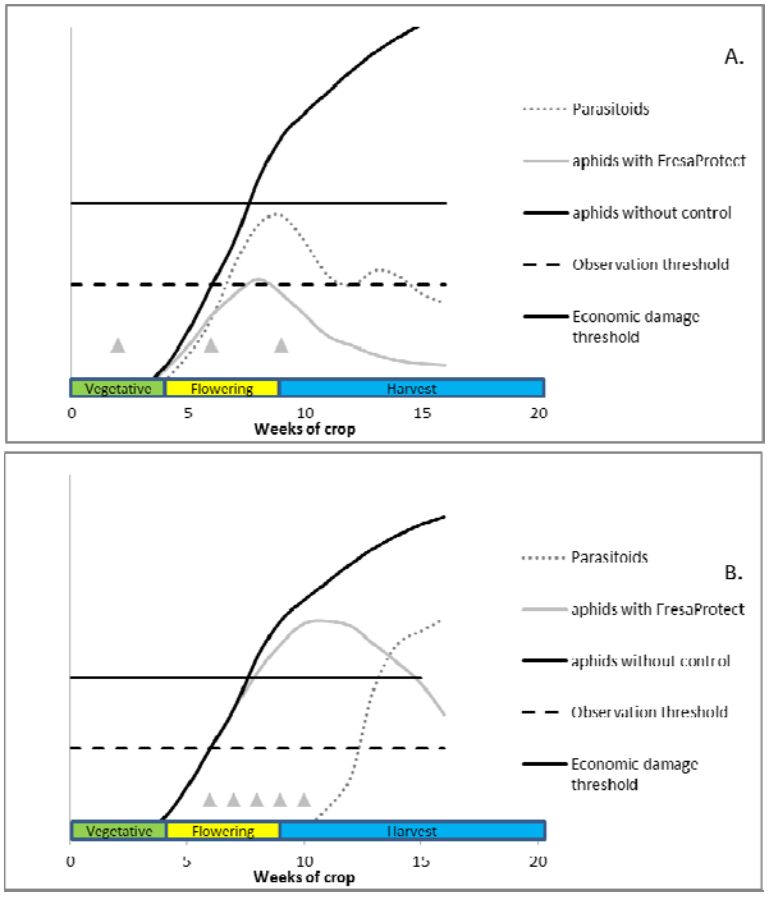

Fig. 2: Model of population dynamics of parasitoids and aphids with or without control. Adapted from Thielemans et al. (2011). Triangles represent the FresaProtect releases. A. Preventive strategy: First release is realized at planting. The aphid population stays below the economic damage threshold. B. Curative strategy: the first release is realized when aphid population exceeds the observation threshold. In these conditions and with a release every week, the aphid population can exceed the economic damage threshold. It is finally controlled but damages to the crop are not avoided during several weeks.

The crops at some growers and in different research stations were regularly monitored. The aphids and mummies were counted on a fixed number of randomly chosen plants using the counting key shown in table 2.

Table 2: Key for aphid and mummies counting

Key for aphid "intensity"		*Key for mummy "intensity"*	
0	*Absence of aphids*	*0*	*absence of mummies*
1	*1-4 aphids per plant present*	*1*	*1-2 mummies per plant present*
2	*5-10 aphids per plant present*	*2*	*> 2 mummies per plant present*
3	*spot with colonies*	*3*	*> 10 mummies per plant present*

2 Example of Results

Here, we show four examples of results of the use of FresaProtect under different conditions.

2.1 Start with clean crop (Fig. 3)

The first release was done in week 15 on a clean crop. Aphid pressure was low and all arriving aphids (*Acyrtosiphon malvae*) were rapidly parasitized. The presence of winged *Aphidius* mummies highlights the efficacy of parasitoids to find isolated aphids.

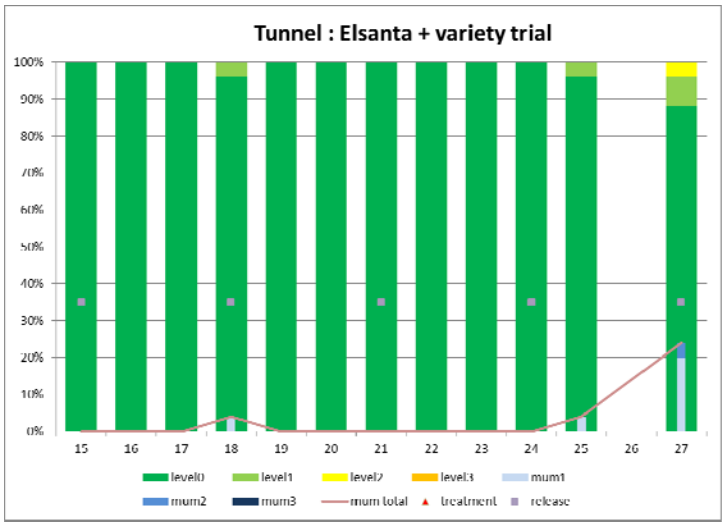

Fig. 3: Results of aphids and mummies counting in a plastic tunnel with a table top crop of strawberries (Elsanta + different other June bearers varieties). Proefcentrum Hoogstraten, April-July 2013. On the right, mummy of *Aphidius* on a winged aphid.

2.2 Start after a cleaning treatment (Fig. 4)

A cleaning treatment with pirimicarb was done in week 17 before the first release. After that, the first aphids were well controlled until week 25. As no release was done during 5 weeks, a new cleaning treatment was applied in week 26 and releases restarted in week 27. After that, aphids were under control until the end of the harvest.

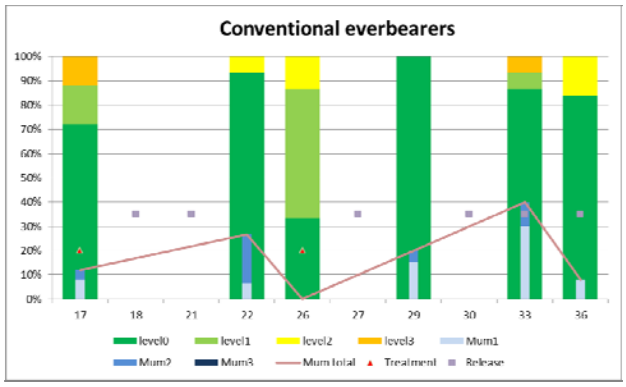

Fig. 4: Results of aphids and mummies counting in a plastic tunnel with a table top crop of strawberries (everbearers, different varieties). Landwirtschaftskammer Nordrhein-Westfalen, Auweiler, April-September 2012.

2.3 Start after organic cleaning treatment (Fig.5)

Just after covering the tunnels, individuals of *Chaetosiphon fragaefolii* were detected. They were eliminated with a pyrethrum cleaning treatment. After that, *Acyrtosiphon malvae* and *Macrosiphum euphorbiae* were observed on a relatively high number of plants. However, the parasitism rate was very high (mummies of *Aphelinus abdominalis*, *Praon volucre* and *Aphidius sp.* were observed) and those aphids never reached the economic damage threshold.

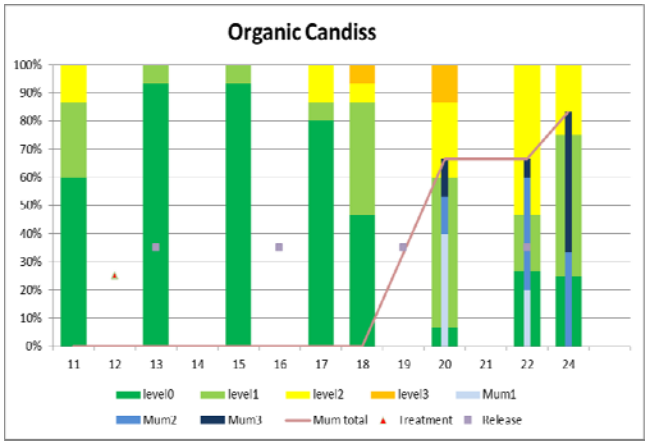

Fig. 5: Results of aphids and mummies counting in a plastic tunnel with an organic full ground strawberry crop (Var Candiss). Provinciaal Proefcentrum voor Klein fruit, Pamel (PPK), March-June 2013.

2.4 Start with aphids

In this second year crop, aphids were already present at first release of FresaProtect. As the population dynamics of aphids is faster than the population development of parasitoids, a corrective treatment can be necessary to avoid economic damages. Such a treatment (thiacloprid) was applied here after the population of *Acyrtosiphon malvae* increased further and before the forming of mummies. After that treatment, parasitoids kept aphids below the observation threshold until the end of the harvest.

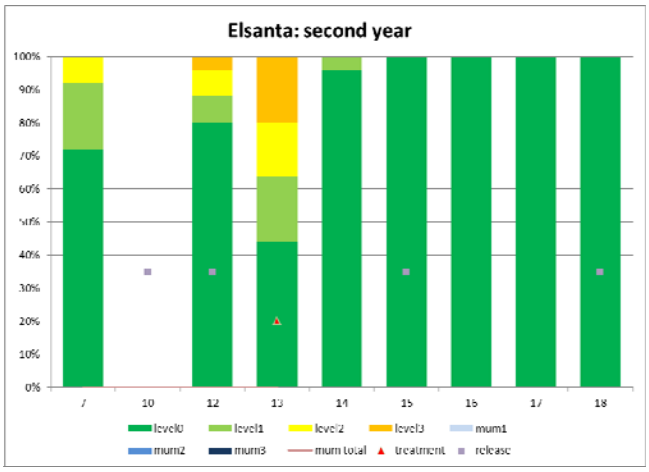

Fig. 6: Results of aphids and mummies counting in a heated glasshouse with table top strawberries (Var Elsanta) in their second year. Proefcentrum Hoogstraten, February-April 2013.

3 Conclusions

FresaProtect, as a ready to use unit, is quick and easy to install. Used in a preventive strategy, it can control all different aphid species attacking strawberries throughout the crop season maintaining them below the economic damage threshold. FresaProtect significantly reduces the need of insecticide treatments during the crop, decreasing therefore residues on the fruits. Controlling the aphids by a completely different mechanism compared to insecticides, FresaProtect can also be considered as a valuable tool in insecticide resistance management strategies.

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References

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