BioGreenhouse

Plant health

Use of banker plants for Entomophthorales-caused epizootics in aphid populations

Fungi belonging to Order Entomophthorales are considered the major pathogen of aphids in natural ecosystems and also in agroecosystems. They are known to cause large scale epizootics, but none of the species of this order have been developed as commercial biological control products. They could be one of the best candidates for controlling aphids in greenhouses because entomophthoran fungi require shorter periods of high humidity for transmission than fungi belonging to the order Hypocreales (*Beauveria* sp., *Lecanicillium* sp., *Paecilomyces* sp. etc), are more effective at low temperatures and are also more host specific. More than 30 fungi of entomophthoralean species have been recorded as aphid entomopathogens. However, a major stumbling block to utilising these fungi as biological control agents has been the difficulties encountered in growing them in vitro. Another approach in utilising these fungi could be to try inducing epizootics by introducing inoculum of infected aphids into the crop by using banker plants.

What is a banker plant system?

In the banker plant method, long-lasting rearing units for beneficials are created in the crop by distributing plants infested with herbivores or carrying other food items, such as pollen. The method has been widely investigated over many years and used to aid establishment, development and dispersal of beneficial organisms employed in biological control. So far, they are mainly used to conserve and augment arthropod natural enemy populations. A widely applied system in greenhouse crops has been the use of monocotyledonous plants with cereal aphids that serve as alternative hosts for parasitoids of aphids that attack the crop. The advantage of this system is that the grain aphids are specific to monocotyledons and pose no threat to crops that are dicotyledons (or dicots) (Figure 1). The same cereal aphids could also be used as entomopathogenic spores “reservoirs”, a source of entomophthoralean inocula, to cause epizootics of aphids which attack greenhouses crops.

Figure 1. Banker plants - wheat seedlings infested with *Sitobion avenae.*

How to use banker plants for Entomophthorales-caused epizootics

One of the most effective entomophthoralean species to control aphids is *Pandora neoaphidis*. Banker plants with this fungus can be produced by raising the wheat aphid *Sitobion avenae* on monocots and infects them artificially with *P. neoaphidis.* The phases of fungal infection are: adherence of spores on the insect cuticle and germination, penetration of tegument by specialized cells coming from germ tubes, development of fungus in the insect’s body as protoplasts or hyphal bodies, death of insect and initiation of the saprophyte phase of the fungus. Under favourable conditions of humidity and temperature, the conidiophores emerge from the cadavers 5 days post infection.

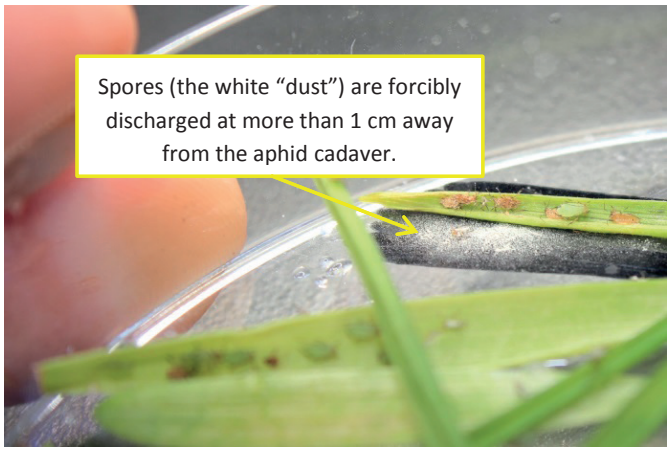

Figure 2. *Sitobion avenae* infected by entomophthoralean fungus.

The conidia of aphid-pathogenic entomophthorales are forcibly discharged from conidiophores (Figure 2) and they are able to cause epizootics quickly through spore dissemination.

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Infection initiation requires just few spores. Conidia of entomopathogenic fungi belonging to the order Hypocreales are not actively discharged and many conidia are required for infection. Furthermore, resting spores of entomophthoralean fungi, developed inside the insect cadaver, allow the entomopathogen to survive and persist in the environment.

Initiation of fungal epizootics

Banker plants infested with infected cereal aphids need to be transferred into greenhouse. They can be hanged in positions which allow fungal spores to reach crop pests (Figure 3). Relative humidity should be kept at high level in the greenhouse for the next two nights (or at least 6 hours). Once infected, winged (alate) aphids from the crop can spread the infection.

Figure 3. Small banker plant with grain aphids infected by *P. neoaphidis*.

Future Research

Aphids are a huge problem in organic greenhouse production systems of sweet pepper, eggplant and cucumber. Growers invest a lot in releases of arthropod natural enemies, but without the guarantee of success. The banker plant system with grain aphids infected by *P. neoaphidis* has potential to increase the efficacy of biological control programmes for aphids. However, this method needs to be further developed and the following issues require more research:

1. The climatic requirements for fungal infection and dispersal under greenhouse conditions.
2. The possibilities to enhance dispersal of conidia through non-target insects such as predatory bugs.
3. Side-effects on other beneficial organisms (including pollinators).
4. Development of new methods to maintain and increase inoculum of entomophthorales on bankers plants.
5. The interaction with other measures for pest and disease control.
6. Development of a mass production system of entomophthorales on aphids or artificial media for spray application.
7. Study the interaction between entomophthorales and their role in causing natural epizootics. Natural epizootics in aphid population in organic greenhouse in The Netherlands were often caused by a mix of two entomophthoralean species: *P. neoaphidis* and *Entomophthora planchoniana*. Little is known about their interaction and how that affects their efficacy in aphid infection.

Figure 4. Peach aphids on sweet pepper infected by *P. neoaphidis*.

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