Entomopathogenic and soil fungi against spotted wing drosophila (*Drosophila suzukii*)

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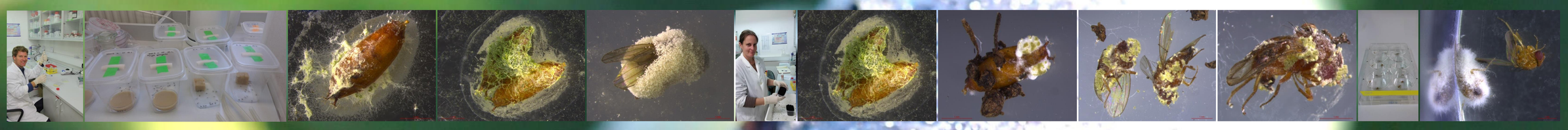


Background

Spotted wing drosophila (*Drosophila suzukii*; SWD; Diptera: Drosophilidae) management is challenging for the most part due to its brief generation time, polyphagy and serrated ovipositor, but also because its larvae can pupate in the orchard soil and are thus protected from aerial insecticide applications. Further, many insecticides are not allowed in organic fruit production and may be disruptive to beneficial agroecosystem services and human health.

Objectives

Interactions between entomopathogenic and soil fungi (EPF) and *D. suzukii* pupae or adults in various fungal deployment strategies were investigated.

Methods

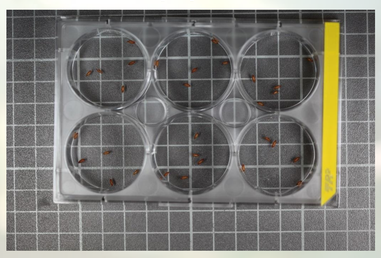
A laboratory investigation of several biocontrol *D. suzukii* treatment strategies utilizing uncommercialized fungal isolated and bioinsecticides against *D. suzukii* in blueberries was performed.

Six fungal isolates were used for testing: ***Metarhizium brunneum*** (isolates H.J.S. 1154 and 1868), ***Trichoderma atroviride*** (1873), ***Clonostachys rosea*** (1884), and ***Beauveria bassiana*** (2121 and 2122). The insecticide **Laser** 240 SC (a.i. spinosad, 22.75% w/w) was used as a positive control and the bioinsecticides **Naturalis** (a.i. *B. bassiana*) and **Mycotal** (a.i. *Verticillium lecanii*), as reference biocontrol agents. Tween 80 (0.1%) was used as a negative control.

Several different strategies of EPF deployment were evaluated:

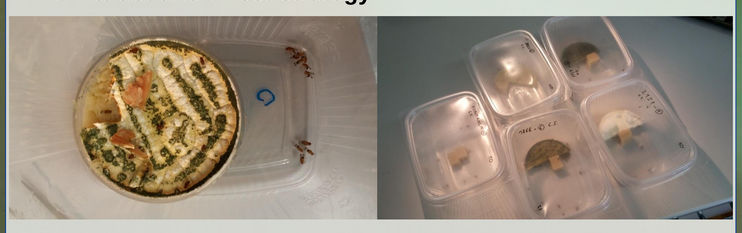
A Soil exposure of *D. suzukii* pupae

B Direct exposure of *D.s.* pupae to conidial suspensions



C Spraying of *D. suzukii* flies

D Attract and infect strategy



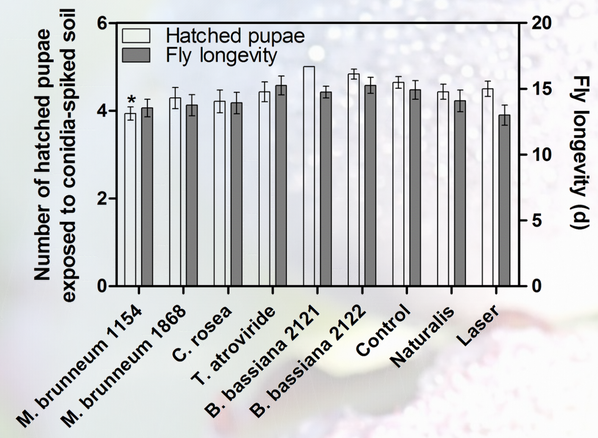
E Horizontal transmission of fungal infection

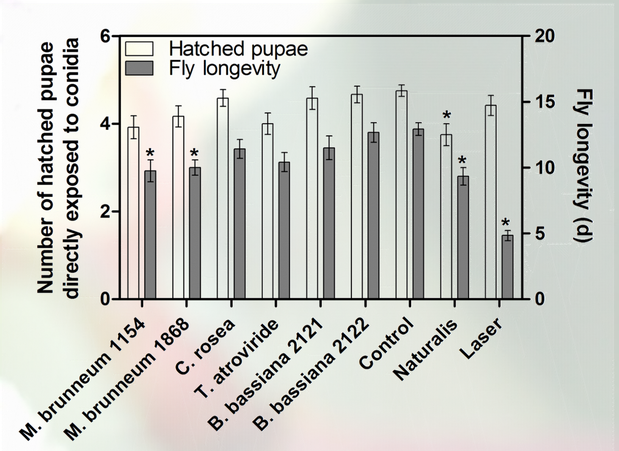
Horizontal transmission of fungal infection was very seldom observed (results not shown).

F Experiment with field-picked blueberries

A laboratory experiment of preventive and curative spraying of field-picked blueberries was performed to compare the efficacy of EPF to spinosad (Laser).

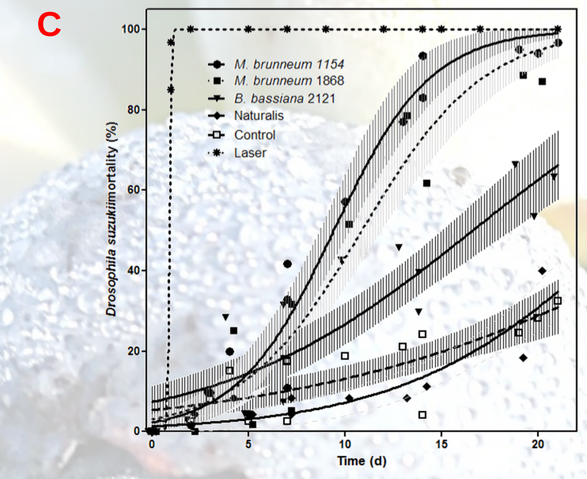
Results

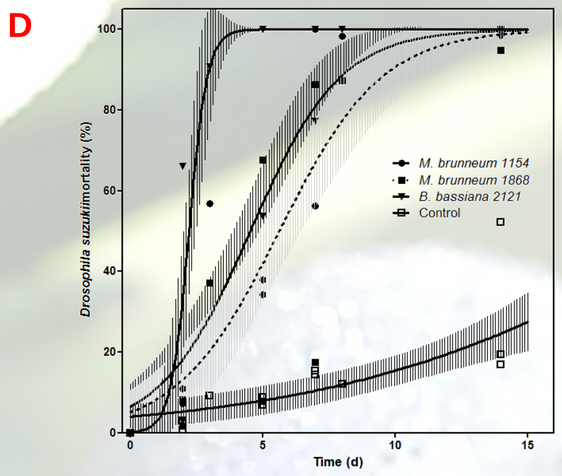




A) Total number of hatched *D. suzukii* pupae exposed to conidia-spiked soil, and parameter Fly longevity. **B)** Total number of hatched *D. suzukii* pupae directly exposed to conidial suspensions, and parameter Fly longevity, calculated as the average sum of living flies observed at all observation days.

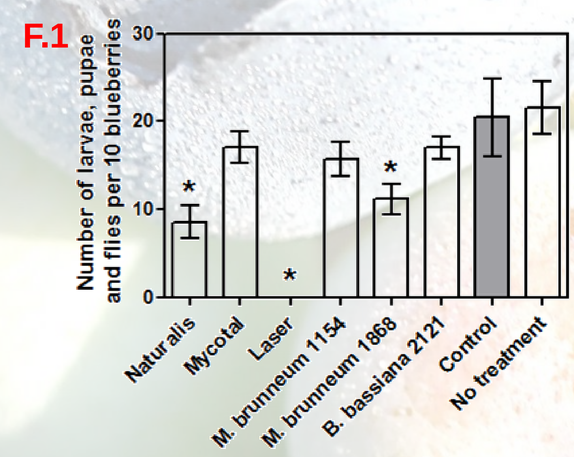
***M. brunneum* strain H.J.S. 1154 significantly reduced fly emergence in conidia-spiked soil, and product Naturalis in direct pupal exposure test. *M. brunneum* isolates 1154 and 1868 and bioinsecticides Naturalis and Laser significantly reduced parameter Fly longevity in direct pupal exposure test.**

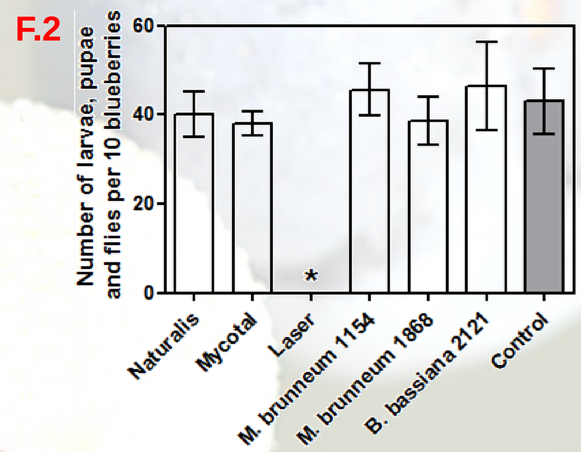




C) Mortality of *D. suzukii* flies sprayed with EPF. **D)** Mortality of *D. suzukii* flies exposed to artificial food source sustaining entomopathogenic fungi. Data are presented as the mean percentage ± standard error of initial number of flies (symbols) and non-linear regression models with 95 % confidence intervals (vertical lines).

***M. brunneum* (1154 and 1868) and *B. bassiana* (2121) caused significant mortality in sprayed flies, and exhibited even higher virulence in the attract and infect experiment (shortest LT_{50} of 2.2 d was obtained in *B. bassiana* (2121) treatment).**





F.1) Preventive spraying of blueberries (prior to infestation with *D. suzukii*) and **F.2)** curative spraying of blueberries (post infestation with *D. suzukii*). Data are presented as mean ± standard error of the number of larvae + pupae + flies, developed in 10 blueberries.

The EPF and 2 reference biocontrol agents, despite decreasing initial *D. suzukii* infestation (not shown), did not prevent an abundant 2nd generation to develop when applied prior to *D. suzukii* infestation (F.1). These treatments also did not have a curative effect on already infested blueberries (F.2). In contrast, Spinosad (Laser) offered preventive protection as well as exhibited curative action when sprayed on infested blueberries.

Conclusions

1. **Imagos were generally more susceptible to fungal infection than pupae. Most probably the pupal stage is too brief to allow entomopathogens to cause a significant reduction of fly emergence.**
2. **The high virulence obtained in attract and infect experiments shows promise as a potential biocontrol *D. suzukii* management strategy.**
3. **Preventive and curative spinosad application prevented or arrested *D. suzukii* development in field-picked blueberries under laboratory conditions. The formulated and unformulated EPF did not show this effect.**

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