

Objectives and Rationale

Entomopathogenic fungi (EPF) previously resulted in significant mortality against FCM, while EPN were found to control >90% pupae and emerging adults in laboratory bioassays. Most control measures for FCM are targeted towards citrus orchards, and information on alternative management in deciduous fruit and grapevine is lacking. The main aim of the study is focused on the biological control of FCM in an integrated pest management system, with emphasis on soil environments.

The objectives of this study include:

1. Evaluate EPN and EPF against FCM larvae and pupae in laboratory bioassays
2. Mass culture EPF and evaluate field efficacy after formulation and storage
3. Evaluate EPN and EPF in field and semi-field bioassays
4. Determine the diversity of parasitoid wasps in orchards
5. Evaluate chemical insecticides against egg parasitoids

Methods

Objective 1: A quick screening method, using FCM larvae and pupae, will be used to select promising EPN and EPF candidates from the US-collection. EPNs will include in vitro cultured *Steinernema yirgalemense* and *S. jeffreyense*, and various in vivo-produced *Heterorhabditis* species. EPFs include *Beauveria bassiana*, *Metarhizium anisopliae*, *M. brunneum*, *M. pingshaense* and *M. robertsii* isolates. The LD50 of the two best performing EPN and EPF species against larvae and pupae will be determined by means of a logarithmic-dose probit-analysis.

Results and Discussion

For EPNs against FCM larvae, at a dose of 50 IJ/larva, *Heterorhabditis noenieputensis* performed the best (100%), followed by *H. zealandica* (green variant) (97%), *Steinernema yirgalemense* (93%) and *H. indica* (89%). The LD50 for *H. indica*, *S. yirgalemense* and *S. jeffreyense* were 7.3, 14.6 and 47.8 IJ/larva, respectively. For EPNs against FCM pupae, at a concentration of 200IJ/pupa, *H. baujardi* (28%), *H. noenieputensis* (26%), *H. indica* (23%) and *H. zealandica* (blue variant) (23%), performed the best. The LD50 for *S. yirgalemense* and *S. jeffreyense* were 296.5 and 811.5 IJ/pupa, respectively.

For EPFs against FCM larvae, inoculated with 1×10^7 spores per insect, *Metarhizium pingshaense* resulted in 90% mortality, followed by *M. anisopliae* (71%), *M. robertsii* (64%) and *M. brunneum* (green variant) (58%).