



Grower Summary

Evaluation of *Metarhizium anisopliae*
for control of black vine weevil
larvae in field grown strawberries

SF103

Final report 2010

Project Title: Evaluation of *Metarhizium anisopliae* for control of black vine weevil larvae in field grown strawberries

Project Number: SF 103

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Key Workers & Their Roles:

1. Dr Minshad Ali Ansari (Field trials officer, responsible for design and execution of trials, collection of data, statistical analysis and preparation of report).
2. Dr Farooq Shah (Field trials officer – left for another job during project)
3. Casual workers (to assist at key times – e.g. collecting weevils, planting, treating sites, monitoring and destructive assessment).

Location of Project:

1. Haygrove Fruits, Tewkesbury Road, Newent, Gloucestershire, GL18 1EB
2. Haygrove Limited, Redbank, Little Marcle Road, Ledbury, HR8 2JL

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'The results and conclusions in this report are based on an investigation conducted over a 20 month period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations'.

GROWER SUMMARY

Headline

- The insect-pathogenic fungus *Metarhizium anisopliae* is highly efficacious against black vine weevil larvae in sandy and clay loam soils.

Background and expected deliverables

The black vine weevil (BVW), *Otiorhynchus sulcatus* (Coleoptera: Curculionidae) is a major pest of strawberries and other soft fruit (e.g. raspberries, blackcurrants). BVW spend part of their life cycle in soil feeding on plant roots. Targeting of the subterranean stages (larval stages) would significantly reduce crop damage and improve crop yield. A strain of the insect pathogenic fungus, *M. anisopliae* V275 (Novozymes F52 = BIPESCO 5), has already been identified which shows much promise as a biological alternative for the control of BVW larvae in hardy nursery stock and strawberries in soil-less media (HNS 133, HortLink project, HL 0171; Shah *et al.*, 2007).

The overall aim of this project was to evaluate two formulations of *M. anisopliae* in controlling BVW larvae in field grown strawberries in different soil types in the UK. It offers a biological alternative to chemical insecticides that are currently at risk of being phased out or of resulting in chemical residues in the fruit. The specific objectives were to:

1. Determine the optimum dose of two formulations (granular and conidial powder) of *M. anisopliae* for BVW control in field grown strawberries.
2. Determine the efficacy *M. anisopliae* on a grower holding (i.e. commercial setting).

Summary of the project and main conclusions

The objective of this study was to evaluate two formulations of the insect-pathogenic fungus, *Metarhizium anisopliae* Met 52, MAPP 15168, measured by infectivity against black vine weevil (BVW) larvae. The trials were conducted in field grown strawberries in sandy and clay loam soil at two different locations of Haygrove Fruits, Ledbury, Gloucestershire, UK in April 2009 and May 2010. The three application methods tested included a granular formulation (122 kg/ha) incorporated into soil before planting of strawberries commenced, a suspension

formulation applied as a drench and the same suspension formulation used as a slurry treatment of the bare roots at planting. Fungal efficacy was then determined.

All three application methods were effective in controlling BVW in the different soil types and locations. The highest dose tested (1×10^{14} conidia/ha = 122 kg product/ha) provided significantly better control than the intermediate (1×10^{13} conidia/ha = 12 kg/ha) or low (1×10^{12} conidia/ha = 1.2 kg/ha) doses. BVW larval control at the high, intermediate and low doses was 71-96%, 40-75% and 6-11%, respectively. Premixing, drench or bare root treatment with *M. anisopliae* gave similar levels of BVW control. The high dose rate gave the best control irrespective of the application method or soil types. Significantly high larval control was achieved (78-97%) when chlorpyrifos was applied at planting rather than 8 weeks post planting (53%).

Additional studies were conducted to determine if entomopathogenic nematodes would increase the efficacy of *M. anisopliae*. Two doses of *Heterorhabditis bacteriophora* and *Steinernema kraussei* at the rate of 12,500 and 25,000 nematodes/plant were applied alone or the same doses were applied 5 months after plants were treated with *M. anisopliae* (1×10^{14} conidia/ha). There were significant differences in BVW control between *M. anisopliae* (88%) and *H. bacteriophora* (20-29%) or low dose of *S. kraussei* (39%) when applied alone. When used together, low dose of *S. kraussei* and *M. anisopliae* provided 100% control of the BVW larvae 6 weeks after nematode application. No significant differences were observed between the high dose of *S. kraussei* alone or in combination with *M. anisopliae*.

In conclusion, our preliminary observations suggest that Novozymes granular formulation of *M. anisopliae* can be premixed into soil or alternatively conidia can be applied as a drench or used as a slurry treatment of the bare roots. **Only the granular growing media incorporated method is currently commercially available.** When used at 122 kg product per hectare, *M. anisopliae* is efficacious in the prophylactic control of BVW larvae and offers an environmentally benign alternative to chemical pesticides.

Financial benefits

An estimated cost comparison has been provided in Table 1 for control of BVW larvae in strawberry. The values in the table show that the cost of the granular formulation of the *Metarhizium* product is 2-3 times higher than the cost of the nematode product currently in use; however, the *Metarhizium* gives better results as indicated in this report. Both the

fungus and nematode products are more costly than the currently recommended chemical insecticides. It is anticipated that the cost of the *Metarhizium* product will be much lower than the nematode product once application methods have been evaluated by growers. For example, the cost of treating bare roots with *Metarhizium* would be much more cost effective than premixing or drenching. However, considerable further research is required to establish the feasibility of treating bare roots with *Metarhizium*. A comparison of the different control methods and treatments is summarised in the table below.

Table 1. Comparison of different agents to control black vine weevil larvae in field grown strawberries.

Products	Equivalent product or conidia/ha	Product cost/ha	Application cost/ha	Total cost/ha
<i>Metarhizium anisopliae</i> F52- granular formulation	1×10^{14} CFU (= 50-100 kg)	£26/kg	No application cost - granular product can be incorporated in soil through strawberry BedMaker (Haygrove Fruits, UK)	£1300-2600
Nematodes- drench (Nemasys L™) (<i>Steinernema kraussei</i>)	25,000 nematode/plant	£0.07/plant = £224/ha × 2-3 times = £672	No application cost - product can be mixed in irrigation tank (general practice)	£500-700
Nematodes- drench (nematop®) (<i>Heterorhabditis bacteriophora</i>)	25,000 nematode/plant	£300/ha × 2-3 times = £600-900	No application cost - product can be mixed in irrigation tank (general practice)	£600-900
Chlorpyrifos- drench	2 l AI 285-570 ml/plant	£250	Cost of drench application is about £400-500/ha	£650-750

Approximately 32,000 strawberries plants/ha (source: Hargrove Fruits, Ledbury, Gloucestershire, UK. AI = Active ingredient).

Action points for growers

- A granular formulation of *Metarhizium anisopliae* F52 (Met52, MAPP 15168) is available in the UK. The product launched 1st February 2011, is produced by Novozymes and distributed through Fargro Ltd, Littlehampton, UK.
- This project shows that growers have a choice of delivery for the inoculum (**currently only the granular formulation is commercially available**).
- There is no additional cost for application of this product because granular formulations can be premixed in the soil during the strawberry bed preparation.
- Once other formulations become available, growers should evaluate different application systems to ascertain which best suits their production methods.
- Growers should acquaint themselves of the strengths and weaknesses of *Metarhizium* products and learn to use these products effectively.