FRIM
TECHNICAL INFORMATION

ISSN: 0128-0694 NO. 87, 2021

WETTABLE POWDER MYCOINSECTICIDE AS AN ALTERNATIVE EFFECTIVE CONTROL OF LEPIDOPTERAN PESTS

WA Wan Muhammad Azrul, A Mohd Farid & N Asib

INTRODUCTION

Entomopathogenic fungi are that specifically infect and often kill insects and other arthropods. They offer an attractive alternative to reduce the use of chemical pesticides in crop protection. This approach is safe to human health, environmentally friendly and is not as hazardous as chemical pesticides (Zimmermann 2007). At present, mycoinsecticides made from entomopathogenic fungi have received a lot of attention from scientists and researchers due to several advantages, especially on safety issues, effectiveness and specificity against targeted host pests (Mantzoukas & Eliopoulos 2020; Rajula et al. 2020)

The genus *Metarhizium* is one of the highly potential biological control agents and it is often reported effective in controlling more than 200 species of insect pests (Pu and Li 1996). However, they are known to be highly specific to certain species, genus or family of pests only (Zimmermann 1993). At the Forest Research Institute Malaysia (FRIM), we have successfully developed a prototype of wettable powder mycoinsecticide. A strain of *M. anisopliae* isolated from a forest soil in Forest Research Institute Malaysia (FRIM) was used as the active ingredient in the developed prototype. It is an effective alternative approach to suppress pest infestation that is safe and environmentally friendly, compared to hazardous chemical pesticides. This paper provides information on the potential and efficacy of the developed prototype of wettable powder mycoinsecticide in controlling infestation of some economically important crop pests from the family Lepidoptera.

The mycoinsecticide ingredients

The mycoinsecticide consists of two vital parts of ingredients, namely active ingredient and inert ingredient. The active ingredient is an active substance that is effective in killing the target pests. For the mycoinsecticide developed by FRIM, the active ingredient used is an entomopathogenic fungus, *M. anisopliae* strain FRIM859 (GenBank No. MG020741).

On the other hand, the inert ingredient is a mixture of vital materials formulated to enhance the effectiveness and efficiency of the active ingredient. It protects the active ingredient from extreme environments, enhances delivery system and prolongs the shelf life during storage. The inert ingredient used in this mycoinsecticide consists of mineral clay, kaolin and common harmless surface active ingredients from sulfonic acid group.

Wettable powder formulation

Formulations of mycoinsecticide can be in various, such as wettable powder, oil emulsion, granular and dust. The mycoinsecticide prototype developed by FRIM is in wettable powder (WP) form. This is the most common form of mycoinsecticide worldwide due to its advantages, mainly on storage, mobility and handling (Wraight et al. 2016). The WP mycoinsecticide consists of 40% active ingredient and 60% inert ingredient. It is dry and olive green in colour (Figure 1).

Other advantages of this WP formulation include safety, in that it does not harm the treated plants, unlike other types of formulations, which may cause foliar injury, among others. It is also easy to be measured and mixed during preparation in the field and is suitable with the common local pesticide application technique, such as knapsack sprayer (Figure 2). More importantly, the mycoinsecticide wettable powder does not cause blockage and clogging on hydraulic nozzles, nor forming sedimentation in the tank.

Figure 1 The wettable powder mycoinsecticide

Figure 2 It is highly practical to apply the mycoinsecticide in the field by using common and easily available knapsack sprayer in the market

Mode of action

This WP mycoinsecticide is a contact pesticide. It is to be sprayed directly to the insect larvae body. During spraying, the active ingredient, *M. anisopliae* conidia is delivered to the larvae and sticks to the cuticle, especially in between the abdominal segments. The insect body as food sources to germinate and further develop into a network of fungal hyphae that penetrate the insect cuticle through chemical and mechanical forces. The mycotoxin produced by the fungus during the invasion process is capable of causing paralysis and death to the insect larvae. The dead larvae will then become a new host for the fungus to reproduce and thus, infect new healthy larvae through secondary infection (Figure 3).

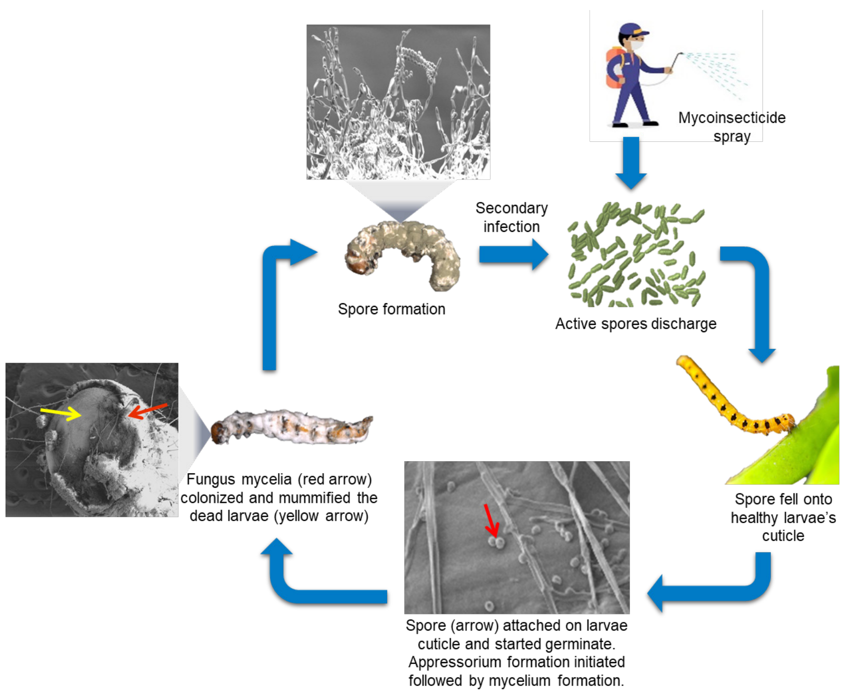

Figure 3 Mechanism of *Metarhizium anisopliae* infection on *Atteva sciodoxa* larvae

The efficacy

In the laboratory, the WP mycoinsecticide is proved very effective in killing insect pests, mainly from the family Lepidoptera, such as *Atteva sciodoxa, Heortia vitoissidase, Plutella xylostella* and *Spodoptera* spp. It caused over 80% mortality of the pest larvae within seven days after treatment (Figure 4). Likewise, the mortality of the target pests in the fields caused by the mycoinsecticide is also high. It has reduced up to 76% of *A. sciodoxa* larvae population in two Tongkat ali cultivation areas, namely KESEDAR Gua Musang, Kelantan and Hutan Simpan Sungai Menyala, Negeri Sembilan (Figure 5a). Besides *A. sciodoxa*, the major Tongkat ali pest, the mycoinsecticide is also effective against Lepidopteran pests of cabbage, such as *Spodoptera* spp. and *Plutella* sp. (Figure 5b). The pest populations were brought down below the economic threshold within 2 months by applying the mycoinsecticide at two-weekly intervals. Interestingly, this mycoinsecticide is comparable to the commercial Saponin-based products in the effectiveness against the Lepidopteran pests.

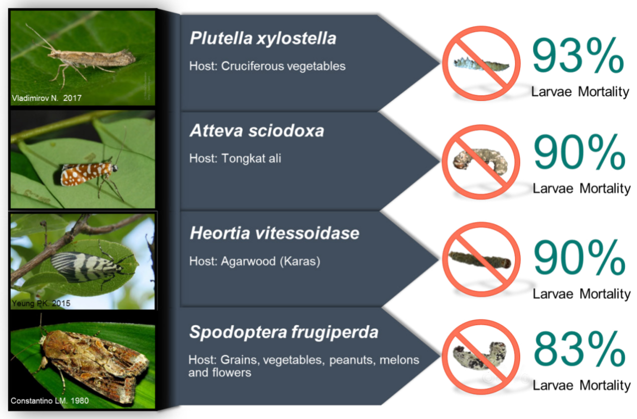

Figure 4 The virulence of *Metarhizium anisopliae* against selected insect pests in the laboratory

Another study conducted in a roselle farm showed that the mycoinsecticide was also effective in combating aphid infestation (Figure 5c). The application of the mycoinsecticide at two-weekly intervals for four months has successfully reduced the pest infestation to below 5%. Notably, the efficacy of the mycoinsecticide against aphid infestation is not significantly different compared with a chemical pesticide which is toxic to the environment, beneficial insects, especially pollinators, as well as to the users. Our study showed that the application of the mycoinsecticide did not affect the pollinators, such as bees and stingless bees in the farm (Figure 5d).

In order to have an optimum effect of the mycoinsecticide, spraying timing is very important. It is suggested to spray the mycoinsecticide early in the morning or late in the afternoon (Cheong et al. 2013). In the morning, feeding activity of the pest larvae is often more active, aggressive and damaging compared to the afternoon, due to low temperature. Furthermore, the combination of low temperature and the presence of dew on plants in the morning makes the surrounding humidity higher than in the afternoon. It provides conditions that are favourable for the active ingredient to grow and infect the larvae. Similarly, spraying the mycoinsecticide late in the afternoon can avoid extreme day light, especially ultra-violet light radiation and high temperature that could affect the effectiveness and survival of the fungus (Cheong et al. 2013). It also provides ample time and conditions for fungal conidia to stay intact from harsh environmental conditions in the afternoon.

ACKNOWLEDGEMENT

The study and development of this mycoinsecticide was funded by the Eleven Malaysia Plan (RMK-11) and Ministry of Agriculture under the Agriculture National Key Economic Area (NKEA) project (Project no. NH0614A019).

REFERENCES

Cheong YL, Sajap AS, Nor HM, Omar D & Abood F. 2013. Effect of UV-B and solar radiation on the efficacy of *Isaria fumosorosea* and *Metarhizium anisopliae* (Deuteromycetes: Hyphomycetes) for controlling Bagworm, *Pteroma pendula* (Lepidoptera: Psychidae). *Journal of Entomology* 10(2): 53–65.

Figure 5 The effectiveness of the mycoinsecticide against targeted pests in the field. The mycoinsecticide successfully (a) killed the larvae of *Atteva sciodoxa* on a tongkat ali, (b) *Spodoptera* sp. on a cabbage leaf, (c) reduced aphid (arrow) infestation harmless to the beneficial insects, (d) mainly stingless bee (arrow). Photos (c) and (d) were taken from a roselle farm.

MANTZOUKAS S, & ELIOPOULOS PA. 2020. Endophytic Entomopathogenic Fungi: A Valuable Biological Control Tool against Plant Pests. *Applied Sciences* 10(1): 360

PU ZL, & LI ZZ. 1996. Insect Mycology. *Anhui Science Technology* Hefei Press, Anhui, China. Pp. 360–368.

RAJULA J, RAHMAN A & KRUTMUANG P. 2020. Entomopathogenic fungi in Southeast Asia and Africa and their possible adoption in biological control. *Biological Control* 151: 104399.

WRAIGHT SP, FILOTAS MJ & SANDERSON JP. 2016. Comparative efficacy of emulsifiable-oil, wettable-powder, and unformulated-powder preparations of *Beauveria bassiana* against the melon aphid *Aphis gossypii*, *Biocontrol Science and Technology* 26 (7): 894–914

ZIMMERMANN G. 1993. The entomopathogenic fungus *Metarhizium anisopliae* and its potential as a biocontrol agent. *Pesticide Science* 37: 375–379.

ZIMMERMANN G. 2007. Review on safety of the entomopathogenic fungi *Beauveria bassiana* and *Beauveria brongniartii*. *Biocontrol Science Technology* 17: 553–596.

Metarhizium anisopliae is one of the most potential fungal candidates that has been intensively studied for the development of mycoinsecticide. This fungus offers an attractive alternative to the pest control industries, especially in the agriculture and forestry sectors. It is safe, effective, economic and environmentally friendly compared to toxic and expensive chemical pesticides. A mycoinsecticide developed by FRIM based on a local isolate of *M. anisopliae* has been proven successful in decreasing the populations of selected Lepidopteran pests below the economic threshold levels. It successfully controlled the destructive insect pests, namely *Atteva sciodoxa*, *Plutella xylostella* and *Spodoptera* spp. in the field. It did not cause injury to treated plants and was harmless to the beneficial insects.

Series Editor : CT Lee
Managing Editor : S Vimala
Typesetter : Y Rohayu

Set in Times New Roman 11

MS ISO 9001:2008

Printed by Publications Branch, Forest Research Institute Malaysia
52109 Kepong, Selangor