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Metarhizium anisopliae : An Ecofriendly Mycoinsecticide

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Abstract

India has an agrarian economy. It needs an improved and newer group of biopesticides as the continuous use of chemical fertilizers and pesticides has resulted in pests outbreak and increased environmental pollution. In order to maintain sustainability and food security, an ecofriendly and sustainable strategy like use of natural enemies and microbes for managing these insects-pests is highly envisaged. *Metarrhizum anisopliae* (green muscardine fungus) have found effective in controlling these insect pests. Due to its mycoinsecticidal properties and easy applicability, various agricultural crops can be benefitted.

Introduction

Agriculture is the most important sector of Indian economy. Indian agriculture sector accounts for 14.4 per cent of India's GDP. India has emerged as the largest producer of pulse, oilseeds, spices and spices products where as second largest producer of food grains, fruits and vegetables in the world. To increase the agricultural production, farmers are using various types of agrochemicals which results in pests outbreak. Pests like termites, caterpillars, whitegrub, borers, locust, grasshopper and miners are causing devastating and huge economic losses in many parts of the world. To eliminate this pests and vectors, chemical pesticides have been commonly used as the solution. However, indiscriminate and non-judicious use of these chemical pesticides have detrimental effects on the environment and are posing threat to human health. The toxicity and non-specifity of these insecticides has reduced the population of natural enemies drastically as well as the development of resistance in pests towards chemical pesticides is a major concern of the present era .

"Food Security" and "Sustainability" is the need of the hour. Nowadays, to increase the agricultural production without deteriorating the natural resources like soil and water is a big challenge. It has become necessary to develop an alternative and sustainable strategy for these chemical pesticides so as to reduce the pollution in the environment as well as to maintain the soil fertility and protect the natural enemies of pests. Biological control of insect pest by using natural enemies and micro-organisms is an emerging approach for the management of these insect pests.

Various types of micro organisms like fungi, bacteria, virus and nematodes are now being used to control these insect-pests. These microorganisms control the pests as well as enhance the plant growth by solubilizing the various mineral nutrients present in soil and so helps in easy uptake by roots

of plants. Among the entomopathogenic fungi, *Metarhizium anisopliae* and *Beauvaria bassiana* play the dominant role in controlling insects. *Metarhizium anisopliae* is being used as a biological mycoinsecticide to control the number of insects such as grasshopper, termites, caterpillars, aphids, red pumpkin beetle and so on. As India provides favourable condition for the growth and reproduction of the fungus, this fungus can be exploited for its mycoinsecticidal properties.

What is Metarhizium?

Metarhizium anisopliae, formerly known as *Entomophthora anisopliae* is a green muscardine fungus that grows naturally in soil throughout the world and causes disease in various insects by acting as a parasitoid. It is a mitosporic fungi belonging to ascomycetes which reproduces by sexual reproduction and produces conidia as asexual spores and is commercially exploited for its mycoinsecticidal properties. It has narrow host range and hence can be used to control various pests of agricultural crops Figure 1 and 2.

Mode of Infection

The infective stage of *Metarhizium anisopliae* comprises of six stages i.e, adhesion, germination, appressorium formation, penetration, colonization of haemolymph, extrusion and sporulation. Initially the conidia which are the asexual spores of Metarhizium species adhere to the waxy epicuticle of their host through a combination of passive hydrophobic forces, electrostatic forces and protein interaction between the conidia and epicuticle. The outer layer of cells on the conidia also known as rodlets, contain hydrophobins which are protein that facilitate the adhesion of conidia to the hydrophobic cuticle. After the adhesion of conidia to the host cuticle, conidial germination is initiated. After germination, the spores swells, producing germ tubes which differentiates into appressorium. A thin layer of mucilage is also secreted by appressorium to consolidate the attachment of the fungus to the cuticle. Chitinases, proteases and nucleases like different enzymes enable the successful penetration and utilisation of nutrients in the haemocoel of the host for efficacious infections. In *Metarhizium anisopliae* destructions especially destructions A and B which are more insecticidal are synthesized to replace the cellular configuration. During sporulation the hyphae extrudes the host cuticle to the outer environment.

Metarhizium anisopliae forms a denser network and green spores on the cadaver of the infected host. The fungus then developed inside the body eventually kills the insect after few days. The cuticle of the cadaver often becomes red. If the ambient humidity is high enough, then white mould grows on the cadaver that soon turns green as the *anisopliae* is effective in all the stages of insect life cycle like egg, larvae, pupa, nymphal and adult. It kills the insect after 8 to 10 days of infection.

Figure 1: Infected grub (Source: Slideshare.net)

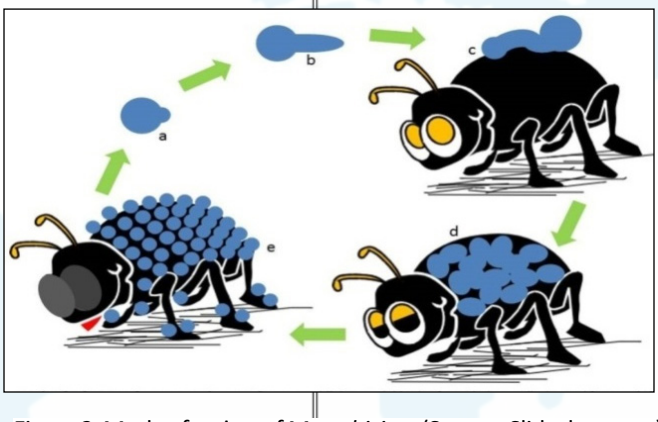

Figure 2: Mode of action of *Metarhizium* (Source: Slideshare.net)

Crops Benefitted

Metarhizium is used for various agricultural crops like sugarcane, cotton, groundnut, maize, sorghum, barley, rice, potato, soyabean, vegetable and fruit crops.

Application

Various insects like grasshopper, termites, caterpillars, aphids, red pumpkin beetle, thrips, mites, mealy bugs, cockroach can be effectively controlled by this fungus. It can be applied by mixing with soil, with irrigation water or as spray in foliage of plants. Farmers can multiply this fungus on their own. It is a very easy and convenient method. Buy 1 kg *Metarhizium anisopliae* and mix it with 100 kg of well rotten FYM and make a pile of the mixture. Sprinkle water for maintaining the moisture. Soak the jute or gunny bags in water and cover the pile. Turn the mixture regularly in 2 days interval. Keep it for 25 days. After 25 days, green olive coloured spores will be visible. These 100 kg mixture is sufficient for application in 1 acre. It can be applied as foliar application. Dissolve 1 kg Metarhizium in 1000 litre water and used as spray. Use the given sticker for its efficacy in foliage.

6. Precaution

Apply preferably in the early

morning hours or during late evening hours to prevent fungus from desiccation .

Formulation

Commercially, it is available in various formulations like powder, dust, liquid and granules. It is available in the market as Biomagic, Kalichakra , Green metal liquid, Meta power as trade name and so on.

Conclusion

Keeping in view the hazardous effect of insecticides on human health and environment, it has become necessary to promote biological control of insect pest. Use of *Metarrhizum anisopliae* in agriculture is now proving to be a promising strategy for the management of crop pests. Its availability, narrow host range, specifity, mycoinsecticidal properties and wide application on various agriculturally important crops has made this an effective tool of pest management.

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