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Review Article

Use of Entomopathogenic Nematode for Management of Insect Pests of Mango-An Overview

Gitanjali Devi*
Department of Nematology, Assam Agricultural University, Jorhat, Assam, India
***Corresponding Author:** Gitanjali Devi, Department of Nematology, Assam Agricultural University, Jorhat, Assam, India
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Abstract

A number of insect pests and mites are recorded which are the major limitation of yield and quality of mango production. Though chemical insecticides are recommended for control of these pests, other alternative control measures like use of biocontrol agents should be considered. One of the promising biocontrol agents is the entomopathogenic nematodes. This review finds the work done so far on bioefficacy of entomopathogenic nematodes on important insect pests of mango.

Keywords: Mango; Insect Pests; Biocontrol Agents; Entomopathogenic Nematodes (EPNs)

Introduction

Insect pests are the major hurdles for quality and quantity of produced in mango production. A number of insect pests and mites are recorded in mango orchards. Worldwide more than 260 species of insect and mites are known to infest mango [1,2]. Hoppers (*Idioscopus clypealis, I. nitidulus and Amritodus atkintoni*), Mealy Bug (*Drasicha mangiferae*), Inflorescence midge (*Erosomyia indica*), Fruit-fly (*Bactrocera dorsalis*, *B. zonatus* and *B. correctus),* Leaf webber (*Orthaga euadrusalis*), Shoot borer (*Chlumatia transversa*), Bark Eating Caterpillar (*Indarbella quadrinotata)*, Stem borer (*Bactocera rufomaculata*), Shoot gall psylla (*Apsylla cistallata*), Scale insects (*Chloropulvinaria polygonata, Aspidiotus destructor* and *Rastococcus* sp), Stone weevil (*Sternochetus mangiferae) are found to be severe causing considerable loss to the crop.* Chemical pesticides have been recommended as a common method for controlling most of these pests which has generated many problems related to environment and human health. In agroecosystems, pathogens and parasites of arthropods which are present naturally can regulate the population of insect pest populations [3,4]. They may be a good alternative to chemical pesticides. Several biocontrol agents like fungi, bacteria, virus as well as entomopathogenic nematodes may serve as alternative control methods against a number of insect pests [5,6,32]. In this review the work done on efficacy of entomopathogenic nematodes for control of some of the important insect pests of mango has been elaborated.

Entomopathogenic nematodes (EPNS)

Entomopathogenic nematodes (EPNs) from the genera *Steinernema* and *Heterorhabditis* in the families Steinernematidae and Heterorhabditidae respectively have the ability to infect and kill insect pests in all habitats. They are naturally found in all types of soils [7-9]. Symbiotic bacteria (*Xenorhabdus* spp. and *Photorhabdus* spp.) are mutualistically associated with these nematodes. The infective juvenile (IJ), the only free-living stage (dauer stage), present in the soil and forages for an insect host. Upon finding a host insect, IJs enter through the mouth, anus, spiracles or soft cuticles and penetrates into the body cavity. In the body cavity, the IJ releases bacterial cells, which multiply rapidly and cause septicemia in its insect host, within 24-48h. The nematodes degraded host tissues and feed on the bacterial cells. Depending on host size and nutrition, one to three nematode generations may occur in the host cadaver. When food materials are exhausted, the pre-IJs confiscate the bacterial cells. The IJs leave the host and rummage around for new hosts [10]. If host are not found, IJs can persist as dauer stage depending on soil environment. EPNs can be produced *in vivo* on some susceptible host and on synthetic artificial media [11]. Now-a-days, several EPN species are being commercially produced and available for large-scale application under field condition.

Bioefficacy of entomopathogenic nematodes against insect pests of mango

Research on the susceptibility of insect pests of mango has been limited to the laboratory. Some of research findings on major insect pests of mango are highlighted here.

Mealy Bug

Mealy Bug (*Drasicha mangiferae*) is a major pest of mango in India and found to be widely distributed throughout India. Both adults and nymphs suck the plant sap, devastate the inflorescence and cause fruit drop and thereby reduce the plant growth. Mealy bug excretes a sticky substance i.e., honey dew, which cause the development of sooty mould fungi (*Maliola mangiferae* and *Capnodium mangiferae)*. The female insect lays eggs in soil in the month of April/May. The eggs hatch in the month of November/December and crawls up the tree and infest again [12]. Application of a formulation carrying *Photorhabdus luminescens*, symbiotic bacteria isolated from *Heterorhabditis indica*, IARI strain at the rate of 1.4 x 10^6 bacterial cell/ml gave significant control to second stage nymphs under laboratory condition. Formula when applied over bug infested mango twigs resulted in 92.5% application was made one hour prior to release of bugs [13].

Fruit-fly

Mango yield and fruit quality are severely affected by infestations by many tephritid species. The fruit-fly, *Bactrocera dorsalis, B. zonatus* and *B. correctus* are the important pests of mango. Adult female lays eggs in the mesocarp of fruits and develop into larvae and feeds on the pulp that fully complete their development inside the infested pulp. Mature larvae/maggot exit the fruit and fall on the ground where they pupate in the top soil [14]. Soil stages (maggots) of several tephritid species such as *Bactrocera oleae, B. dorsalis, Ceratitis capitata* and *C. rosa* are susceptible to entomopathogenic nematode (EPN) species and can be used as good tool within IPM programs [15-18]. Lindegren, [19] observed that mango fruit fly, *Bactrocera* (*Dacus*) *dorsalis* pre-pupae mortality ranged from 9 to 85% by *S.carpocapsae* at 5000 to 50,000 IJs/cup under laboratory condition. Pupae were not susceptible to infection. Pathogenicity of 12 EPN species and strains to *C. capitata* at a concentration of 100 IJs/one 3rd instar larva in containers was investigated [20]. As for pupae, % mortality of *B.dorsalis* averaged 5.5% and 1% in 3 day old pupae by *H.taysearae* and *S.kandii* respectively [21]. After 14 days insect mortality ranged 7-96% by the 12 tested nematode species and strains (infected pupae were considered larvae). Usman., *et al*. [22] observed susceptibility of *B.dorsalis* larvae and pupae to *H.taysearae* and *Steinernema* sp. The results showed that Per cent mortality in 3rd instar larvae was 94% by *H.taysearae* and 99% by *Steinernema* sp. Although *Anastrepha ludens* is susceptible to a variety of EPN species under laboratory conditions [23-25], extremely high dose is required for control in the field (2.5 X 10^2 IJs of *H. bacteriophora*/cm^2) [26]. Similarly, laboratory and field research conducted on the effectiveness of EPNs against *Ceratitis capitata*, revealed susceptibility of larvae to several nematode species [17,27,28], but high application rates are required for control in the field 5-50 X 10^2 IJs of *S. carpocapsae*/cm^2 [19]. Lindegren and Vail [17] reported on the susceptibility of *B. dorsalis* to *S. carpocapsae* and Beavers and Calkins [29] reported on the evaluation of *A. suspensa* susceptibility to several steinernematids and heterorhabditids. However, field experimentations to investigate such ability of EPNs to control fruit fly population are limited. In China, up to 86.3% mortality of *B. dorsalis* larvae and pupae was achieved with 300 IJs/cm^2 density of *S. carpocapsae* under field conditions [30]. Hominick and Reid [31] suggested the penetration ability of a nematode as an indication of its virulence. The penetration percentages of *H. taysearae* Hessa1, *H. taysearae* Korobororou F4 and *S. kandii* Thui IJs inside *B. dorsalis* larvae increased with time of insect exposure to IJs. *Heterorhabditis taysearae* Hessa1 displays the highest percentage (24.42% ± 2.77) after 24 h exposure time [33].

Conclusion

Incorporation of entomopathogenic nematodes as biocontrol agent in IPM programme with specific species even strain along with proper application technology should be projected for increase yield and quality of fruits in mango orchards.

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