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Efficacy of entomogenous fungi on biological suppression of *Pentalonia nigronervosa* f. *caladii* Van der Goot of cardamom (*Elettaria cardamomum* Maton)

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Abstract

Experiments were conducted in the laboratory on the biological suppression of the aphid *Pentalonia nigronervosa* f. *caladii* of cardamom (*Elettaria cardamomum*) using four entomogenous fungi namely, *Beauveria bassiana, B. brongniartii, Verticillium chlamydosporium* and *Metarhizium anisopliae*. Fungal spore suspensions ($1x10^7$ spores/ml) when applied on the aphid colonies caused mortality to both apterous adults and nymphs ranging from 37.0 to 96.6 per cent and 32.8 to 75.4 per cent, respectively. *B. bassiana* was the most potent biocontrol agent effecting 96.6 and 75.4 per cent mortality for adults and nymphs, respectively, in the indirect expsoure method and 65.9 and 70.9 per cent, respectively, in the direct exposure method.

Key words: biological suppression, cardamom aphid, *Elettaria cardamomum,* entomogenous fungi, *Pentalonia nigronervosa* f *caladii.*

Abbreviation

DAT: Days after treatment

The viral diseases, *katte* or mosaic disease and *kokke kandu* (which means 'hooked tiller' in Kannada) are important diseases affecting cardamom (*Elettaria cardamomum* Maton) in India causing severe yield losses. Both these diseases are transmitted by the aphid *Pentalonia nigronervosa* f. *caladii* Van der Goot which is also a minor pest in cardamom plantations during summer months. The aphids are generally found in colonies inbetween the pseudostems and loose leaf sheaths and also occasionally on leaf spindles, young suckers and panicles. Because of their concealed occurrence on the plants, the

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possibility of direct access to insecticides are limited. Further, insecticide treatments disturb aphid colonies resulting in their hyperactivity, probing and intermittent migration in search of a suitable host, which leads to the further spread of the disease (Rajan *et al.* 1989). This warrants the development of alternate strategies to reduce aphid populations through predators and parasites. Cardamom plantations are confined to a stable ecosystem with low temperature and high humidity which can be ideal for biological control agents (Varadarasan 1995). The natural enemies recorded on the aphid include *Pullus* sp., *Coccinella transversalis* Fab. (Coccinellidae), *Ischiodon scutellaris* Fab., *Paragus tibialis, Episyrphus viridaureus* Weid. (Syrphidae), an unidentified neuropteran (Hemerobiidae) and the entomogenous fungus *Verticillium intertextum* (Rajan 1981). The present study was undertaken to evaluate the efficacy of four species of entomogenous fungi on the aphid vector with regard to its mortality.

Four entomogenous fungi *(Beauveria bassiana* (Bals.-Criv.) Vuill., *B. brongniartii* Sacc., *Metarhizium anisopliae* (Metch.) Sorok. and *Verticillium chlamydosporium* Goddard were tested under greenhouse conditions to determine their ability to cause mortality to the aphid vector. The fungi were obtained from the Division of Crop Protection, Indian Institute of Spices Research, Calicut, India. The test fungi were cultured on standard potato dextrose agar and spore suspensions were prepared @ $1x10^7$ spores/ml. Due to inadequate sporulation, *V. chlamydosporium* spore suspension was prepared @ 194 chlamydospores/ml along with mycelium. The experiment was performed by adopting two methods namely, indirect expsoure method and direct expsoure method.

Indirect exposure method

The spore suspensions were applied to cardamom leaf funnels @ 20 ml/leaf funnel in the form of a spray. Twenty apterous adults and 20 newly hatched nymphs were released on each leaf funnel. Leaf funnels sprayed with distilled water alone served as control. Each treatment was replicated thrice. Insect mortaility was recorded from 1 DAT to 9 DAT. The newly hatched nymphs were removed as and when they appeared in order to avoid fluctuations in the test population.

The values of insect mortality were adjusted using Abbot's formula (Busvine 1957). The data were analysed by Duncan's multiple range test after transforming the percentage values into angular values (Gomez & Gomez 1984).

Direct exposure method

In this method, 20 apterous adults and 20 newly emerged nymphs were released per leaf funnel. The spore suspensions were sprayed directly over the aphids. In control, distilled water alone was sprayed. The observations were recorded and the data were analysed as in the case of indirect expsoure method.

Among the four fungi tested, *B. bassiana* showed maximum efficacy causing 96.6 and 75.4 per cent mortaility on adults and nymphs respectively, in the indirect exposure method. *V. chlamydosporium* caused 84.6 and 75.4 per cent mortality, respectively; *B. brongniartii and M. anisopliae* caused 55.1 to 70.2 per cent mortality (Table1). In the direct expsoure method, *B. bassiana* caused

Table 1. Effect of entomogenous fungi on cardamom aphid by indirect expsoure method

Test fungus	Percent mortality* (cumulative)	
	Adults	Nymphs
Beauveria bassiana	96.6 a	75.4 a
Verticillium chlamydosporium	84.6 b	75.4 a
Beauveria brongniartii	60.2 c	56.2 b
Metarhizium anisopliae	55.1 c	70.2 ab

*Values adjusted using Abbot's formula

Values followed by the same letter in a column do not differ significantly according to DMRT at P=0.05

Table 2. Effect of entomogenous fungi on cardamom aphid by direct exposure method

Test fungus	Percent mortality* (cumulative)	
	Adults	Nymphs
Beauveria bassiana	65.9 a	70.9 a
Verticillium chlamydosporium	45.9 ab	32.8 b
Beauveria brongniartii	37.0 b	39.1 b
Metarhizium anisopliae	44.0 c	41.1 b

*Values adjusted using Abbot's formula

Values followed by the same letter in a column do not differ significantly according to DMRT at P=0.05

65.9 and 70.9 per cent mortality to adults and nymphs, respectively. *V. chlamydosporium, B. brongniartii* and *M. anisopliae* were less effective causing less than 50 per cent mortality (Table 2).

The test insects started dying on the second day onwards after treatment. The dead insects were characterised by the presence of fungal mycelium covering the entire body surface. Microscopic examination of the parasitised adults and nymphs revealed the emergence of fungal mycelium through the intersegmental sutures, lateroventral sides of the thorax and abdomen and the anal and oral openings.

Since all the test fungi were potent enough in effecting mortality of aphids to a greater or lesser extent, it is required to undertake investigations using mixtures of different fungi in various proportions to derive an effective schedule for their application. Further, the promising entomogenous fungi need to be evaluated in the field against the aphids.

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