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Some entomogenous fungal infections of a sporophagous Tubuliferan *Elaphrothrips denticollis* (Insecta: Thysanoptera)

G SURESH and T N ANANTHAKRISHNAN
Entomology Research Institute, Loyola College, Madras 600 034, India

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Abstract. Nature of infection, sites of localization and propagule production by *Cunninghamella echinulata* (Matruchot) Thaxter, *Metarrhizium anisopliae* (Metchnikoff) Sorokin, and *Penicillium* Link ex. Gray, on *Elaphrothrips denticollis* (Bagnall), a sporophagous tubuliferan, were studied using a scanning electron microscope.

Keywords. *Elaphrothrips denticollis*; entomogenous fungi; *Cunninghamella echinulata*; *Metarrhizium anisopliae*; *Penicillium* sp.

1. Introduction

Information relating to aspects of entomogenous fungi of insect vectors and pests is extensive (Steinhaus 1963), while studies on the entomogenous fungal infections of thrips are extremely limited. Available literature on aspects of fungal infections of thrips is restricted to *Alternaria alternata* (Fr.) Keissler infecting *Thrips flavus* Schrank; *Cladosporium cladosporoides* (Fresen) de Vries infecting *Microcephalothrips abdominalis* (Crawford) and *Thrips flavus*; *Trichothecium roseum* Link infecting *Thrips flavus*, *Scirtothrips dorsalis* Hood and *Microcephalothrips abdominalis* (Raizada 1976); *Entomophthora parvispora* MacLeod & Carl infecting *Thrips tabaci* Lindmann (Carl 1975; MacLeod *et al* 1976), and *Entomophthora thripidum* Samson, Ramakers & Oswald infecting *Thrips tabaci* (Ramakers 1976, 1978; Samson *et al* 1979). Studies relating to the nature of fungal infections, infection sites, localization of fungi in specific areas and their spread, nature of fungal propagules produced *in vivo*, and the behavioural study of the diseased individuals of mycophagous thrips species also appear limited. While all the species of fungi reported as entomogenous on thrips belong to the class Deuteromycetes, the recent discovery of a species of *Cunninghamella* Matr., a zygomycete, infecting mycophagous thrips appears to be of interest. An attempt has therefore been made to study the entomogenous fungal infections of *Elaphrothrips denticollis* (Bagnall), a mycophagous species generally found associated with fungi on drying leaves in arecanut plantations and feeding on fungi such as *Pestalotia* de Not and *Phomopsis tectonae* Tiwari, Rajak and Nikhra. In view of the potential of this species to act as a vector of some of the plant pathogenic fungi in forest areas (Suresh and Ananthakrishnan 1983), an understanding of the association of entomogenous fungi with this species appears significant.

2. Material and methods

Larvae and adults of *E. denticollis* infected by entomogenous fungi/nematodes were collected from drying and decaying fallen leaves of *Areca catechu*. Infected and dead

individuals (due to infection) were incubated, in aerated plastic vials humidified with wet Whatman 1 filter paper discs, at 20°C. Both dead and live infected individuals were fixed in 70% alcohol, transferred to absolute alcohol, incubated for 24 hr and then air-dried. The air-dried specimens were then teased and mounted on aluminium stubs using a double adhesive tape and coated with gold using an ion coater. Observations were made on the fungal ramifications and nematode infections and photographed, using a Hitachi scanning electron microscope.

3. Results and discussion

In screening for bio-control agents of thrips such as entomogenous fungi and nematodes, an assessment was made of the degree of infection and incidental mortality of *E. denticollis* (a sporophagous tubuliferan feeding on *Pestalotia* sp., which causes leaf spot diseases, and incidental vector of this fungus) due to entomogenous fungi and nematode infestation. Large number of individuals of this thrips species were collected from drying and decaying fallen leaves in arecanut plantations at an altitude of 167·74 m (mean temperature 28–30°C and 90% RH) in Western Ghats. Careful observations of every individual instar and adult revealed entomogenous fungal infections. Infected individuals were sluggish, getting confined to a particular spot and dying after 24 hr. SEM observations revealed the presence of fungal colonization in the haemocoel of the live insects, while luxuriant fungal growth was evident in the dead ones. Analysis of fungi in infected individuals revealed the presence of *Cunninghamella echinulata* (Matruchot) Thaxter, (Mucorales: Zygomycetes), *Metarrhizium anisopliae* (Metchnikoff) Sorokin (Moniliales: Deuteromycetes) and *Penicillium* Link ex Gray (Moniliales: Deuteromycetes). All three species of this fungi individually infected the insect and were not found together in the same individual.

C. echinulata is of interest as there are no earlier reports on its being entomogenous on thrips. Observations on the nature of infection and colonization revealed the presence of fungal mats in the entire haemocoel, and also external extensive ramification. Live individuals when analysed revealed mycelial growth and the presence of sporangioles and conidia on the surface (figure 1 D) while dissected individuals showed profound mycelial growth and presence of zygospores in the haemocoel and sporangioles and large numbers of conidia on the surface of the body (figures 1A and B). *Metarrhizium anisopliae* also attacks a wide variety of insects. Individuals of *E. denticollis* infected by this fungus showed the aforesaid symptoms. The fungus ramified the body cavity and was also localised externally around the compound eye region, producing chains of catenulate conidia on conidiophores (figure 1 C). Screening for entomogenous fungi also revealed the infection of live individuals of *E. denticollis* as due to a species of *Penicillium* which grew luxuriantly after the death of individuals indicating its efficient parasitic and saprophytic abilities. Chains of conidia were produced externally in large numbers on the body surface. It may not be out of place to indicate that *Cunninghamella echinulata* infected also the mermithid nematode, *Mermis* sp., inside the body cavity of *E. denticollis*. Hyphal outgrowths were noticed in the infected nematodes found entangled in the haemocoel ramified by the fungus (figures 1E and F).

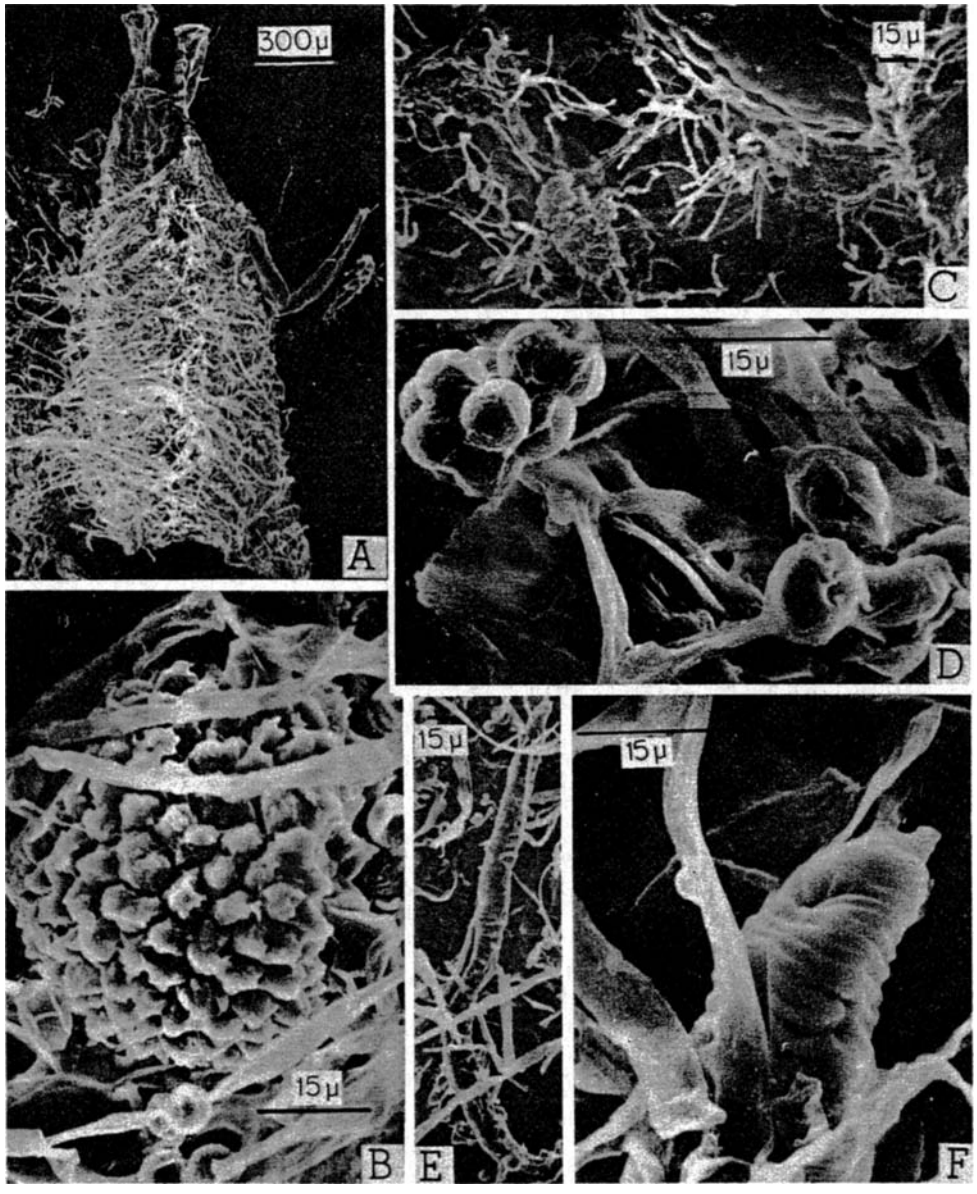

Figure 1. A–F. **A.** Body cavity of a larva of *E. denticollis* ramified by the fungus *C. echinulata*. **B.** A zygospore of *C. echinulata* in the body cavity of *E. denticollis*. **C.** Localised growth of hyphae and conidial production of *M. anisopliae* in and around the compound eye region. **D.** Sporangioles and conidia of *C. echinulata* on the body surface of *E. denticollis*. **E.** *Mermis* sp. in the body cavity of *E. denticollis* entangled with the mycelium of *C. echinulata*. **F.** Hyphal outgrowths of *C. echinulata* from the body of *Mermis* sp.

4. Conclusion

Commonplace occurrence of entomogenous fungi like *C. echinulata*, *M. anisopliae* and *Penicillium* sp., appears to sufficiently indicate the potential of these fungi in possible control of thrips.

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