

Notes on entomophthoraceous fungi infecting insects in the Netherlands

by

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ABSTRACT. — During the summer and fall of 1984, specimens of several species of insects were found which were infected by fungi belonging to the group of Entomophthorales. Eleven different species of entomophthoraceous fungi were identified. Diptera of the family Helomyzidae were noted as new hosts for *Conidiobolus destruens*.

Infection of insects by entomogenous fungi is commonly found in nature, especially when insects are subjected to stress factors, such as high population density, high relative humidity or to other adverse conditions. Among these fungi, the group of the Entomophthorales has extensively been studied, also because it is felt that some of these may have potential as biological control agents of noxious insect species. Epidemiological reflections on the application of these fungi for the control of insect pests may be found in Verberne & Zadoks (1984). These fungi, however, have scarcely been studied in the Netherlands: the only reports in the literature concern observations by Teernstra-Eeken & Engel (1967) on the incidence of *Entomophthora* infections in Helomyzidae and Culicidae hibernating in marl caves in Southern Limburg, observations by Loosjes (1976) on the development of *Entomophthora* infections in populations of the onion fly *Delia antiqua* (Meigen) (Anthomyiidae) and the description of *Entomophthora thripidum* by Samson et al. (1979) found on *Thrips tabaci* Lindeman (Thripidae) in greenhouses. Despite these few reports on Entomophthorales in the Netherlands, infection of insects by these fungi is frequently observed especially after periods of warm, humid weather.

The order Entomophthorales belongs to the Zygomycetes, a class of fungi characterized by the presence of a coenocytic mycelium, by the absence of flagellate spores and by sexual reproduction through the formation of zygospores (King & Humber, 1981). The only family in the Entomophthorales is the Entomophthoraceae. Conidia (asexual spores) of fungi belonging to this family are oval in shape and forcibly discharged from the apex of their conidiophore. The family contains over 200 different species, almost all parasitic on insects. Identification of species is mainly based on the size and shape of the conidia (Waterhouse & Brady, 1982).

Infection of insects by these fungi proceeds by means of a germ tube which is formed by the discharged conidium, when conditions are favourable (a high relative humidity). The germ tube penetrates the insect through the integument, partially mechanically, partially enzymatically. After penetration of the fungus into the host, vegetative growth of the mycelium starts, which may fragmentate into so-called hyphal bodies. The fungus is subsequently distributed throughout the host and invades the vital organs, usually resulting in the death of the insect. After death, conidiophores grow out of the cadaver through the integument and form conidia which may infect new individuals.

Some entomophthoraceous fungi have a limited host spectrum and can infect only certain groups of insects: *Entomophthora muscae* Cohn is only found on Diptera, *Entomophthora planchoniana* Cornu only on aphids. Other species, such as *Conidiobolus obscurus* (Hall and Dunn) Remaudière & Keller, have a broader host spectrum and may infect many different species of insects.

During a survey from June to December 1984, several species of insects were found infected by fungi belonging to the Entomophthorales. Identification of the insects was in a few instances not possible because of the presence of mycelium in and on the body of the insects.

OBSERVATIONS

A few marl caves in Southern Limburg were visited in December. A large proportion (more than 90%) of hibernating Diptera (Culicidae and Helomyzidae) appeared to be killed by entomogenous fungi, among which *Conidiobolus destruens* (Weiser & Batko) Ben-Ze'ev. This fungus was until now only found by Weiser & Batko (1966) on *Culex pipiens* Linnaeus (Culicidae) in caves and wine cellars in Czechoslovakia. Several other pathogenic fungi, not belonging to the Entomophthorales were also noted. Information on these fungi may be found in Rombach and Samson (1983).

Conidiobolus obscurus (Hall & Dunn) Remaudière & Keller has been collected throughout the year near Amsterdam on *Microlophium evansi* Theobald (Aphididae) on *Urtica dioica* Linnaeus and on unidentified aphids on *Lamium maculatum* Linnaeus. The fungus could easily be cultured on artificial media (Sabouraud dextrose egg yolk agar).

Specimens of *Tyria jacobaeae* (Linnaeus) (Arctiidae), collected in Meyendel near Leiden in August, were kindly provided by R. A. Samson. They appeared infected by *Entomophaga aulicae* (Reichardt) Humber.

In September, many cadavers of *Tipula paludosa* Meigen (Tipulidae) were observed hanging on grass in a meadow near Amsterdam. They all were infected by *Entomophthora caroliniana* (Thaxter) Keller.

The best known pathogen of this group of fungi is probably *Entomophthora muscae* Cohn. It was found on *Musca domestica* Linnaeus (Muscidae) from July to October at several places, in June on a few specimens of the cabbage root fly *Eustalomyia brassicae* (Hoffmannsegg in Wiedemann) (Muscidae) and in July on *Platypalpus* sp. (Empididae) on the underside of leaves of *Acer* sp. These flies, killed by the fungus, remained attached to the leaves by means of their proboscis. Epizootics of *E. muscae* were noted in June in populations of *Scatophaga stercoraria* (Linnaeus) (Scatophagidae) near Wageningen and in October in the Amsterdam area. In the second part of October, *E. muscae* was found near Amsterdam on *Melanostoma mellinum* (Linnaeus) (Syrphidae).

Entomophthora planchoniana Cornu, common on aphids, was observed from July to October. In June and July, it occurred on *Microlophium evansi* of nettle together with *Erynia neoaphidis* Remaudière & Hennebert and from the end of July to September on *Sitobion avenae* (Fabricius) (Aphididae) in the ear of grasses. In the second half of September, *E. planchoniana* was observed on unidentified aphids of *Aquilegia* sp. In this last case, the fungus produced resting spores in addition to conidia. Aphids with resting spores were stained blackish. Early September, epizootics of *E. planchoniana* were noted on aphids on *Acer*. Efforts to culture the fungus on artificial media failed.

Erynia neoaphidis Remaudière & Hennebert is the most common fungal pathogen of aphids. It was found throughout the survey period on different species of aphids: in June on *Microlophium evansi* on nettle near Amsterdam and in July on *Sitobion avenae* on wheat near Wageningen. In July and August, this fungus killed especially the alate form of *S. avenae*, while apterous individuals were generally infected by *Entomophthora planchoniana*. *Erynia neoaphidis* caused in August epizootics in *Aphis fabae* Scopoli (Aphididae) populations in a broad bean field near Amsterdam, resulting in the collapse of the population. Later in the year, in October, the fungus was found near Wageningen on *Brevicoryna brassicae* (Linnaeus) (Aphididae) and in November and December on unidentified species of aphids on cabbage.

Erynia petchi Ben-Ze'ev & Kenneth was found near Amsterdam on two specimens of *Philaeus spumarius* Linnaeus (Cercopidae). This fungus, originally described in Israel in 1980, has since then only been found in Poland in 1983 (Balazy, personal communication).

Erynia radicans (Brefeld) Humber, Ben-Ze'ev & Kenneth was found in October on nymphs and adults of *Trioza urticae* Linnaeus (Psyllidae) causing even epizootics among the nymphs. This fungus could be cultured on an artificial medium (Sabouraud dextrose egg yolk agar).

In November, a few specimens of *Aphis fabae* on *Euonymus europea* Linnaeus were found infected by *Neozygites fresenii* (Nowakowsky) Remaudière & Keller.

In the second half of October and the beginning of November, four specimens of unidentified Thysanoptera, killed by *Neozygites parvispora* (MacLeod & Carl) Remaudière and Keller were found on leaves of *Lamium maculatum* Linnaeus. Both primary and secondary conidia were produced by the fungus.

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EEN DERDE VONDST VAN *ORTHOLOMUS PUNCTIPENNIS* (HERRICH-SCHÄFFER) IN BELGIË (HETEROPTERA: LYGAEIDAE). Tot dusverre waren van *Ortholomus punctipennis* slechts twee vindplaatsen in België bekend, namelijk Feschoux en Eprave in de provincie Namen (Aukema & Woudstra, 1985, *Ent. Ber., Amst.* 45: 119-120). Hieraan kan nu een derde vindplaats in dezelfde provincie worden toegevoegd: Rochefort, 18.VII.1982, twee ♂ en een ♀, leg. & coll. C. F. M. den Bieman, Bennekom.

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PERSONALIA

Op 20 maart 1985 promoveerde ons lid mevr. S. A. Ulenberg aan de Rijksuniversiteit te Leiden tot doctor in de Wiskunde en Natuurwetenschappen op een proefschrift getiteld „The systematics of the fig wasp parasites of the genus *Apocrypta* Coquerel”. Promotor was prof. dr. J. T. Wiebes, co-promotor: dr. M. Zandee, referent: dr. C. C. Berg.