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First Record of *Neozygites parvispora* Remaudière and Keller (Zygomycetes: Entomophthorales) from Hungary

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Neozygites parvispora Remaudière and Keller (Zygomycetes: Entomophthorales) is a pathogen of thrips species. It is widespread and probably occurs throughout Central and Southern Europe. This is the first report on the occurrence of *Neozygites parvispora* Remaudière and Keller in Hungary.

Keywords: thrips, fungus, *Entomophthora, Neozygites.*

Bourne and Shaw (1934) reported large numbers of *Thrips tabaci* found in Massachusetts in 1932 that were completely filled with mycelium of *Entomophthora (?) sphaerosperma* Fres. The fungus was subsequently discovered to be well distributed throughout the onion-growing region of the Connecticut River Valley. Its appearance and increase in 1932 in many fields coincided with a sharp decline in thrips abundance about mid-August (Carl, 1975).

From 1968 to 1971, a project was undertaken by the Commonwealth Institute of Biological Control on behalf of the Agricultural Research Council of Great Britain to investigate the possibilities of biological control of thrips in glasshouses. During this investigation a fungus of the genus *Entomophthora* was frequently found attacking *T. tabaci* on onion crops near Lake Neuchâtel and in other localities (MacLeod et al., 1976). The fungus was identified as an undescribed species of *Entomophthora* by Dr. E. Müller-Kögler. It was unlikely that this fungus was identical to *E. (?) sphaerosperma* observed by Bourne and Shaw (1934) in the U.S.A. In *E. sphaerosperma* and related species the mature conidiophores are digitately branched at the distal end with one conidium developing at the end of each branch, whereas the European *Entomophthora* sp. had unbranched conidiophores. *E. sphaerosperma* forms a mycelium and produces rhizoids whereas *Entomophthora* sp. has only hyphal bodies (Carl, 1975).

Following the first record of *Entomophthora* sp attacking *T. tabaci* on an onion crop near Lake Neuchâtel in Switzerland, it was found elsewhere in Switzerland, Germany, eastern Austria, and southern France. These records suggest that the species is widespread and probably occurs throughout central and southern Europe (Carl, 1975). In 1984 it was also found in the Netherlands (Mietkiewski and Geest, 1985) and in 1993 in Poland (Balazy, 1993).

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MacLeod (1976) wrote about the fungus the followings: “It could not be assigned to any known species within the genus Entomophthora and is described as a new species”. The name of the new species is: *Entomophthora parvispora* MacLeod and Carl sp. nov. The unusually small conidial and resting spore states of this fungus suggested the specific epithet parvispora, a combination of the Latin words parva (= rather small) and spora (= spore) (MacLeod et al., 1976).

In 1980, Remaudière and Keller revised the taxonomy of Entomophthoraceae and transferred the species to the genus *Neozygites (Neozygites parvispora).*

Host Range

The fungus was reared from field populations of *T. tabaci* Lind. on onions and leeks and from *T. fuscipennis* Hal. on cucumbers. In the laboratory it also infected *T. major* Uzel. and *Taeniothrips atratus* Hal. Attempts to infect the predacious *Aeolothrips intermedius* Bagnall were unsuccessful (Carl, 1975). It was also identified on *Frankliniella occidentalis* Pergande in Italy (Vacante et al., 1994) and *Thrips palmi* Karny in Japan (Saito et al., 1989).

Morphology

The vegetative phase of the fungus consists almost entirely of rectangular hyphal bodies. These are formed soon after the penetration of the integument of the host by the conidial germ tube has taken place. The hyphal bodies rapidly increase in numbers by fission, killing the host within 3–6 days after infection. At this stage they form a compact mass, which almost completely fills the body of the insect. The hyphal bodies growing through the cuticula form simple, unbranched conidiophores, each one developing a single conidium, which is spherical. Discharge of primary conidia occurs at humidities over 70% and is most rapid with a film of moisture on the host and surrounding substrate (MacLeod et al., 1976). Within 5–24 hours of being released, the primary conidia form almond-shaped, anadhesive secondary conidia. These are the only infective propagules and they are not spread by active discharge. They are picked up by passing host insects, for which purpose the capilliconidia (secondary conidia on capillary conidiophores) bear a sticky appendage, termed discoidal haptor (Grundschober et al., 1998).

Only towards the end of the season hyphal bodies change into brown resting spores, which are zygospores, formed by fusion between two hyphal bodies, and arising by budding from the cytoplasmic passage connecting the two fusion cells (MacLeod et al., 1976). Individuals filled with resting spores turn black in colour. Since adults are the prevalent stage in the field at the end of the season, it is mainly this stage, which is infected with resting spores. From late October onwards the fungus is found only in the form of resting spores, which are apparently the only stage that hibernates (Carl, 1975) *(Figs 1, 2, 3).*

Carl (1975) stated that although *Entomophthora* sp. reacts in a density-dependent manner and although it may cause high rates of mortality in both nymphs and adults of the host, the fungus is not an effective control agent under field conditions. Only after an initial phase of one or two months during which the fungus operates ineffectively does it become an important mortality factor in September, but by that time the host has already damaged the crop.

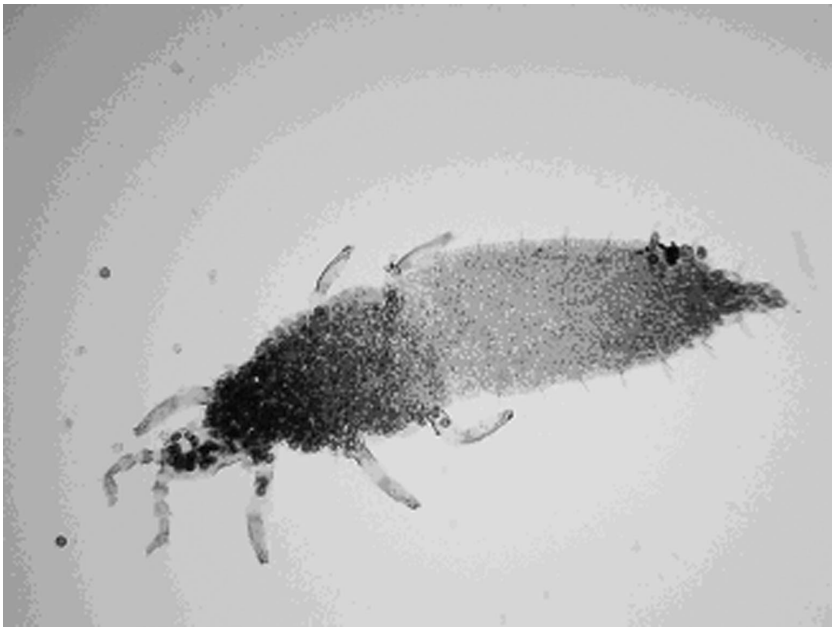

Fig. 1. Thrips larvae filled with the resting spores of *Neozygites parvispora*

Fig. 2. Thrips adult filled with the resting spores of *Neozygites parvispora*

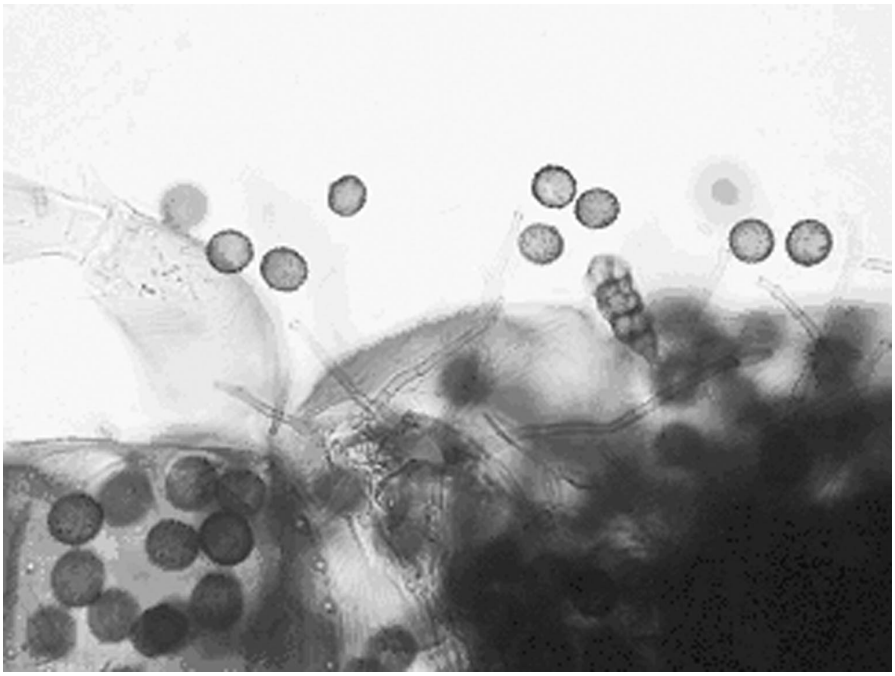

Fig. 3. Hyphae and resting spores of *Neozygites parvispora*

A study was carried out on *Frankliniella occidentalis,* in a commercial crop of pepper in a plastic-house in Sicily. The thrips population was monitored from November 16, 1990 up to April 19, 1991, at one-week intervals. Thrips infected by *N. parvispora* were first detected on December 7, 1990. The incidence of *N. parvispora* infections increased exponentially in January and fluctuated between 53.5 and 60.4% throughout February, reaching a maximum of 61.7% on March 1. During the epizootic, over a 7-week period, from the end of January to the middle of March, the density of the thrips population remained low, varying between 1 and 2 mobile forms per leaf. The incidence of *N. parvispora* infections began to fall off sharply from the second week of March and this rapid decline was apparently associated with an increase of maximum daily temperatures, which in March and April often exceeded 30 °C. Many reports of epizootics of Entomophthorales in agricultural ecosystems consider the relative humidity to be the most critical factor among those promoting the development and the maintenance of epizootic. However, the moisture level did not appear to be the driving environmental variable in the development of *N. parvispora* epizootic inside the plastic-house infested by *F. occidentalis.* No correlation was found between the epizootic progression and the daily number of hours when the RH exceeded 90% (Vacante et al., 1994).

Vegetative and asexual reproductive structures of the fungus (hyphal bodies, primary conidia and capilliconidia) differentiated on infected thrips from December through April, but sexual resting spores were not found (Vacante et al., 1994).

Vacante et al. (1994) assumed that the microclimate within the plastic-house in South-eastern Sicily could favour the occurrence of *N. parvispora* epizootics during the winter months, but in spring and summer, temperatures above 30 °C could limit the potential of this entomopathogenic fungus as a biocontrol agent.

For a long time *Neozygites* spp. could not have been cultured on simple artificial media (Keller, 1991). Grundschober et al. reported the first in vitro formation of capilliconidia of *N. parvispora* in 1998. This was a crucial step towards the application of this species for biological control. The obvious question whether in vitro capilliconidia are infective will be addressed in their future bioassays (Grundschober et al., 1998).

First record of the fungus from Hungary

Ten leek plants were collected at random on November 17, 2003 from a commercial leek field in Szabadszállás. Plants were dissected leaf by leaf in the laboratory and all thrips were collected from them. Among the 108 specimens collected, 17 were found to have the resting spores of a fungus inside their body cavity and two specimens had also hyphal bodies. Infected specimens were mostly adults, but two larvae were also found. Based on the literature we identified the fungus as *Neozygites parvispora,* an entomopathogene of thrips species. There was no previous record of this fungus from Hungary. The circumstances coincided with the literature: "Only towards the end of the season hyphal bodies change into brown resting spores (MacLeod et al., 1976). Individuals filled with resting spores turn black in colour. Since adults are the prevalent stage in the field at the end of the season, it is mainly this stage, which is infected with resting spores. From late October onwards the fungus is found only in the form of resting spores, which are apparently the only stage that hibernates (Carl, 1975)."

Infected thrips were not adequate for species identification, but uninfected specimens from the same sample were identified as the onion thrips *(Thrips tabaci).*

Acknowledgments

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Literature

Balazy, S. (1993): Flora of Poland (Flora Polska), Fungi (Mycota). Vol. 24. Entomophthorales. Polish Acad. Sci., W. Szafer Inst. Botany, Krakow. 356 pp.

Bourne, A. I. and Shaw, F. R. (1934): Notes on fungus attacking onion thrips. J. Econ. Entomol. 27, 860–861.

Carl, K. P. (1975): An *Entomophthora* sp. (Entomophthorales: Entomophthoraceae) pathogenic to *Thrips* spp. (Thysan.: Thripidae) and its potential as a biological control agent in glasshouses. Entomophaga, 20: 4, 381-388.

Grundschober, A., Tuor, U. and Aebi, M. (1998): In vitro cultivation and sporulation of *Neozygites parvispora* (Zygomycetes: Entomophthorales). Systematic and applied microbiology 21, 461–469.

Keller, S. (1991): Arthropod-pathogenic Entomophthorales of Switzerland: II. Erynia, Eryniopsis, Neozygites, Zoophthora and Tarichium. Sydowia 43, 39–122.

MacLeod, D. M., Tyrrell, D. and Carl, K. P. (1976): *Entomophthora parvispora* sp. nov., a pathogen of *Thrips tabaci*. Entomophaga 21, 307–312.

Mietkiewski, R. and Geest, L. P. S van der. (1985): Notes on entomophthoraceous fungi infecting insects in the Netherlands. Entomologische berichten 45, 190–192.

Remaudière, G. and Keller, S. (1980): Revision systematique des genres d'Entomophthoraceae a potentialite entomopathogene. Mycotaxon 11, 323–338.

Saito, T., Kubota, S. and Shimazu, M. (1989): A first record of the entomopathogenic fungus, *Neozygites aprvispora* (MacLeod and Carl) Rem. and Kell., on *Thrips palmi* Karny (Thysanoptera: Thripidae) in Japan. Applied Entomological Zoology 24, 233–235.

Vacante, V., Cacciola, S. O. and Pennisi, A. M. (1994): Epizootiological study of *Neozygites parvispora* (Zygomycota: Entomophthoraceae) in a population of *Frankliniella occidentalis* (Thysanoptera: Thripidae) on pepper in Sicily. Entomophaga 39, 123–130.