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Nematode-Destroying Fungi of Johnson County, Iowa

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The nematode-destroying fungi in woodland areas of Johnson County, Iowa were surveyed. Twenty-six species of predacious fungi were identified, including 5 species newly reported for Iowa: *Arthrobotrys superba* Corda, *Cephalosporium balanoides* Drech., *Dactylella asthenopaga* Drech., *Harposporium bysmatosporum* Drech., and *H. subuliforme* Drech. A fungus similar to *Nematoctonus pachysporus* Drech., but lacking clamp connections, is discussed.
INDEX DESCRIPTORS: Fungi, nematode-destroying fungi, *Nematoctonus*.

The nematode-destroying fungi are a heterogenous group of organisms, with Phycomycete, Basidiomycete, and Deuteromycete representatives. Several books have dealt with their biology including Dollfus (1946), Duddington (1957) and Barron (1977); over one hundred species have been described. The first reports of nematode-destroying fungi from Iowa were made by Drechsler (1937), who isolated *Dactylella gephyropaga* Drech. from decaying plant material collected near Ames, and G.W. Martin (1937), who observed *Helicocephalum sarcophilum* Thaxter growing in laboratory culture on dead wood collected from the Iowa City area. Martin (1960) also reported *Rhopalomyces elegans* Corda from the same habitat. More recently two surveys have been made of nematode-destroying fungi in Central Iowa. Norton (1962) identified 17 species newly reported for the State from a variety of habitats, and Van Dyke (1968) added an additional 15 species from his investigations of woodlands.

The purpose of this study was to determine the number of species of nematode-destroying fungi present in woodland areas of Johnson County in Eastern Iowa.

MATERIALS and METHODS

One hundred and sixty-six samples of soil, leaf litter, and rotted wood were collected from numerous woodland sites in Johnson County from June, 1975 to July, 1976. One hundred and ten of these collections were made from oak-hickory woodlands, 40 were made from riparian woodlands largely composed of soft maple, willow, black locust and river birch, and 16 collections were made from a coniferous plantation composed of Austrian and white pine. Small amounts of each sample were placed on 5 previously poured 2% water agar plates. All plates were incubated on a laboratory bench at room temperature, and observed periodically until the plates dried out. Measurements of the fungi were made on material taken from nematode-infested cultures.

Attempts were made to isolate and maintain, in axenic culture, all the predacious fungi that were identified. Spores of each fungus were placed on natural media, such as corn meal or malt agar, where approximately one-half of them germinated, giving rise to saprophytic colonies. These fungi showed no evidence of their predacious nature, but when nematodes were added to subcultures on water agar, all the species once again formed their trapping organs. The fungi whose spores failed to germinate in axenic culture could often be maintained in mixed cultures with nematodes and bacteria, on 2% water agar.

RESULTS and DISCUSSION

The following 26 nematode-destroying fungi were identified:

Arthrobotrys conoides Drech.*
A. dactyloides Drech.*
A. oligospora Fres.*
Cephalosporium balanoides Drech.+
Dactylaria brochopaga Drech. *
D. candida Drech.*

Dactylella asthenopaga Drech.*
D. bembicodes Drech.*
D. ellipsospora Grove*
D. gephyropaga Drech.*
Haptoglossa heterospora Drech.

Harposporium anguillulae Lohde+
H. bysmatosporum Drech.+
H. helicoides Drech.+
H. oxycoracum Drech.+
H. subuliforme Drech.

Meria coniospora Drech.+
Meristacrum asterospermum Drech.
Nematoctonus leiosporus Drech.+
N. robustus Jones*
N. tylosporus Drech.+

Nematoctonus sp.*
Spicaria coccospora Drech.
Stylopage grandis Duddington
S. hadra Drech.
Triposporina aphanopaga Drech.

*Species maintained in axenic culture.
+Species maintained in mixed cultures with bacteria and nematodes.

Descriptions of newly reported species:

Arthrobotrys superba Corda (1839)

Nematodes captured by sticky networks. Mycelium hyaline, septate, approximately 4 microns wide, giving rise to sticky networks. Conidiophores hyaline, septate, erect, 230-285 μm in length, bearing a whorl of conidia. Conidia hyaline, 2-celled, 14.7-18.9 × 7.4-9.5 μm. Isolated from soil of deciduous woodland, University of Iowa Field Campus. Reported by Drechsler from leaf mold of deciduous woodlands at Beltsville and Cumberland, Maryland; Butternut and Madison, Wisconsin; and Arlington, Virginia.

Cephalosporium balanoides Drech. (1941)

Endozoic. Assimilative hyphae hyaline, septate, approximately 2 microns wide. Conidiophores extending from nematodes, bearing phialids. Conidia hyaline, 1-celled, 2.8-3.5 × 1.9-2.8 μm. Isolated from soil of coniferous plantation, University of Iowa Field Campus.

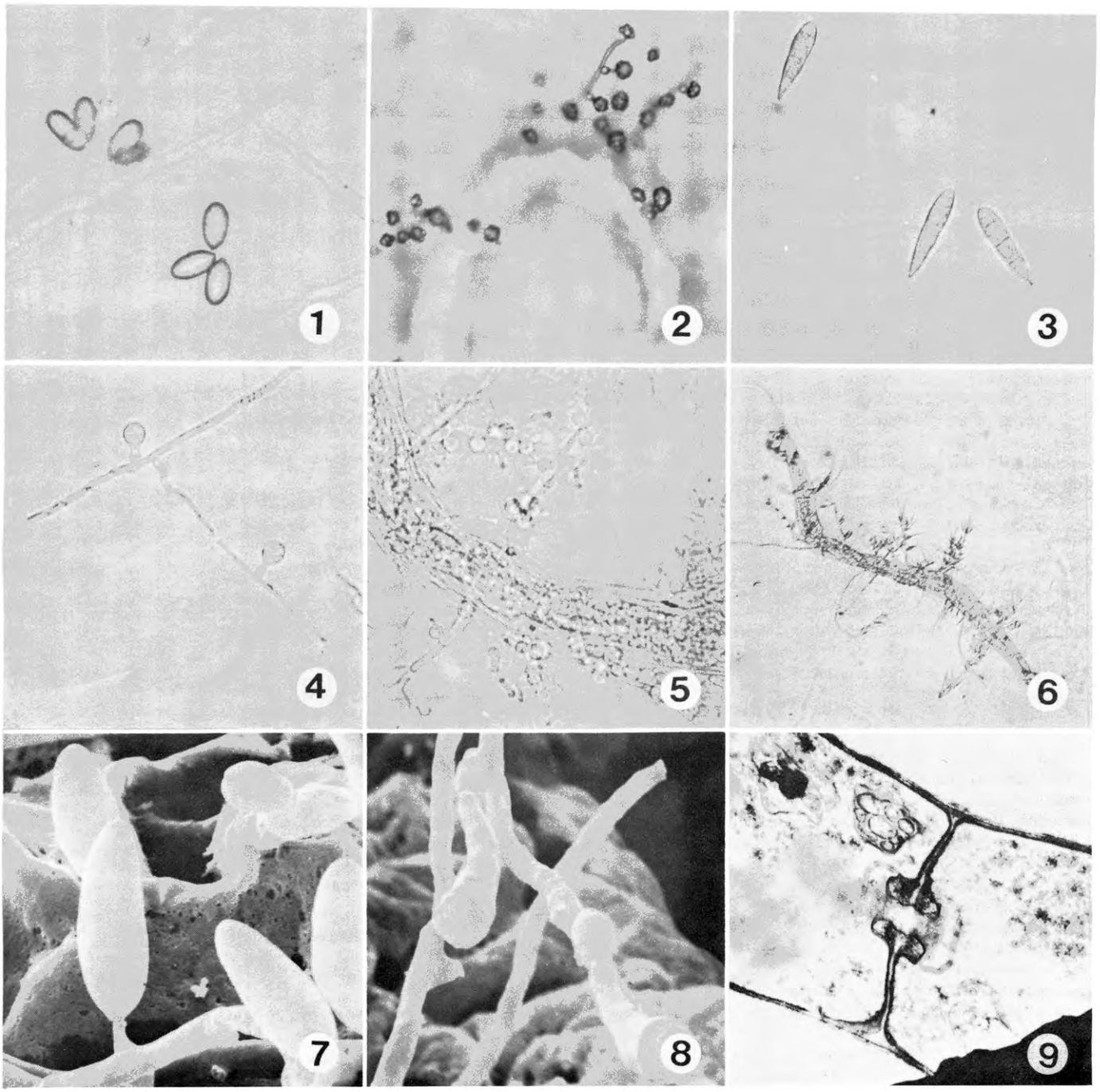

Fig. 1. *Conidia of* Arthrobotrys superba. *X1400*. Fig 2. *Nematode parasitized by* Cephalosporium balanoides. *X735*. Fig. 3. *Conidia of* Dactylella asthenopaga. *X600*. Fig. 4. *Sticky pegs of* D. asthenopaga. *X650*. Fig. 5. *Nematode parasitized by* Harposporium bymatosporum. *X960*. Fig. 6. *Nematode parasitized by* Harposporium subuliforme. *X250*. Fig. 7. *Scanning electron micrograph of conidia of* Nematoctonus *sp. X3465*. Fig. 8. *SEM of conidia of* Nematoctonus *sp. with terminal adhesive cells. X3440*. Fig. 9. *Transmission electron micrograph of dolipore septum in hyphae of* Nematoctonus *sp. X28,000*.

Reported by Drechsler from leaf mold, Haugen, Wisconsin.

Dactylella asthenopaga Drech. (1937)

Nematodes caputred by sticky pegs. Mycelium hyaline, septate, 2.1-3.2 μm wide, giving rise to sticky pegs. Conidiophores hyaline, septate, erect, 145-180 μm in length, often branched, with each branch bearing a terminal conidium. Conidia hyaline, mostly 4-celled, 28.8-38.4 × 6.4-8.4 μm. Isolated from soil of deciduous woodland, Lake MacBride State Park. Reported by Drechsler from decaying acorns and leaf mold from Beltsville, Maryland and Arlington, Virginia.

Harposporium bysmatosporum Drech. (1946)

Endozoic. Assimilative hyphae hyaline, septate, 2.8-3.5 μm wide. Conidiophores extending from nematodes, bearing phialids. Conidia hyaline, 1-celled, 4.9-6.8 × 1.4-2.0 μm. Isolated from soil of riparian woodland along Iowa River, Iowa City. Reported by Drechsler from friable barley straw collected near Greeley, Colorado.

Harposporium subuliforme Drech. (1950)

Endozoic. Assimilative hyphae hyaline, septate, approximately 2 μm wide. Conidiophores extending from nematodes, bearing phialids. Conidia hyaline, 1-celled, 13.6-16.0 × 1.6 μm. Conidia forming an adhesive process at their apex after detachment from the phialids. Isolated from leaf litter of riparian woodland along small stream, Solon. Reported by Drechsler from decaying leaves and stems of various grasses, Beltsville, Maryland.

Nematoctonus sp.

An interesting strain of *Nematoctonus* was isolated from woodland soil collected from the University of Iowa Field Campus. This isolate is most similar to *N. pachysporus* Drech. (1943) but does not produce either clamp connections or chlamydospores. The hyphae are approximately 2.8 μm wide, and examination by transmission electron microscopy revealed the presence of dolipore septae. Numerous 1-celled conidia, 12.8-16.8 × 4.0-4.8 μm, are borne along the hyphae on sterigmata. These conidia, while still attached to the sterigmata, or after becoming detached, have the ability to produce a terminal adhesive cell which exudes a droplet of adhesive fluid. Such conidia readily adhere to the surface of nematodes. Once attached the fungus behaves as does *N. pachysporus,* forming a penetration tube and killing the nematode by filling its interior with assimilative hyphae.

When conidia of this isolate are placed on natural media such as corn meal or malt agar, they germinate and the fungus grows well as a saprophyte. Numerous conidia are produced, but in axenic culture adhesive cells are rarely formed. However, when placed on the surface of an agar plate inhabited by nematodes, the conidia readily form a terminal adhesive cell and resume a predacious habit. Efforts to isolate other strains of this fungus failed.

The absence of clamps in this isolate of *Nematoctonus* suggests the fungus may be heterothallic. G.L. Barron (1977) reported having isolated several species of *Nematoctonus* in axenic culture, one of which produced basidiocarps which were identified as belonging to the genus *Hohenbuehelia* (Agaricaceae). Basidiospores of this fungus were able to form adhesive cells which could attach to nematodes, and the hyphae from single basidiospore infections produced no clamp connections. Barron also was able to demonstrate bipolar heterothallism by mating single basidiospore cultures. The resulting dikaryotic mycelium had clamp connections.

Three other species of *Nematoctonus* were identified in this study and attempts were made to axenically culture these organisms. Conidia of *N. robustus* readily germinated on corn meal agar, but the conidia of *N. leiosporus* and *N. tylosporus* would germinate only when attached to nematodes. All hyphae produced by these species had clamp connections.

CONCLUSION

Woodland areas of Johnson County have a wide variety of nematode-destroying fungi, with 26 different species having been identified; 6 of which are newly reported for the State. A total of 40 fungi parasitic on nematodes have now been reported from Iowa, but further investigations need to be conducted throughout the State before a more complete picture of this flora will be available.

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