Mycologia, 86(3), 1994, pp. 451–453.

Orbilia fimicola, a nematophagous discomycete and its *Arthrobotrys* anamorph

Donald H. Pfister

Farlow Reference Library and Herbarium, Harvard University, Cambridge, Massachusetts 02138

Abstract: Cultures derived from a collection of *Orbilia fimicola* produced an *Arthrobotrys* anamorph. This anamorph was identified as *A. superba*. A discomycete agreeing closely with *O. fimicola* was previously reported to be associated with a culture of *A. superba* but no definitive connection was made. In the present study, traps were formed in the *Arthrobotrys* cultures when nematodes were added. The hypothesis is put forth that other *Orbilia* species might be predators of nematodes or invertebrates based on their ascospore and conidial form.

Key Words: *Arthrobotrys*, nematophagy, *Orbilia*

Species of the genus *Orbilia* Fr. (Leotiales, Orbiliaceae) are common on highly decayed wood in both tropical and temperate regions where, for the observant collector, they may be among the most frequently encountered discomycetes. Until the description of *Orbilia fimicola* Jeng & Krug (Jeng and Krug, 1977), only one poorly documented species had been described as occurring on dung, *Orbilia leporina* Vel. Jeng and Krug reported *O. fimicola* based on a single collection derived from moist chamber culture of burro dung from Venezuela. Recently the author found a second collection of *O. fimicola* on deer dung from Berkshire County in western Massachusetts.

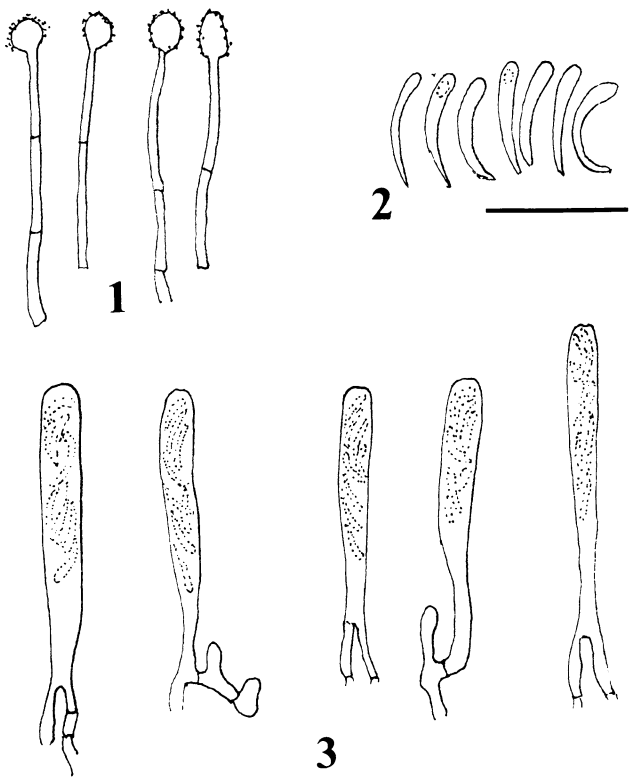
The purpose of this note is to report on this collection. In all details it agrees with the description given by Jeng and Krug. Both the original collection and the Massachusetts collection were discovered on dung that had been incubated in a moist chamber for an extended period. In the first instance the dung had been kept for 2 months. The Massachusetts material developed on dung, which also supported nematodes and a variety of other fungi, that had been maintained in a moist chamber for 2½ months. Often materials from moist chambers are discarded after a month of incubation, a practice which might unduly restrict the range of fungi observed. In field studies, Angel and Wicklow (1983), for example, showed the presence of coprophilous fungi for as long as 54 months.

Deer dung was placed in a moist chamber 1 day after it was collected. The moist chamber was maintained at room temperature and in natural light. It underwent periodic drying. Cultures were derived from ascospores gathered by fastening ascomata to the inside of a petri plate lid which contained corn meal agar (BBL). Germination of deposited ascospores was observed through the bottom of the petri plate. Cultures were kept at room temperature in natural light. Ascomata from the moist chamber collection are deposited in FH.

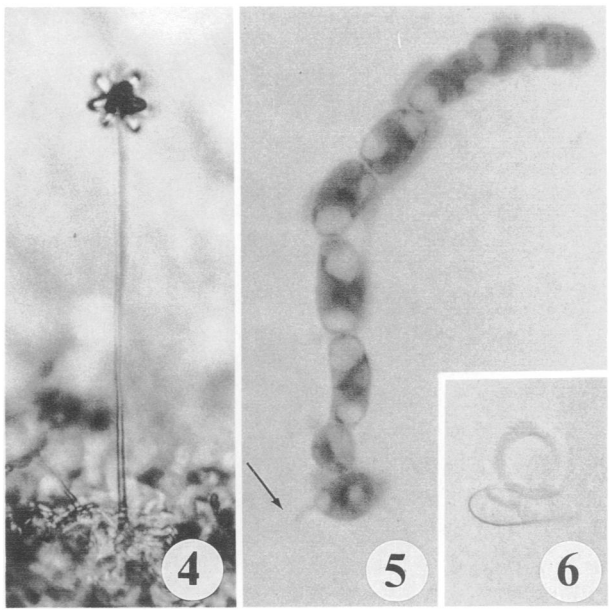
The specimen of *Orbilia fimicola* was studied and compared with the original description. The morphology of the Massachusetts collection agrees with the original description; diagnostic features are shown in FIGS. 1–3. The ascospores are somewhat curved within the asci; in deposit they are decidedly curved, some being nearly semicircular. Approximately 90% of the deposited ascospores germinate. Prior to germination, one end of the spore swells slightly and becomes rounded and blunt at the tip where a large lipid droplet is prominently positioned. The other pole of the spore remains thin and tapers to an acute tip. Germination proceeds at the enlarged end and seems to involve the more or less direct deposition of new wall material, rather than the formation of a discrete germ pore or tube. The young hyphae are frequently septate and are irregularly branched, often built up of barrel-shaped cells. On certain hyphae the original spore wall can be seen long after germination as a slender, pointed projection (FIG. 5). In cultures and in slide cultures an *Arthrobotrys* Corda state developed (FIG. 4). This has been tentatively identified as *A. superba* Corda *sensu* Drechsler (1937). When 10–12 nematodes were added to the slide culture, hyphal traps formed within 24 h (FIG. 6).

Although Drechsler (1937) observed a discomycete in one of his cultures of *A. superba* and described it, he did not name it and was reluctant to assign it the status of teleomorph of *A. superba*. There have been no reports of *Arthrobotrys* teleomorphs, but Zachariah (1983) obtained initials of an unidentifiable discomycete in cultures of *A. dactyloides* Drechsler and an *Orbilia* species did develop in cultures of another nem-

Accepted for publication February 25, 1994.



FIGS. 1–3. *Orbilia fimicola*. 1. Paraphyses, material mounted in congo red in ammonia replaced by glycerine. 2. Ascospores, material treated as above. 3. Asci with ascospores, material treated as above. Scale = 20 μm in FIGS. 1 and 3, = 10 μm in FIG. 2.



FIGS. 4–6. *Orbilia fimicola* and *Arthrobotrys*. 4. *Arthrobotrys* anamorph of *O. fimicola* in slide culture, unmounted, ×200. 5. Filament arising from ascospore of *O. fimicola*. Fresh material treated as above, bright field optics, ×1000. Note ascospore remaining on the lower cell indicated by an arrow. 6. An *Arthrobotrys* conidium with a ring trap, unmounted, ×400.

atode trapping fungus, a strain of *Dactylella rhopalota* Drechsler (Thakur and Zachariah, 1989). The discomycete Drechsler (1937) described and illustrated is without doubt a species of the genus *Orbilia*. The genus *Orbilia* is characterized by small apothecia that are composed of globose excipular cells; the asci are small, apically blunt, two-pronged at the base and rarely reach a length of 50 μm; the ascospores are one-celled and minute, rarely exceeding 8 μm × 1 μm. Drechsler (1937) described sessile, or nearly so, "flesh-colored disciform apothecia mostly between 0.5 and 0.8 mm in diameter. Viewed from above, these apothecia showed individually a central, perceptibly upcurved hymenial region, and surrounding it a slight prominent circular border. . . . In sections of the hymenium the most nearly mature of the cylindrical asci, measuring 29–32 μ in length and 3.1 to 3.4 μ in width, revealed 8 colorless hyaline tear-shaped ascospores about 5 μ long and 1.3 μ wide, the widened ends of the upper spores being directed toward the apex, those of the lower spores toward the base." His drawings include three asci which, like those in *Orbilia,* have flattened tops and prominent, two-pronged bases.

An anamorph has been previously reported by Berthet (1964) for *O. xanthostigma* [a *nomen ambiguum* fide Spooner (1987); the taxon is called *O. alnea* Vel. by Korf (1992)]. Berthet considered this anamorph to be referable to the genus *Dicranidion* Hark., which has multicellular conidia that have two arms. The genus was briefly reviewed by Peek and Solheim (1958). The placement of this anamorph is questionable as is its possible synonymy with *Pedilospora* Höhn. An anamorph for *Orbilia piloboloides* Haines & Egger (Haines and Egger, 1982) was reported, but Spooner (1987) has suggested that this species should, in fact, be referred to the genus *Habrostictis* Fuckel.

The ecology of *Orbilia* species needs some comment. Benny et al. (1978) reported finding algae in association with the apothecia of *Orbilia luteorubella* (Nyl.) Karst. Judging from their electron micrographs, there is no penetration of the algal host cells by the fungus. No algae were found associated with our material of *Orbilia fimicola*. Several *Orbilia* species have been found to be associated with fungi on deteriorated fabric by W. L. White (letters and specimens at FH). Edith Cash studied the specimens but no publications resulted. White's notes (in FH) indicate that repeated attempts resulted in the cultivation of a variety of fungi but not the Orbilias. *Orbilia inflatula* (Karsten) Karsten is often associated with old stromatic pyrenomycetes (Spoon-

er, 1987), and several species listed by Velenovský (1934) and by Svrček (1954) are found on polypores. There is but scant information about the ecology of most species. All of the substrates discussed above can be densely populated by nematodes; thus, other *Orbilia* species may prove to be nematophagous as well. It should be mentioned that various organisms inhabit the substrates on which *Orbilia* teleomorphs are found in nature and that little is known about their interactions and influences. For example, Thakur and Zachariah (1989) demonstrated that, by growing *D. rhopalota* with certain bacteria, formation of ascomata of *Orbilia* could be promoted in culture.

The species of the genus *Orbilia* deserve serious comparative study, particularly in light of their possible interactions with other organisms. Regional taxonomic studies have been published by Svrček (1954), Spooner (1987), and Korf (1992). *Orbilia* has been placed with only a few other genera in the Orbiliaceae Nannf., a family considered to be rather isolated among the Leotiales. Isolated though it may be, the suggestion by Benny et al. (1978) that *Orbilia* be transferred to the Lecanorales is disputable.

The form of the ascospores in *Orbilia* has long been noted and considered unusual in the Leotiales. These range in shape from ovoid to ellipsoid to curved to nearly helical; all are small, rarely reaching 8 μm in length. In size and shape they are comparable to the conidia of several nematode-destroying fungi. Drechsler (1937) concluded that the discomycete associated with *A. superba* had ascospores similar in form to those found in nematode endoparasitic fungi. Barron's (1977) discussion and illustrations of endoparasitic fungi on nematodes demonstrate the common occurrence of such spore forms in those fungi. Of particular note are the variously-formed conidia of the deuteromycetous genera *Meria* Vuill. and particularly *Harposporium* Lodhe. Such similarities in spore form seem to represent convergences associated with adherence, penetration or lodging of spores in or on nematodes.

Future work will be done in this laboratory to further test the hypothesis that other *Orbilia* species are associated with nematodes and perhaps other invertebrates.

Thanks are offered to Elizabeth J. Kneiper for the collection of deer dung from the Berkshire Mountains on which *O. fimicola* developed. Kathie Hodges brought to my attention a paper I had overlooked, and Meredith Blackwell, Jean Cargill, John Haines, and Richard Korf commented and improved upon the manuscript in various drafts. I thank them.

LITERATURE CITED

Angel, K., and D. T. Wicklow. 1983. Coprophilous fungal communities in semiarid to mesic grasslands. *Canad. J. Bot.* 61: 594–602.

Barron, G. L. 1977. The nematode-destroying fungi. *Topics Mycol.* 1: [1]–140.

Benny, G. L., D. A. Samuelson, and J. W. Kimbrough. 1978. Ultrastructural studies on *Orbilia luteorubella* (Discomycetes). *Canad. J. Bot.* 56: 2006–2012.

Berthet, P. 1964. Formes conidiennes de divers discomycètes. *Bull. Soc. Mycol. France* 80: 123–149.

Drechsler, C. 1937. Some hyphomycetes that prey on free-living terricolous nematodes. *Mycologia* 29: 447–552.

Haines, J. H., and K. N. Egger. 1982. A new species of *Orbilia* from Canada. *Mycotaxon* 16: 107–113.

Jeng, R. S., and J. C. Krug. 1977. A new species of *Orbilia* from Venezuela. *Mycologia* 69: 832–835.

Korf, R. P. 1992. A preliminary discomycete flora of Macaronesia: Part 8, Orbiliaceae. *Mycotaxon* 45: 503–510.

Peek, C. A., and W. G. Solheim. 1958. The hyphomycetous genera of H. W. Harkness and the ascomycetous genus *Cleistosoma* Harkn. *Mycologia* 50: 844–861.

Spooner, B. M. 1987. Helotiales of Australasia: Geoglossaceae, Orbiliaceae, Sclerotiniaceae, Hyaloscyphaceae. *Biblioth. Mycol.* 116: 5–711.

Svrček, M. 1954. Revise Velenovského druhů rodu *Orbilia* (Discomycetes). Revisio critica J. Velenovskýi specierum generis *Orbilia*. *Sborn. Nár. Mus. v Praze, Řada B, Přír. Vědy* 10: 3–23.

Thakur, S., and K. Zachariah. 1989. Response of the fungus *Dactylella rhopalota* to bacteria. *Pl. & Soil* 120: 87–93.

Velenovský, J. 1934. *Monographia Discomycetum Bohemiae.* Vols. I and II. Publ. by the author, Prague, Czech Republic. 436 pp.

Zachariah, K. 1983. Ascocarp induction in a natural auxotroph of a predatory fungus. *Canad. J. Bot.* 61: 3262–3266.