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A NEW SPECIES OF STYLOPAGE PREYING ON NEMATODES

CHARLES DRECHSLER

(WITH 1 FIGURE)

In Zopf's (**11**) account of the capture of nematodes by *Arthrobotrys oligospora* Fres. and *Monosporidium repens* Zopf were described, apparently for the first time, instances of a biological habit comparable in part to the carnivorous habit of insectivorous flowering plants. More recently (**1, 2, 3**) nearly a score of additional fungi occurring in soil, in leaf mold, and in solid decaying materials generally, have been found to capture and consume nematodes in large numbers; evidently, indeed, subsisting in nature entirely through such predacious activity. By far most of these fungi are closely related to those dealt with by Zopf, being referable to a group of interrelated genera including *Arthrobotrys, Trichothecium, Cephalothecium, Dactylaria, Dactylella* and *Monacrosporium* (**4**). The relatively few nematode-capturing forms alien to this hyphomycetous series are conidial phycomycetes belonging to the Zoopagaceae, a family whose known members are mostly destructive to terricolous amoebae, some operating in parasitic, others in predacious relationships (**5, 6**). Of the few species preying on nematodes, only one, *Stylopage hadra* Drechsl., has hitherto been described in detail (**7**); so that the description offered herein, of a second species of like biological habit, may be of interest even in the absence of pronounced departures in morphology.

The fungus in question was obtained in quantity from several samples of soil collected by F. L. Wellman in celery fields near Sanford, Florida, January 1935. Pinches of the soil were placed on old maizemeal-agar plate cultures liberally infested with nematodes representing species of *Rhabditis, Cephalobus* and *Acrobeles*. After a period varying usually from 1 to 3 weeks, vegetative mycelium was found present here and there in fairly extensive tracts. In general character this mycelium resembled that of *Stylopage*

hadra; the hyphae, filled with densely granular protoplasm, following rather straightforward courses to give off branches at moderate or longish intervals, mostly at wide angles. Evacuation of the older filaments was found frequent, the retreat of the protoplasm being accomplished in stages and thus resulting, as in many other phycomycetes, in the laying down of a succession of cross-walls (FIG. 1, *H*). As the hyphae were consistently narrower than those of *S. hadra,* scarcely measuring two-thirds as much in width, the mycelium had a noticeably more graceful, less staring appearance.

Capture of nematodes was brought about by adhesion to living mycelial filaments provided with deposits of a yellowish sticky substance (FIG. 1, *A–C*). Commensurate with the smaller width of hyphae in the present species, the animals caught and held on them were, on the whole, smaller than those destroyed by *Stylopage hadra;* the eelworms captured measuring ordinarily less than .2 mm., and rarely more than .25 mm. in length. Globose protuberances like those formed on filaments of *S. hadra,* presumably serving to increase the areas of adhesive contact, have never been observed here; their absence probably accounting in part for an apparent inacapacity to hold larger and more vigorous prey. As far as could be determined the death of a captured animal was never hastened through any special development such as is represented among the predacious Hyphomycetes in the intrusion of a bulbous outgrowth, or in the closing of a constricting loop. Consequently the struggles of the hapless eelworm to free itself were continued for a relatively long period. When the ineffectual writhing had become feeble through exhaustion, the integument of the animal was perforated and hyphae thrust inside, where the progress of their elongation was promtply marked by readily visible degeneration of organs and masculature. Death appeared to ensue about at the time the internal hyphae had extended themselves nearly the entire length of the nematode. These internal hyphae were approximately of the same width as the generality of external hyphae. On depletion of the fleshy substance of the prey, the protoplasmic contents were gradually withdrawn back into the parent filament. Thus in the end, only the empty collapsed integument adhering to a local irregularity in the filament remained behind as visible evidence of the animal's fate.

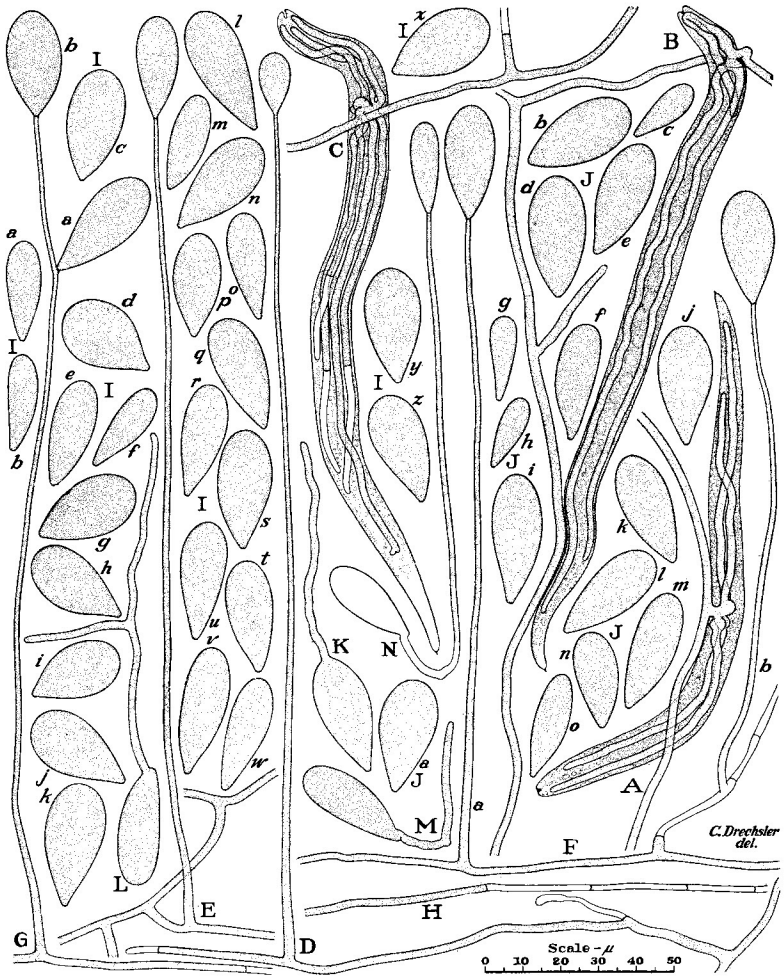

FIG. 1. *Stylopage leiohypha.*

The scattered conidiophores of the Florida fungus (FIG. 1, *D; E; F, a, b; G*) closely resemble those of *Stylopage hadra* in manner of origin and in general habit; but differ from them in having smaller dimensions. Owing to the rather wide variation in height of the fertile hyphae, the differnece in stature between the two species is not especially striking; but the difference in width of the conidiophores, which is more constant as well as proportionally more pronounced, readily distinguishes the slenderer from the

sturdier form. As might be expected, the narrower conidiophores produce the smaller conidia (FIG. 1, *I, a–z; J, a–o*); measurements of 50 spores of the Florida fungus selected at random giving computed averages of 29.3 μ and 12.8 μ for length and width respectively, as compared with averages for the corresponding dimensions in *S. hadra* of 34.6 μ and 17.3 μ respectively. In size, therefore, the southern form is intermediate between *S. hadra* and *S. araea* Drechsl. Its resemblance to the latter species, with respect to a feature shared, to be sure, by all the rest of its amoeba-capturing congeners (**6**), may perhaps appropriately be suggested in a term having reference to the absence of globose protuberances in the capture of prey.

Stylopage leiohypha sp. nov.

Sparsa; hyphis sterilibus incoloratis, 2–3 μ crassis, sine tuberibus animalia tenentibus, integumentum perforantibus, hyphas 2–2.5 μ crassas intus evolventibus, carnem exhaurientibus. Hyphae fertiles 125–300 μ, basi 2.5–3.5 μ crassae, sursum attenuatae, apice 1–1.4 μ crassae, unicum conidium vel interdum usque 3–4 conidia post incrementa repetita ferentes; conidiis incoloratis, obovoideis vel elongato-obovoideis, 20–35 μ longis, 7–18 μ latis. Zygosporae ignotae.

Habitat in terra, nematoda diversa usque .25 mm. longa capiens et consumens, prope Sanford, Florida.

Sparse; vegetative hyphae colorless, 2 to 3 μ wide, capturing nematodes without the production of orbicular protuberances, perforating the integument of each animal, then giving rise inside to haustorial hyphae, 2 to 2.5 μ wide, which assimilate the fleshy contents. Conidiophores 125 to 300 μ high, 2.5 to 3.5 μ wide at the base, tapering upward, 1 to 1.4 μ wide at the tip, bearing a single conidium, or often producing up to 3 or 4 conidia one by one after repeated elongation. Conidia colorless, obovoid or elongate obovoid, measuring 20 to 35 μ (average 29.3 μ) in length by 7 to 18 μ (average 12.8 μ) in width. Zygospores unknown.

Occurring in soil, capturing and consuming nematodes up to .25 mm. in length belonging to species of *Rhabditis, Cephalobus* and *Acrobeles,* near Sanford, Florida.

The new species contributes little additional information concerning the taxonomic position of the Zoopagaceae. Its conidia germinate usually by a single hypha (FIG. 1, *K, L*), which may originate either from the rounded apex, or from a position immediately adjacent to the slightly flattened basal hilum. Often

the germ tube after growing some distance horizontally on the substratum, changes its direction (FIG. 1, *M*) and continues growth vertically into the air as a conidiophore to produce terminally a secondary conidium (FIG. 1, *N*). Apparently the same process may be repeated to give rise to a tertiary conidium. This repetitional development, as was pointed out in the discussion (**7**) of *Stylophage hadra,* recalls the behavior frequent with conidia of various species of *Empusa,* and thus provides one of the few indications of relationship to the Entomophthorales. These indications direct attention also to the possibility of relationship with other conidial zygomycetes made known in recent years; such, for example, as the Harpellaceae, a family of singular fungi that Léger and Duboscq (**8**) and Léger and Gauthier (**9**, **10**) have briefly described from the digestive tube and rectal cuticle in the aquatic larvae of various insects. The presence of curious evanescent spiral basal appendages on the conidia of the Harpellaceae, and the biconic shape of the zygospore in the forms wherein the sexual stage has been observed, constitute morphological features no less alien to the Zoopagaceae than to the older established groups in the Entomophthorales. Nevertheless, provoking analogies would seem present, which, if supplemented through the discovery of additional types, may well lead not only to an appropriate orientation of the newer groups, but also to a more satisfactory ordering of the old.

DIVISION OF FRUIT AND VEGETABLE CROPS AND DISEASES,
BUREAU OF PLANT INDUSTRY,
U. S. HORTICULTURAL FIELD STATION,
BELTSVILLE, MARYLAND

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EXPLANATION OF FIGURE

Fig. 1. *Stylopage leiohypha;* drawn with aid of camera lucida at a uniform magnification; × 500 throughout. *A–C,* Portions of hypha on each of which has been captured a nematode (referable probably to *Cephalobus* sp.), showing haustorial filaments, disorganization of animal's fleshy parts, and in *C,* early stage in evacuation of haustorial filaments. *D,* Conidiophore with young growing conidium. *E; F, a, b;* Conidiophores, each with one fully grown conidium. *G,* Conidiophore with 2 conidia, *a* and *b,* produced successively. *H,* portion of vegetative hypha, partly evacuated, showing 3 septa in empty portion. *I, a-z; J, a-o;* Mature conidia. *K, L,* Conidia germinating vegetatively. *M,* Conidium with a germ tube developing distally into an erect conidiophore. *N,* Conidium with a germ tube that has developed distally into an erect conidiophore bearing a nearly mature secondary conidium.