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Observations on Chytridiaceous Parasites of Phanerogams

XVIII. A *Physoderma* on *Juncus pelocarpus* Mey.

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Summary. A hitherto unnoted species of *Physoderma* on the basal leaves of *Juncus pelocarpus* Mey. is described. The fungus produces light brown irregularly-placed spots on the outermost leaves. The endobiotic system is composed in addition to rhizoids of non-septate or 1—2 septate turbinate cells, resting spores and ovate haustorial-bearing cells. Resting spores germinate by dehiscence of a lid and protrusion of a finger-like zoosporangium. No epibiotic stage has as yet been seen. The host range of the fungus has not as yet been studied. This is the first account of a *Physoderma* on a member of the Juncaceae.

This paper gives an account of a species of *Physoderma* found parasitic on *Juncus pelocarpus* Mey. in the shallow water of a small lake (Vincent L.) near the University of Michigan Biological Station at Douglas Lake. It was first found in early July (1963) by Joyce Griffin Longcore and has been regularly collected there in all subsequent years. It is the first *Physoderma* to be found on a member of the Juncaceae. An examination of herbarium sheets in the Biological Station Herbarium indicates it also occurs on this host in Devereaux Lake, Penny Lake and "Blanchard Lake", Cheboygan Co.; Big Lake 16, Presque Isle Co.; and Hardwood Lake, Otsego Co. A comprehensive study of more such sheets would doubtless indicate it to be present generally where the host occurs.

The *Physoderma* is found typically on the outermost of the basal, equitant leaves. Here it forms light brown, irregularly-placed spots 0.5—1.0 mm and up to 4.0 × 1.0 mm (Fig. 1). Infected areas are always covered by the host epidermis at least as long as the leaf is attached to the plant. Such leaves, however soon become brown, flaccid and drop away from the plant and disintegrate.

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An examination of the infected site in mid-May showed new growth arising from the center of the host rosettes surrounded by dead leaves of the previous growing season bearing blackened areas of *Physoderma* resting spores. The latter were mostly germinated and the new season's endobiotic infection was already visible on some of the colorless basal sheaths of the new plants. By the last week in May practically all the previous season's resting spores had germinated. New infections occurred just at or beneath the mud surface, the more distal parts of the plants being free of the fungus and usually covered by a heavy growth of algae. A thorough search in the field at this time for the epibiotic stage was unsuccessful. Inasmuch as observations in late July and mid-August revealed on plants with decaying infected leaves young infections on relatively new leaves, it would seem to confirm that resting spores were germinating throughout the summer and providing a continuous source of infection.

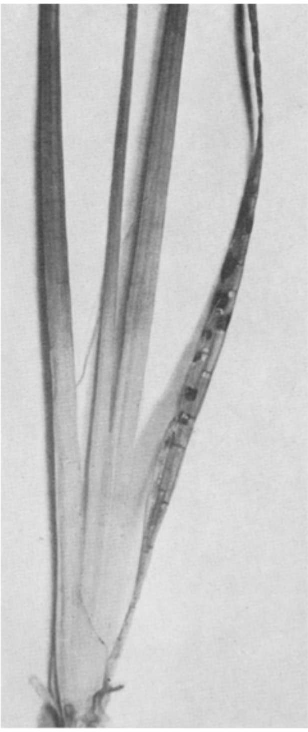
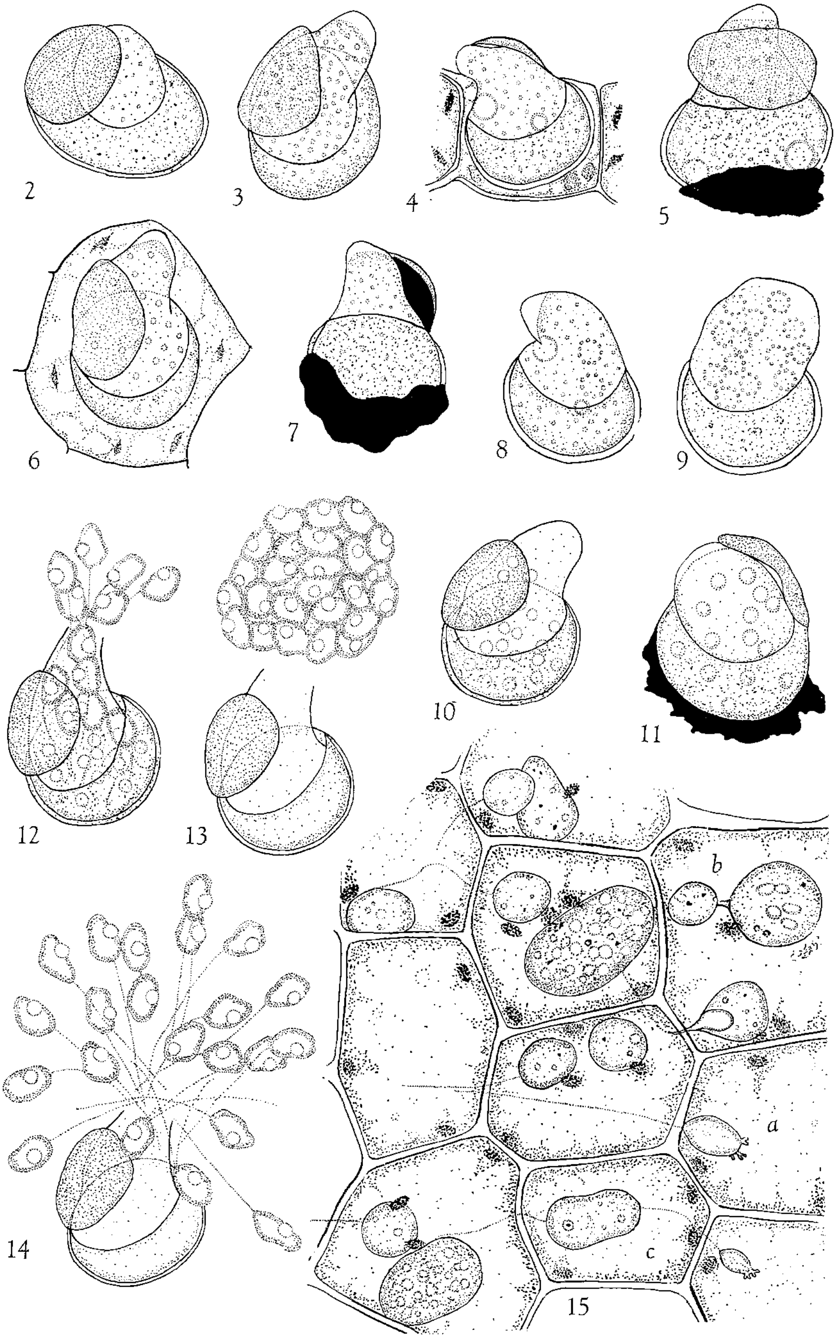


Fig. 1. Basal leaves of *Juncus pelocarpus* showing right hand outer leaf heavily infected with *Physoderma*

The endobiotic system consisted of the usual delicate, seemingly unbranched rhizoids on which were placed at intervals non-septate or 1—2 transversely septate turbinate cells (Figs. 15—17) up to $20.0 \times 12.0\ \mu$. In addition, as was true of *Physoderma maculare* (Sparrow, 1964), there were globose bodies which terminated rhizoids and which bore distally finger-like haustorial appendages (Fig. 15a). There was also some evidence that, like *P. maculare,* the rhizoids bearing these had their origin in segments of the aforementioned turbinate cells (Fig. 15c).

Resting spores were one or occasionally two in a subepidermal host cell and as observed in other species of the genus, originated at the tips of short lateral tubes produced by segments of the turbinate cell (Fig. 17b). Antler-like processes, usually only a single cluster, were sometimes visible during the formative stages of the resting spores (Fig. 17a).

After a sequence of changes in contents entirely similar to that described elsewhere (Sparrow, Griffin and Johns, 1961) the resting spores were at maturity surrounded by a relatively thin, light brown wall,



Figs. 2—15

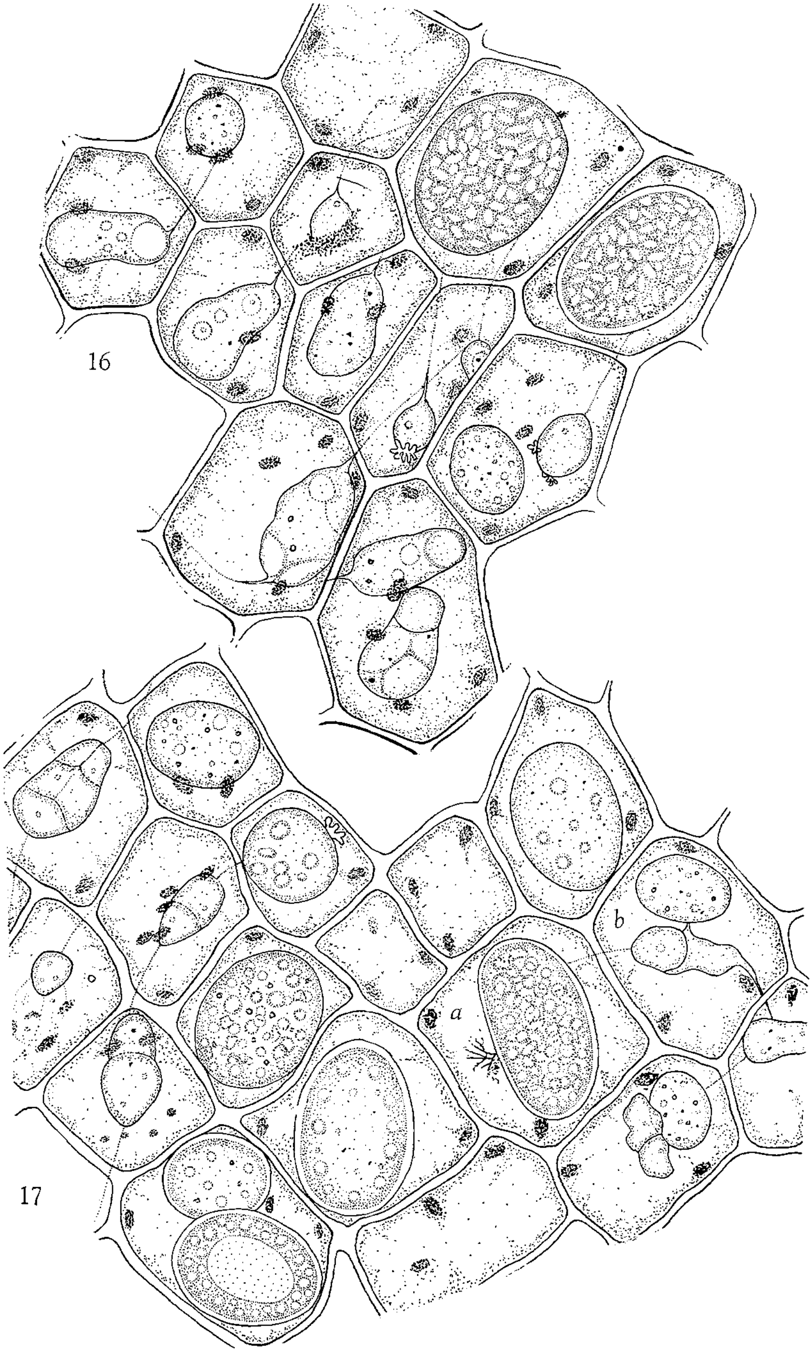
approximately 1.5—2.0 μ thick (Fig. 17 lowermost cell). They were characteristically ovoid, flattened somewhat on one side and bore within numerous fatty globules surrounding a large central vacuolate area. At full maturity the resting spores (av. of 50) were 24.20 × 19.61 μ.

As earlier indicated, germination apparently took place successively throughout the summer. In the laboratory resting spores in infected tissue were stored at about 1° C until germination tests were set up. Best success was obtained by setting up old infected plants in beakers of microbead water cultures of mixed distilled and sterile lake water. These were also planted with young plants of the host in an attempt to obtain epibiotic sporangia from germinated resting spore zoospores. After 6 days at room temperature in diffuse light germination was obtained.

Stages in the process of the germination of resting spores of *Physoderma* have been repeatedly described (Sparrow, Griffin and Johns, loc. cit.) and need not be stated here in any detail (Figs. 2—14). Suffice to say, a rather broad, convex, somewhat irregularly shaped cap was dehisced and from the orifice in the resting spore thus formed, the endosporangium gradually developed. At maturity of the usually somewhat curved endosporangium, a very prominent apical papilla was formed. This deliquesced at the moment of zoospore discharge and the zoospores popped out successively (Fig. 12) and milled around in a loose group at the orifice of the endosporangium (Fig. 13). Subsequently the spores drew farther apart, the cluster increased in size and the individuals suddenly swam away (Fig. 14). These zoospores were somewhat ellipsoidal, approximately 7.0 × 5.0 μ with a prominent eccentric, colorless oil globule and a single long trailing flagellum.

The fate of resting spore zoospores could not be followed and whether or not an epibiotic stage is formed awaits further observations. In two instances somewhat slipper-shaped empty structures were found on *Juncus* tissue, but there is no assurance that they belong to the fungus.

Figs. 2—15. Stages in germination of resting spores of *Physoderma* sp. on *Juncus pelocarpus*. Fig. 15. Portion of infected leaf showing endobiotic system. Figs. 2—7. Early stages in dehiscence of cap of resting spore and protrusion of endosporangium. Figs. 8 and 9. Characteristic "ring stage" of protoplasm. Figs. 10 and 11. Nearly mature sporangia with globules of zoospores being organized. Figs. 12—14. Successive stages in discharge of resting spore zoospores from endosporangium. Fig. 15. Portion of infected host tissue showing elongate turbinate cells, and at "*a*" ovate body with terminal tuft of haustoria. At "*b*" is shown a turbinate cell (left) in top view with a tube to which is attached a distal, enlarging rudiment of a resting spore. Cell to left shows a nearly full-sized rudiment of a resting spore. At "*c*" a haustorial cell appears to be connected to a turbinate cell. All figures × 825



Figs. 16 and 17. Portions of infected tissue of *Juncus pelocarpus* showing invasion by *Physoderma*. Fig. 16. Septate, nonseptate and haustoria-bearing turbinate cells of *Physoderma* in tissue. The two upper right-hand cells each bears an immature resting spore. Fig. 17. Same. At "*a*" is shown an immature resting spore with cluster of haustoria. At "*b*" is shown a somewhat collapsed turbinate cell attached by a tube to a resting spore rudiment. All figures ×825

No host seedlings could be obtained and our inability to provide sufficiently young vegetative host material on which the epibiotic stage would be visible frustrated efforts to find a possible epibiotic stage. Our lack of success in finding them in the field in early spring has already been mentioned. We do not say this fungus lacks an epibiotic stage but simply that we have not seen it, as yet.

Discussion

Resting spores have not been germinated in sufficient numbers to set up any cross-inoculation studies. As with several other Physodermas known to us we cannot say, therefore, with what "species" we are dealing. No other *Physoderma* is known to us on *Juncus* and we might suppose our fungus to be confined to this or a related host. Inasmuch as it was previously shown, however, (Sparrow and Griffin, 1964) that a *Physoderma* from quack grass could attack a wide range of grass hosts and also *Potentilla anserina* (Rosaceae) it hardly seems safe without supporting evidence to assume that the present fungus is confined to *Juncus*. As usual, no striking morphological features are seen in the endobiotic system. One feature, however, allies it to *P. maculare*, namely, the presence of globose or ovate bodies bearing haustoria (Fig. 15a). Just how widespread these are in other Physodermas we do not know although they are suggested in the figures of some early described species. We have only found them in these two. For the moment, therefore, we are not establishing a new taxon for the *Juncus* parasite, hoping that we will learn something of its host range in the future.

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