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AQUATIC ASCOMYCETES FROM LAKE ITASCA, MINNESOTA

A. R. CAVALIERE*

ABSTRACT — A preliminary report of the aquatic Ascomycetes of Lake Itasca, Minnesota. Included is an introduction, methods of harvesting and studying, a key, descriptions, and illustrations of 19 common ascomycetous fungi inhabiting the study area.

Other than the unpublished account of aquatic fungi of the Lake Itasca region (Johnson and Wagner, 1967), the freshwater mycoflora of this region is unknown. The aquatic Ascomycetes in this area are saprophytes or weak parasites infesting moribund species of aquatic phanerogams. The two most common hosts are bulrushes and cattails, *Scirpus acutus* Muhl. and *Typha latifolia* L. Other species of *Scirpus* and *Typha* harbor Ascomycetes as well (*S. validus* Vahl., *S. subterminalis* Torr., *S. torreyi* Olney, *T. angustifolia* L., et al.).

The aquatic fungi at Itasca display a seasonal variation. Spring and summer mycoflora differ markedly in kind and stages of development than do those occurring in fall.

Harvesting and examining fungal collections follow methods outlined in detail elsewhere (Cavaliere, 1973). Bulrushes and cattails afloat at the edge of the lake were gathered either from the shore or by rowboat; those still rooted to the lake bottom were collected by severing the culms with a probe.

With a dissecting scope, clusters of ascocarps were located and subsequently removed with a spearhead dissecting needle. Occasionally, culms heavily infested with algae had to be scraped before the underlying perithecia were exposed. Ascocarps were mounted in lactophenol, crushed and examined.

Although these fungi are not difficult to find, identifying them is often tedious and uncertain. With Ascomycetes there is presently much disagreement as to the taxonomic position of many species. Because this is a preliminary account of these fungi, no attempt is being made, beyond an occasional comment to discuss taxonomic positions of any of the organisms. Keys, descriptions and spore illustrations of the Ascomycete flora are reported as a means by which these organisms may be tentatively identified.

Facilities of the Lake Itasca Biology Station of the University of Minnesota were used and are here acknowledged.

KEY TO GENERA OF ASCOMYCETES IN LAKE ITASCA, MINNESOTA

1. Spores hyaline 2
1. Spores pigmented 5
 2. Spores filiform, many septations *Ophiobolus*
 2. Spores not filiform, never more than 4 septations 3
3. Spores usually more than 2-celled *Metasphaeria*

3. Spores never more than 2-celled 4
 4. Spores clavate or attenuate, never more than 20 μ long *Mycosphaerella*
 4. Spores oblong or bacillate, never attenuate, 40-50 μ long *Hypoderma*
5. Spores with transverse septa only 6
5. Spores with transverse and longitudinal septa 7
 6. Spores with a single septation *Didymosphaeria*
 6. Spores with 2-10 or more septations *Leptosphaeria*
7. Spores with more than 7 transverse septa *Pleospora*
7. Spores with less than 7 transverse septa 8
 8. Spores flattened in one plane *Platyspora*
 8. Spores not flattened in one plane *Pyrenophora*

KEY TO SPECIES OF OPHIOBOLUS

- Spores under 200 μ in length,
6 septations *O. typhae*
- Spores larger than 200 μ in length,
12 septations *Ophiobolus* sp.

Ophiobolus typhae Feltgen (Figure 1)

Ascocarp scattered or gregarious, globose to pyriform or flattened, dark brown or black, concolorous, carbonaceous or subcarbonaceous, innate, 100-250 μ in diameter, neck, if present, short, eccentric to lateral. Asci numerous, cylindrical, thick apical wall, unitunicate, 8-spored, hyaline, to 180 μ long, 14-20 μ in diameter. Ascospores scolecosporous, usually 6 septations, parallel, cylindrical, hyaline, not constricted at septa, to 162 x 7-8 μ .

Ophiobolus typhae Feltgen is the only species of *Ophiobolus* described on *Typha*. Neither the spore characteristics nor the features of the perithecia in our material resemble very closely the description of this organism. The Itasca material more clearly resembles *O. trichosporus* or *O. junci*.

On floating and submerged culms of various species of *Typha* and *Scirpus*.

Ophiobolus sp. (Figure 2)

Ascocarps scattered or gregarious, innate, black, subcarbonaceous or submembranous, subglobose to pyriform, occasionally flattened, to 300 μ in diameter, neck, if present, papilliform or long, centric to slightly eccentric. Asci 8-spored, numerous, cylindrical, more or less curved, apices thick, unitunicate, hyaline, 190-270 x 14-36 μ . Ascospores scolecosporous, straight or curved, occasionally S-shaped, more or less parallel, cylindrical, ends rounded, usually 12 septations, not constricted, 165-290 x 3.5-5.0 μ .

The extremely long asci and spores prevents adequate assignment of this collection to any described species of *Ophiobolus* at this time. Dimensions of asci and length of

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spores are close to *O. volkarti* Müller (Müller, 1952) and *O. stictosporus* C & E (Ellis & Everhart, 1892). A literature survey of several members of the genus *Ophiobolus* suggests that many of these organisms are being separated solely on the basis of spore length. This criteria may prove to be as untenable with members of this genus as was found with members of the genus *Lulworthia* (Cavaliere & Johnson, 1966).

On submerged culms of various species of *Typha* and *Scirpus*.

KEY TO SPECIES OF METASPHAERIA

Spores smaller than 50 μ in length *M. juncinella*
 Spores larger than 50 μ in length *Metasphaera* sp.

Metasphaeria juncinella Mout. (Figure 3)

Ascocarps scattered, clustered or cespitose, innate, occasionally slightly erumpent, globose to subglobose or pyriform, black, concolorous, subcarbonaceous to membranous, 100-125 μ in diameter, neck papilliform, centric, ostiole usually visible. Asci 8-spored, thin-walled, broadly cylindrical to clavate, pedicellate, 116-180 x 11-20 μ . Ascospores hyaline, broadly cylindrical to ellipsoidal, if cylindrical, widest at the center, straight or slightly curved, 4-celled, occasionally a 4th septum may form at tip, slightly constricted, irregularly uniseriate, 25-40 x 5-7 μ .

All collections of this fungus at Itasca have larger asci than reported for the same organism elsewhere. In addition, with the material collected in this area, spore range is larger, 25-40 μ in length as compared to 32-40 μ in length, reported elsewhere (Wehmeyer, 1946).

On submerged culms of various species of *Scirpus*.

Metasphaeria sp. (Figure 4)

Ascocarps scattered or gregarious, but never cespitose, innate, globose to subglobose, subcarbonaceous to membranous, black, concolorous, or black above, brown to hyaline below substrate, 150-250 μ in diameter, neck papilliform, rising to surface of substrate. Asci 8-spored, bitunicate, thick-walled, broadly cylindrical or clavate cylindrical, short pedicellate, interthelial threads abundant, 150-200 x 30-40 μ ; Spores ellipsoidal to broad-ellipsoidal, occasionally slightly curved, biseriate, hyaline, 4-5 celled, primarily 4-celled, sheathed in cytoplasm for a short time after leaving ascus, not, or only slightly constricted at septa, 54-70 x 14.5-20 μ .

The *Metasphaeria*-like character of these collections coupled with the large spore size makes the placing of this organism into any recognized species questionable.

On submerged culms of various species of *Scirpus*.

MYCOSPHAERELLA

Mycosphaerella typhae (Lasch) Lindau (Figure 5)

Ascocarps small, scattered to densely cespitose, innate or occasionally slightly erumpent, membranous to subcarbonaceous when old, brown or black, 50-75 μ in diameter, neck, if present, papilliform. Asci 8-spored, oblong or broadly fusiform, occasionally narrow clavate, short pedicellate, 30-40 x 8-12 μ . Ascospores clavate or attenuated, rounded at both ends, obliquely biseriate, 2-celled, hyaline or slightly yellowed with age, not constricted at septa, 10-14 x 4-5 μ .

On submerged culms of *Typha* and *Scirpus*.

HYPODERMA

Hypoderma scirpinum D.C. ex. Mérat (Figure 6)

Ascocarps hysterothelial, uniformly scattered along substrate, developing beneath epidermis and raising it into a black blister up to 0.5mm high and 2mm long, dimidiate or subdimidiate, opening by a longitudinal slit along apex. Asci abundant, clavate, cylindrical or fusoid, 8-spored, pedicellate, 110-125(140) x (10)15-18 μ . Ascospores oblong, fusiform cylindrical or fusoid-bacillate, straight or curved, hyaline and single-celled at first, becoming yellowish and septate at maturity, (30)40-56 x (4)5-6 μ .

On culms of *Scirpus*.

DIDYMOSPHAERIA

Didymosphaeria typhae Peck (Figure 7)

Ascocarps small, scattered, deeply innate, membranous, globose to subglobose or oval, 40-75 μ in diameter, neck present, short, centric or eccentric. Asci 8-spored, cylindrical to fusiform, 50-70 x 7-8 μ . Ascospores oblong or ellipsoidal, obliquely uniseriate, 2-celled, brown at maturity, not, or only slightly constricted at septum, 8-15 x 4-7 μ .

On leaves and submerged culms of various species of *Typha*.

KEY TO SPECIES OF LEPTOSPHAERIA

1. Spores with 2-3 septations 2
1. Spores with 4-10 septations 5
 2. Spores longer than 30 μ *L. junicola*
 2. Spores shorter than 30 μ 3
3. Spores more than twice as long as broad *L. typhae*
3. Spores not more than twice as long as broad 4
 4. Spores narrow, usually less than 10 μ *L. eustoma*
 4. Spores broad, usually more than 10 μ *L. typharum*
5. Spores with 7-10 septations *L. acuta*
5. Spores with 4-6 septations 6
 6. Spores ellipsoidal, usually with 5 septations *L. scirpina*
 6. Spores subcylindrical, 5-6 septations, antepenultimate cell enlarged *L. sowerbyi*

Leptosphaeria junicola Rehm apud Winter (Figure 8)

Ascocarps gregarious to scattered, innate, subglobose to oval, subcarbonaceous to membranous, black or brown, concolorous, 100-250 μ in diameter, neck absent. Asci 8-spored, clavate-cylindrical or broadly clavate, thick-walled, slightly pedicellate, 60-90 x 10-20 μ . Ascospores fusoid to broadly fusoid, straight or curved, hyaline when young, yellow to brown when mature, 4-celled, with constrictions at septa bordering slightly enlarged penultimate cell, 32-48 (50) x 4-6.0 (10) μ .

On culms of *Scirpus* species.

Leptosphaeria typhae (Karst.) Saccardo (Figure 9)

Ascocarps gregarious, innate, globose to subglobose, more or less carbonaceous, black concolorous, 150-160 μ in diameter, neck absent, Asci 8-spored, clavate to cylindrical, thin-walled, short pedicellate, 50-100 x 15-20 μ . Ascospores fusiform, but more commonly narrowly clavate, slightly curved, 4-celled, brown or yellowish at maturity, not or only

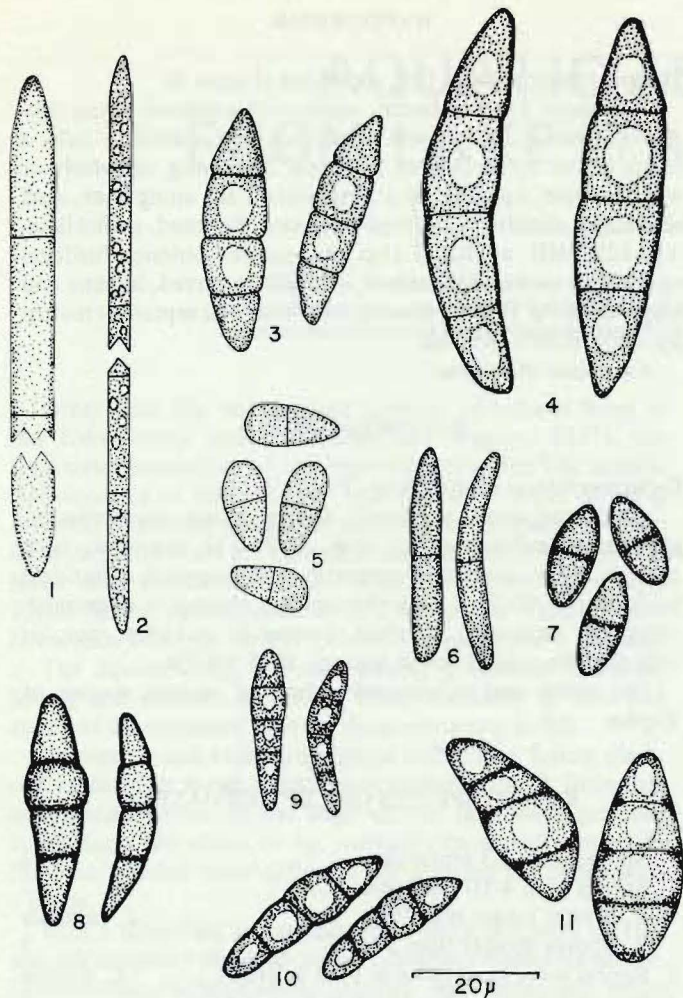


Figure I. 1. *Ophiobolus typhae*, 2. *Ophiobolus* sp., 3. *Metasphaeria juncinella*, 4. *Metasphaeria* sp., 5. *Mycosphaerella typhae*, 6. *Hypoderma scirpinum*, 7. *Didymosphaeria typhae*, 8. *Leptosphaeria junicola*, 9. *Leptosphaeria typhae*, 10. *Leptosphaeria eustoma*, 11. *Leptosphaeria typharum*.

slightly constricted at septa, penultimate cell broadest, 15-24 x 3.5-5.0(5.5) μ .

This species is very close to both *L. typharum* and *L. eustoma*. It differs from the latter only by having extremely narrow spores, never exceeding width of 5.5 μ .

Leptosphaeria typhae may be, in fact, merely a variant of *L. eustoma*.

On submerged culms of various *Scirpus* and *Typha* species.

Leptosphaeria eustoma (Fkl.) Saccardo (Figure 10)

Ascocarps clustered or cespitose, deeply innate, innate or occasionally erumpent, globose to subglobose or pyriform, carbonaceous or subcarbonaceous, brown or black, 100-200 μ in diameter, neck, if present, papilliform. Asci 8-spored, cylindrical to clavate-cylindrical, thin-walled, 75-105(120) x 15-20 μ . Ascospores ellipsoidal or slightly clavate, occasionally slightly curved, ends rounded, obliquely uniseriate, hyaline when young, brown at maturity, 4-celled, slightly constricted at septa, penultimate cell slightly enlarged, (13)18-33 x 4.5-10.5 μ .

This species is very close to *L. typharum*, but differs in having slightly narrower spores with constricted septa.

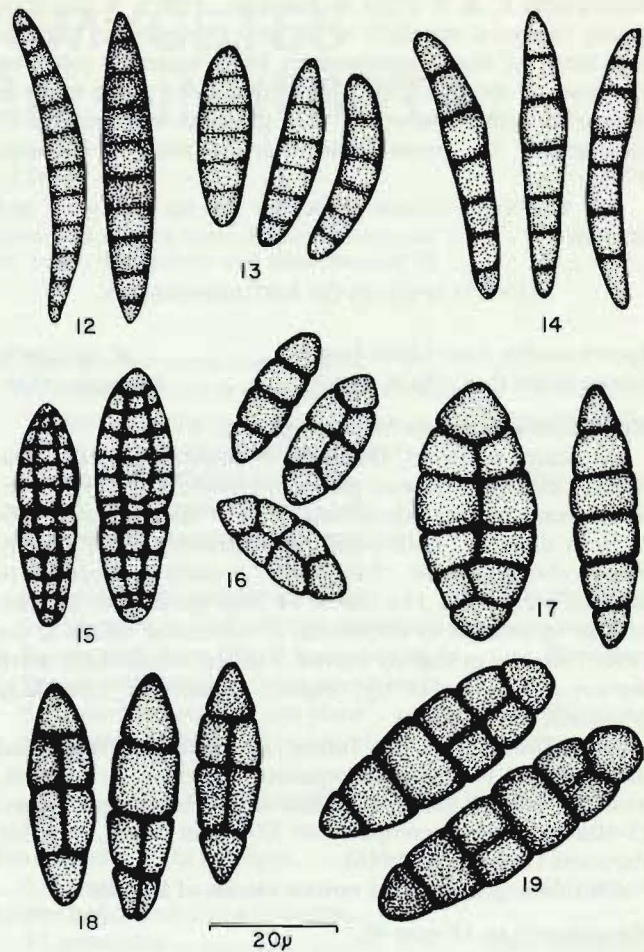


Figure II. 12. *Leptosphaeria acuta*, 13. *Leptosphaeria scirpina*, 14. *Leptosphaeria sowerbyi*, 15. *Pleospora pulchra*, 16. *Platyspora permunda*, 17. *Platyspora planispora*, 18. *Pyrenophora typhaecola*, 19. *Pyrenophora scirpi*.

On submerged culms of various species of *Scirpus* and *Typha*.

Leptosphaeria typharum (Desm.) Karsten (Figure 11)

Ascocarps scattered, globose to subglobose or oval to oblong, deeply innate, carbonaceous to submembranous, brown or black, concolorous, to 150 μ high, 200 μ long, many collections predominantly 150 μ in diameter, neck absent. Asci 8-spored, clavate-cylindrical or oblong, short pedicellate, 60-100 x 16-25 μ . Ascospores broadly ellipsoidal or oblong, slightly curved, usually irregularly arranged in asci, hyaline and 2-celled when young, 4-celled, yellowish to brown at maturity, scarcely or not at all constricted at septa, penultimate cell broadest, 20-30(35) x 9-15 μ .

On submerged culms of *Typha*.

Leptosphaeria acuta (Fries) Karsten (Figure 12)

Ascocarps gregarious or scattered, erumpent or commonly superficial, globose to subglobose, black, subcarbonaceous to membranous, 150-200 μ in diameter, neck, if present, papilliform. Asci 8-spored, clavate to cylindrical, short pedicellate, thick-walled, 100-190 x 10-30 μ . Ascospores fusiform, straight or curved, hyaline when young, becoming yellow or brown-

ish when mature, 8-10 celled, not or only slightly constricted at septa, 36-50(58) x 5-7 μ .

On species of *Scirpus*.

Leptosphaeria scirpina Winter (Figure 13)

Ascocarps scattered, sparse, deeply innate, globose to subglobose, carbonaceous to subcarbonaceous, black, 125-250 μ in diameter, neck absent. Asci 8-spored, clavate to cylindrical, thin-walled, pedicellate, base of pedicel bulbous, 100-125(150) x 15-29 μ . Ascospores fusoid to subfusoid or ellipsoidal, straight or slightly curved, obliquely uniseriate or overlapping, hyaline when young, yellow to brown at maturity, 5-6 celled, primarily 6-celled, not constricted at septa, (25)30-36 x (6)10-14 μ .

On submerged culms of *Scirpus* species.

Leptosphaeria sowerbyi (Fkl.) Saccardo (Figure 14)

Ascocarps gregarious or occasionally clustered, innate, globose to pyriform, subcarbonaceous to membranous, black or brown, 75-100 μ in diameter, neck, if present, papilliform. Asci 8-spored, cylindrical, short pedicellate, thin-walled, 60-75 x 16-20 μ . Ascospores ellipsoidal to subcylindrical, yellowish to brown, 7-celled, not constricted at septa, antepultimate cell slightly enlarged, 42-50 x 5-6 μ .

On submerged culms of various species of *Scirpus*.

PLEOSPORA

Pleospora pulchra Kirschst. (Figure 15)

Ascocarps gregarious, innate, globose to spherical, carbonaceous, black, concolorous, neck absent, 150-200 μ in diameter. Asci 8-spored, broadly clavate, thick-walled, short pedicellate, 130-150 x 25-35 μ . Ascospores obliquely biserial, broadly fusoid, to oblong ellipsoidal, tapered, constricted inequally, brown, muriform, 8-12 transverse septations, 1 or 2 longitudinal septations in any or all cells, usually one or both terminal cells without longitudinal septa, 35-45 x 12-18 μ .

On submerged culms of various species of *Scirpus* and *Typha*.

KEY TO SPECIES OF PLATYSPORA

Spores with 3 transverse septa *P. permunda*

Spores with 5 transverse septa *P. planispora*

Platyspora permunda (Cke.) Wehmeyer (Figure 16)

Ascocarps scattered or gregarious, innate, globose to spherical or slightly flattened, subcarbonaceous, dark brown or black, concolorous, neck absent, 150-200 μ in diameter. Asci 8-spored, stout, clavate, thick-walled, base claw-like, 50-65 x 16-24 μ . Ascospores ellipsoidal or clavate-ellipsoidal, pigmented, usually straight, occasionally inequilateral, symmetric or tapered below, muriform, 3 transverse septations with a single longitudinal septum in each of the central cells, but none in the end cells, slightly flattened in edge view, 18-22 x 8-10 μ .

On submerged and floating culms of various species of *Scirpus* and *Typha*.

Platyspora planispora (Ell.) Wehmeyer (Figure 17)

Ascocarps gregarious or scattered beneath host epidermis, globose, subspherical or pyriform, carbonaceous to subcarbonaceous, black, 100-200 μ in diameter, neck, if present, papilliform. Asci 8-spored, stout, clavate, thick-walled, short pedicellate 250-290 x 54-65 μ . Ascospores broad, fusoid or fusoid-ellipsoidal, hyaline when young, becoming pigmented with maturity, muriform, 5 transverse septations, usually

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equal, only 1 longitudinal septation per cell, none in end cells, slightly constricted at septa, straight or slightly curved, flattened in one plane, 40-58 x 21-25 μ .

In Wehmeyer's (1961) treatment of *Pleospora* and its segregates, *Platyspora planispora* is reported to have asci and spores much smaller than those in the Itasca material (asci 75-125 x 17-25 μ ; spores 23-41 x 11-17 μ). The present collection is being retained as *P. planispora* on the basis of spore shape and septation number.

On submerged and floating culms of various species of *Scirpus* and *Typha*.

KEY TO SPECIES OF PYRENOPHORA

Spores with 3-4 transverse septa *P. typhaecola*

Spores with 4-5 transverse septa *P. scirpi*

Pyrenophora typhaecola (Cke.) Müll. (Figure 18)

Ascocarps scattered or gregarious, innate or slightly erumpent, globose, spherical or occasionally oval, carbonaceous to subcarbonaceous, black or brown, concolorous, 250-350 μ in diameter, neck, if present, papilliform, centric. Asci 8-spored, clavate, thick-walled, short pedicellate, 120-150 x 20-30 μ . Ascospores oblong-ellipsoidal to broadly ellipsoidal, slightly depressed, pigmented, usually 3, but occasionally 4 transverse septa, inequilateral, longitudinal septations in any or all cells, but usually only 2, constricted at all or only mid-septum, rounded at both ends, irregularly biserial, 25-50 x 12-16 μ .

On submerged culms of various species of *Typha*.

Pyrenophora scirpi (Rab.) Wehmeyer (Figure 19)

Ascocarps scattered or clustered, more or less globose, innate or occasionally slightly erumpent, subcarbonaceous to membranous, black, concolorous, 250-300 μ in diameter, minutely ostiolate. Asci 8-spored, broadly cylindrical or clavate, thick-walled, provided with a short, claw-like base, 100-180 x 35-45 μ . Ascospores irregularly biserial, broadly fusoid or more commonly ellipsoidal, brown muriform, 4-5 transverse septa, one longitudinal septum in any or all cells, guttulate or not, straight or slightly curved, slightly narrower in edge view, (36)40-54 x 15-22(25) μ .

On submerged culms of various species of *Scirpus*.

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