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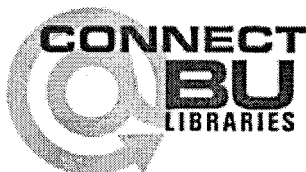
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LEMNACEAE

Lemma minor L. Duckweed. B 1197. Abundant on W ponds. Flowering June–August.

LILIIDAE

LILIACEAE

Allium tricoccum Aiton. Wild leek. S 292, 1614. Locally common in S woods, forming large patches. Flowering July–August.

Asparagus officinalis L. Garden asparagus. S 941. Adventive along E edge. Flowering May–June.

Erythronium americanum Ker. Dogtooth-violet. F 3, 10; Grashoff 47; S 273. Abundant in drier areas. Flowering April–May.

Lilium michiganense Farw. Michigan lily. S 1600. In rich S-central woods, uncommon. Flowering June–July.

Maianthemum canadense Desf. Wild lily-of-the-valley. B 1040; S 347. In S woods, uncommon. Flowering May–June.

Medeola virginiana L. Indian cucumber-root. B 1118. Near SW pond, rare. Flowering May–June.

Polygonatum pubescens (Willd.) Pursh. Solomon-seal. B 1213; F 149, 207A; S 330. Scattered in central woods. Flowering May–June.

Smilacina racemosa (L.) Desf. False spikenard. B 1034; F 14; S 350. Scattered through woods. Flowering May–June.

S. stellata (L.) Desf. False Solomon-seal. S 311. In S-central woods, uncommon. Flowering May–June.

Trillium cernuum L. Nodding trillium. S 314. In S woods, scattered but not common. Flowering May–June.

T. grandiflorum (Michaux) Salisb. Common trillium. Anderson 2242; B 1229; F 12; S 298. Common throughout woods. Flowering April–May.

Uvularia grandiflora Sm. Bellwort. F 2, 53, 135; S 295. Scattered in central and S-central woods. Flowering April–May.

IRIDACEAE

Iris virginica var. *schrevei* (Small) Anderson. Southern blue flag. B 1027; S 1535. In wet places along S edge and in S-central woods, uncommon. Flowering in May.

SMILACACEAE

Smilax ecirrata (Kunth) S. Watson. Carrion-flower. Disosway 13; S 799, 872. Scattered in central and S-central woods. Flowering in May.

S. illinoensis Mangaly. Carrion-flower. Disosway 52; S 328, 875. Scattered in central and S woods. Flowering May–June.

S. tamnoides var. *hispida* (Muhl.) Fern. Bristly greenbrier. F 153. Scattered through drier parts of woods, uncommon. Flowering in June.

DIOSCOREACEAE

Dioscorea villosa L. Wild yam. F 107. Uncommon in S woods. Flowering June–July.

ORCHIDACEAE

Aplectrum hyemale (Willd.) Torrey. Putty-root. B 1148; Miller in 1964. Scattered but uncommon, in central woods. Flowering May–June.

Cypripedium calceolus L. Yellow lady-slipper. F 60; S 870. Three small groups of plants in S woods. Flowering May–June.

Orchis spectabilis L. Showy orchis. S 335. One group of several plants in rich S-central woods. Flowering May–June.

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STUDIES ON MICHIGAN AMBROSIA FUNGI

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The ambrosia fungi (Fungi Imperfecti) in this report are associated with wood-boring beetles of the family Scolytidae. Association between ambrosia fungi and beetles is a mutualistic symbiosis. The fungi are transmitted by special ectodermal glands of the beetle called mycangia (Francke-Grossman, 1967). The mycangia are located on adult females in *Trypodendron* and *Xyleborus* and on adult males of *Gnathotrichus*. The mycangia are associated with the sex of beetles initiating the construction of gallery systems in wood. In temperate regions ambrosia beetles infest the xylem cylinder of weakened, dead, or logged trees and propagate their primary symbiotic fungi upon the walls of the gallery system which they excavate. Ambrosia fungi serve as the sole source of nutrient to the beetle larvae. The gallery systems produced by the beetles and the stains produced by the fungi degrade the economic value of the wood.

Batra (1967) summarized information on taxonomy, beetle association, and distribution of ambrosia fungi. He considered a primary ambrosia fungus one that can be isolated regularly from the mycangium of a beetle, observed being consumed by larvae of the beetle, and isolated repeatedly from galleries formed by the beetles. Fungi not isolated from the mycangium and only occasionally isolated from galleries are considered to be auxiliary. The present study reports the collection of *Ambrosiella ferruginea* (Mathiesen-Kaarik) Batra, *A. gnathotrichi* Batra, *A. hartigii* Batra, and *A. sulphurea* Batra in Michigan for the first time. New

fungal-beetle associations of *Ambrosiella ferruginea* with *Trypodendron betulae* Swaine, *Ambrosiella gnathotrichi* with *Gnathotrichus materiarus* Fitch, and *Ambrosiella hartigii* with *Xyleborus sayi* Hopkins and *X. obesus* Leconte were found.

Portions of beetle-infested timber were dissected to remove beetles or fungi from galleries. Mycangia of *Trypodendron* and *Xyleborus* species were removed entirely from female adults by dissecting the beetle in a series of drops of sterile water. The mycangium was separated, rinsed in sterile water, and crushed directly on agar, or its contents were squeezed out onto agar. Fungi were isolated from the coxal mycangia of *Gnathotrichus* males by complete dissection as above or by killing the beetle, placing it on its back, removing the coxa, lifting out the fungal mass with a fine needle, and placing it on agar. Ambrosia fungi were isolated from galleries immediately after splitting the galleries open. Isolations were made primarily from the fungal layer upon which active larvae were feeding. Single and streak inoculations were made upon agar medium from each gallery.

Isolation media employed were 3% malt agar, 0.6% malt extract agar, 3% malt extract and 1% yeast extract agar (YEME agar), and potato dextrose agar. Pure cultures were maintained and described on YEME agar after 3 weeks. Color designations of cultures of YEME agar follow Ridgway (1912). (Cultures and dried specimens of isolates are maintained in the laboratory of the senior author.)

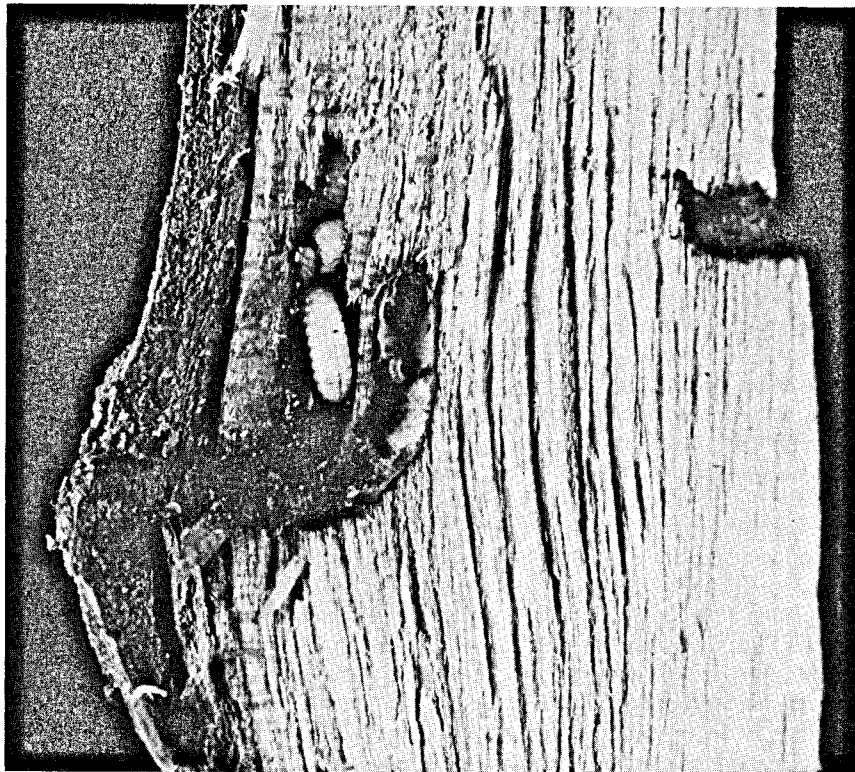


Fig. 1. Gallery of *Xyleborus obesus* with beetle larvae feeding upon *Ambrosiella hartigii* lining the tunnel walls, $\times 6$.

Ambrosiella ferruginea (Mathiesen-Kaarik) Batra

In Culture on YEME Agar: Growth 9–12 mm/day; colony center effuse, outer half cottony; “Vinaceous Rufus,” “Ferruginous,” “Carob Brown”; reverse diffusing pigment “Ferruginous” to “Carob Brown”; sporodochia dark reddish-brown to black, 1–2 mm in height, abundant in center of fresh isolates; hyphae reddish-brown with age, septate, anastomosing, interwoven, 3.0–10.0 μ in diameter; torulose hyphae budding, septate, thin, smooth-walled; individual cells globose to ellipsoidal, 7.5–10.0 (\bar{x} = 9.6) \times 7.5–9.0 (\bar{x} = 8.5) μ ; sporodochia loose, interwoven, reddish-brown, pseudoparenchymatous at base; conidiophores unbranched, reddish-brown, smooth-walled, 80–150 \times 6–10 μ ; conidia formed in basipetal succession, smooth, thick-walled, reddish-brown with age, solitary or in chains, globose to ellipsoidal, 6.3–10.0 (\bar{x} = 8.0) \times 5.0–9.0 (\bar{x} = 7.2) μ ; odor fruit-like.

Isolations Examined: Associated with *Trypodendron retusus* Leconte from *Populus tremuloides*, 7 mi. SW of Alma, Gratiot Co., 14 VI 1973; *P. tremuloides*, 1 mi. S of Sumner, Gratiot Co., 14 VI 1973; *P. tremuloides*, 3 mi. E of M-66 on Phinney Bridge Rd., Antrim Co., 7 VII 1973; *P. grandidentata*, Alma College Ecological Tract, Montcalm Co., 14 VII 1973 & 20 V 1977; *P. grandidentata*, 2.5 mi. S of Elm Hall, Gratiot Co., 14 VI 1977; *P. grandidentata*, 4 mi. SE of Alma, Gratiot Co., 14 VII 1977. Associated with *Trypodendron betulae* Swaine from *Betula papyrifera*, 5 mi. S of Traverse City, Grand Traverse Co., 18 VI 1973; *B. papyrifera*, 2 mi. SW of Antlers, Marquette Co., 10 VII 1973. Associated with *Trypodendron rufitarsis* Kirby from *Pinus resinosa*, 9 mi. W of Gaylord, Otsego Co., 7 VI 1973.

The association of this fungus as the primary fungal symbiont of the beetle *Trypodendron betulae* represents a new record, though Leech et al. (1940) undoubtedly observed the fungus with this beetle in Minnesota; Batra (1967) assumed association. The collection of *Ambrosiella ferruginea* from *T. rufitarsis* confirms a recent study of this fungal-beetle association in the western U.S. (French & Roper, 1972a). This fungus appears to be widely distributed and associated with other *Trypodendron* in both North America and Europe (Batra, 1967).

Ambrosiella gnathotrichi Batra

In Culture on YEME Agar: Growth 1–3 mm/day; colony (3 weeks) center raised 3.0–5.0 mm high, cerebriform, slimy, shiny, “Mouse Grey,” sporodochial folds radiating from center to margin of colony; outer third of colony appressed to velvety, “Blackish Mouse Grey,” lacking sporodochia; reverse with sparse intramatrical mycelium, no pigment diffusing into medium irregular cracks beneath colony; mycelium hyaline to yellowish brown, anastomosing, 2.5–5.0 μ in diameter; sporodochia composed of compact, fasciculated hyphae which often coil and twist about each other, 3–5 mm in height; conidiophores hyaline at apex, yellow-brown below, torulose or hyphal, branched or unbranched, individual conidiophores twisting and coiling about center of fasciculate sterile hyphae, 40–165 \times 2.0–3.0 μ ; conidia hyaline, smooth-walled, globose to turbinate with a truncated scar, 5.2–11.0 (\bar{x} = 7.8) \times 3.0–5.5 (\bar{x} = 3.5) μ ;

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sprout cells thin-walled, irregular-shaped, borne in chains from conidia in situ, 6.5–9.0 (\bar{x} = 8.2) \times 6.0–8.0 (\bar{x} = 7.0) μ ; aleuriospores thick-walled, solitary, 5.0–9.2 \times 4.0–7.5 μ ; odor fruit-like.

Isolations Examined: Associated with *Gnathotrichus materiarus* Fitch from *Pinus resinosa*, Arcadia Township, Gratiot Co., 7 VI 1973; *P. resinosa*, ½ mi. W of Sidney, Montcalm Co., 17 VI 1973.

Batra (1967) recorded this fungus in association with the western beetle *Gnathotrichus retusus* Leconte. This collection of *Ambrosiella gnathotrichi* as the primary symbiotic fungus of *Gnathotrichus materiarus* provides new record of a beetle association for this fungus. Batra (1967) recorded the fungi associated with *G. materiarus* in Pennsylvania and also reported *Endomycopsis fasciculata* Batra and *Cephaloascus fragans* Hanawa as associates but did not record *Ambrosiella gnathotrichi*. *Endomycopsis fasciculata* and *Cephaloascus fragans* were not isolated in our study and should therefore be considered as auxiliary ambrosia fungi of *Gnathotrichus materiarus*.

Ambrosiella hartigii Batra

In Culture on YEME Agar: Growth 14.5–16.5 mm/day; colony (3 weeks) cottony, with small droplets of brownish pigment, "Fuscous" to "Olivaceous Black (1)," after repeated transfer "Natal Brown" to "Bone Brown"; reverse with slight intra-matrical mycelium with diffusing pigment, "Blackish Brown" to black; hyphae septate, anastomose-branched, hyaline to brownish, 3.0–7.5 μ in diameter; torulose hyphae hyaline to subhyaline, smooth, thin-walled, individual cells globose to ellipsoidal, rarely clavate, 7.0–11.0 (\bar{x} = 9.7) \times 4.0–8.0 (\bar{x} = 6.3) μ ; sporodochia rare, where present the base composed of interwoven dark-brown hyphae and torulose hyphae; conidiophores torulose hyphae or hyphal, unbranched, 2–6 cells, 10–50 \times 6.0–8.5 μ ; conidia formed in basipetal succession, smooth, thick-walled, hyaline to subhyaline, globose to ellipsoidal, 8.0–13.5 (\bar{x} = 10.4) \times 6–12 (\bar{x} = 7.8) μ ; odor of ripened apples.

Isolations Examined: Associated with *Xyleborus sayi* Hopkins from *Acer rubrum*, 1 mi. N of Torch Lake, Antrim Co., 1 VII 1973; *A. rubrum*, 2 mi. W of Clam Lake, Antrim Co., 7 VII 1973; *A. rubrum*, 2 mi. E of M-66 on Phinney Bridge Rd., Antrim Co., 7 VII 1973; *A. rubrum*, Alma Ecological Tract, Montcalm Co., 10 VII 1973; *A. rubrum*, 1 mi. S of Cedar Lake, Gladwin Co., 28 VI 1973; *A. saccharum*, 5 mi. W of Gould City, Schoolcraft Co., 20 VII 1973; *A. saccharinum*, 3 mi. S of Elm Hall, Gratiot Co., 5 VI 1977; *Quercus rubra*, 2 mi. S of Elm Hall, Gratiot Co., 25 VI 1977. Associated with *Xyleborus obesus* Leconte from *A. rubrum*, 1 mi. N of Torch Lake, Antrim Co., 2 VII 1973; *A. rubrum*, 2 mi. W of Clam Lake, Antrim Co., 7 VII 1973; *P. grandidentata*, 1.5 mi. E of Sumner, Gratiot Co., 20 VII 1973; *A. saccharum*, 5 mi. SW of Alma, Gratiot Co., 20 VIII 1975.

The associations of this fungus as the primary fungal symbiont with *Xyleborus sayi* and *Xyleborus obesus* represent new records. Previously the fungus had been associated with a closely related beetle *Xyleborus*

dispar F. in Germany (Batra, 1967) and the western U.S. (French & Roeper, 1972b).

Ambrosiella sulphurea Batra

In Culture on YEME Agar: Growth 14.0–16.5 mm/day; colony (3 weeks) with superficial mycelium, cottony to densely effuse, "Amber Yellow" to "Old Gold"; reverse with diffusing pigment, "Chaetura Black"; mounds of effuse sterile mycelia 1–3 cm in diameter, 0.5–1.0 cm high; sporodochia consisting of conidiophores with mass of conidia, borne on a mat of interwoven hyphae, black, 1–2 mm in diameter, 1 mm high; conidiophores determinate, hyaline to yellowish-brown, septate, 4.0–7.0 μ in diameter; conidia blastosporic, hyaline to slightly yellowish, thick-walled, slightly truncated, globose to subglobose, 5.0–12.0 (\bar{x} = 7.3) μ ; odor sweet.

Isolations Examined: Associated with *Xyleborus saxeseni* Ratzeb. from *Prunus serotina*, Arcadia Township, Gratiot Co., 12 VI 1973; *P. avium*, 2 mi. N of Vestaburg, Montcalm Co., 15 VI 1973; *Acer saccharinum*, Arcadia Township, Gratiot Co., 25 VIII 1975 & 25 IX 1976.

This association with *Xyleborus saxeseni* was recorded previously from Pennsylvania, North Carolina, Kansas, and Germany (Batra, 1967).

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