

SOME XYLARIAS OF INDIANA.

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Xylarias have been collected for many years in various counties of the state, but we have studied them particularly from localities near Indiana University. The most striking thing about this interesting genus is the small number of species found in proportion to the large number of individuals that occur throughout the world. However, the wide distribution and the frequent occurrence of our few species is equally striking. There is no intention in this brief paper to make a complete list of the species.

World Distribution. Xylarias are almost world-wide in their distribution. They are far more abundant in the tropics, but retain their peculiar characteristics in all regions. They are, for the most part, saprophytic but are capable of becoming parasitic and infecting living plants under certain conditions. Of the many reports of parasitism, mention may be made of the infection of coconut palms in East Africa and the infection of the rubber plant, *Hevea*, in Asiatic regions from Ceylon to the East Indies. For the most part, the growth of the fungus is limited to the roots or the bases of trees but in some regions (mainly tropical) they have been found frequently on fallen limbs, fallen herbaceous material, and dead leaves. In Europe, considerable trouble is experienced by the hastening of decay of oak grape vine stakes by species of *Xylaria*.

Behavior of Certain Species in United States. Xylarias are found growing on the roots of living beech, maple, oak, and other forest trees and are considered saprophytic as there seems to be no apparent injury to the host. In the locality of Bloomington, Indiana, they occur most commonly on the bark of living beech at the ground line. Just whether injury is done or whether there is some sort of symbiosis has never been definitely determined. It is known, however, that the parasitic infection of three species of this genus is very destructive to apple orchards, and cases are cited east of the Mississippi River where they also affect pear trees. From Virginia to Illinois, reports have been made of orchard infection by *Xylaria polymorpha* (Pers.) Grev., *X. Hypoxylon* (Linn.) Grev., and *X. digitata* (Linn.) Grev. So far as it can be determined, the spores which fall on old stumps or roots, develop mycelia which spread through the soil and attack the apple tree roots causing a disease called black root rot. Infection takes place wherever there is a broken place in the bark of the root, or where a small portion of the root has decayed. The writer, however, has found *X. Hypoxylon* growing on dead places in living apple trees in Shelby County, Indiana, in August, 1926. The fruiting parts appeared some four feet above the ground and, as far as could be ascertained, the fungus was entirely saprophytic.

Since both the conidia and ascospores may be carried by wind, water, and insects, it is advisable to carry on a campaign of general sanitation in regions that have become infected. Also, it is not advisable to plant an orchard in a plot of ground that has but recently been cleared of timber for fear of infected roots or stumps. And in planting, care should be taken not to injure the roots of the young trees.

Harder, reporting on studies of *X. Hypoxylon* (Naturw. Ztschr. Forst. u. Landw. 7:429-436; 441-467, 1909), states that the wood attacked by this fungus has a peculiar black color which, he believes, is not due to the Xylaria itself but to some accompanying fungi. The rot produced by *X. Hypoxylon* is white or yellowish but is penetrated and surrounded by black crust-like formations. In investigations conducted, two kinds of mycelia, one white and the other brown, were found. The nature of the dark coloring matter was investigated but proved resistant to reagents used. However, Stevens (Plant Disease Fungi, p. 210, 1925) states that a root rot of apple trees is due to a fungus closely related to or perhaps identical with *X. Hypoxylon*. Concerning *X. polymorpha* and *X. digitata* which are reported in similar connection, he states that "roots of affected trees are covered with a thin, white, compact, mycelial growth which soon develops into a black stroma. Black, anastomosing rizomorphs radiate from the stroma several centimeters along the root; the cortex below is disintegrated and the distal parts of the roots die. The mycelium extends also into the wood, turning it brown." It is probable that both writers observed the same structures and that only Xylaria species may be present in the infected area.

Peculiar Characteristics of Some Xylarias. In making an investigation of the pentosan content of some of the wood destroying fungi, Wichers and Tollens (Jour. Landw. 58:238-242, 1910) found that by the Boddner method *X. polymorpha* has a pentosan content of 1.21 per cent but by the Krober method no test was given.

Wollenweber (Phytopath. 3:25, 1913) states that the stroma of many species of fungi is not, as a rule, of any taxonomic value but that in such cases as *Claviceps*, *Cordyceps*, and *Xylaria*, where the stroma completely encloses the perithecia, or grows with a coremium-like base, that portion of the plant may be used in its classification. Seaver (Mycologia 5:178, 1913), however, states that there are certain species of *Xylaria* that have their perithecia entirely superficial. Discounting taxonomic value, it is interesting to note that there is a considerable variation in the manner in which the perithecia are borne. They range from those with stromata with a smooth to pitted appearance to those exceedingly roughened by the superimposed perithecia.

In making a survey of the luminescence of fungi, Murrill (Mycologia 7:131-132, 1915) states that *Xylaria Hypoxylon*, when growing in its native habitat, is reported as having the power, in natural periods of darkness, to produce light either in its mycelium or in some part of its fruit-body, but will not so respond when growing in pure cultures. The reason for this difference is not known but may possibly be due to the association of photogenetic bacteria or light-producing organisms under natural conditions.

Much credit is due Prof. J. M. Van Hook who aided in the identification of species and in the organization of this paper. I desire also, to acknowledge the assistance given by Prof. John Dearness in the identification of certain difficult forms. I appreciate very much the contributions made by those who sent in specimens for study. The chief references drawn upon, were Ellis and Everhart's North American Pyrenomycetes and Saccardo's Sylloge.

KEY TO SPECIES.

- A. Heads fertile throughout.
1. Heads subclavate to clavate, stipes short to obsolete or occasionally $\frac{1}{2}$ the entire length (in *X. polymorpha*.)
 - a. Stromata simple to lobed, solitary to several-cespitose; spores large, 20-30 microns.....*X. polymorpha*.
 - b. Stromata simple, solitary; spores medium, 7-15 microns *X. castorea*
 2. Heads clavate; stromata simple, solitary; stipes short, villous; spores medium, $7\frac{1}{2}$ -12 microns.....*X. corniformis*.
- B. Heads sterile at apex.
1. Stromata filiform, simple, attached to matrix by a felt-like subiculum; spores medium, 10-12 microns.....*X. subterranea*.
 2. Stromata simple, furcate to variously branched; spores medium, black, 9-14 microns.....*X. Hypoxylon*.

XYLARIA POLYMORPHA (Pers.) Grev.

Sphaeria polymorpha Pers., Comm., p. 149.

Valsa clavata, Scopoli, Flora Carniel., p. 398.

Xylaria clavata, Schrank, Bayrische Flora II, p. 566.

Clavaria digitata & hybrida, Bull., Champ. de France I, pp. 192-194.

Sphaeria digitata, Müller, Flora Danica XV, p. 6.

Xylaria polymorpha, Grev., Flora Edin., p. 355.

The stromata of these specimens are solitary to several cespitose—connected at the base, erect, cylindrical, to subclavate to subattenuate above or below, simple to somewhat lobed, subglobose to irregular in form, generally thick, brown to black, areolate because of irregular depressions, interior woody, from 1-9 cm. high and $\frac{1}{2}$ -2 $\frac{1}{2}$ cm. thick, and fertile throughout; the stipes range from obsolete to $4\frac{1}{2}$ cm. in length. The perithecia are compressed because of compact nature, $\frac{1}{2}$ -1 mm. in diameter, ovate to subglobose, with fairly prominent papilliform ostiola. The asci are 8 spored, long stiped, *p. sp.* 120-140x7 $\frac{1}{2}$ -10 microns (140-180x8-10, in E. & E.). The spores are uniseriate, somewhat elliptical to fusoid, subacute at the ends, subinequilateral or curved, brown, 20-30x6-10 microns (20-30x6-9, in E. & E.).

Specimens number 4,060 of Indiana University Herbarium, identified by Prof. Dearness, have stromata ranging from $5\frac{1}{2}$ -9 cm. with stipes one-half of the entire length.

XYLARIA CASTOREA Berk.

Xylaria castorea Berk., Fl. Nov. Zel., p. 204

These specimens are simple, solitary, arising from a reddish-brown, spongy, bulb-like (sometimes conical) base which is from 1-2 cm. high;

stipes short, from $\frac{3}{4}$ -2 cm. in length; heads subclavate to clavate, somewhat compressed or flattened, 1-4 $\frac{1}{4}$ cm. high and $\frac{1}{2}$ -1 cm. wide, brown to brownish-black, smooth to minutely areolate from depressions in the surface and with a few scattered, protruding ostiola, obtusely rounded at the apex, and fertile throughout. The perithecia are compact to scattered, generally compressed because of crowded condition, and measure from $\frac{1}{3}$ - $\frac{3}{4}$ mm. in diameter. The asci are cylindrical, 8 spored, and measure (*p. sp.*) 55-80x5-7 $\frac{1}{2}$ microns with a stipe from $\frac{1}{3}$ - $\frac{1}{2}$ as long. The spores are brown, uniseriate, elliptical, slightly inequilateral, and measure from 7-15x5-7 microns.

Specimens number 4,058 of Indiana University Herbarium, identified by Prof. Dearness, are unusual because of the Indian-club shape and of their smoothness.

XYLARIA CORNIFORMIS Fr.

Sphaeria corniformis Fr., Elench II, p. 57

Xylaria corniformis Fr., Summa Veg. Sc., p. 381

The stromata are generally single and scattered but sometimes two or three are connected at the base, simple, club-shaped, not compressed, obtuse at the apex, fertile throughout, with the surface of the heads in well matured specimens divided into small, variously shaped areas, brownish-black, rough with papilliform ostiola, and measure 3-6 mm. in diameter (4-5, in E. & E.) and 2 $\frac{1}{2}$ -5 cm. high (3-5, in E. & E.); stipes short, black, villous, arising from a spongy, brownish-purple, tubercular base. The perithecia are compact, compressed because of crowded condition, and measure from $\frac{1}{3}$ - $\frac{1}{2}$ mm. across. The asci are cylindrical, somewhat stipitate, 8 spored, and measure (*p. sp.*) 45-60x5-6 microns (60-70x5-6, in E. & E.). The spores are obliquely uniseriate, inequilaterally elliptical, rounded at the ends, brown, and measure 7 $\frac{1}{2}$ -12x4-5 $\frac{1}{2}$ microns (8-10x4 $\frac{1}{2}$ -5, in E. & E.).

XYLARIA SUBTERRANEA (Schw.) Sacc.

Sphaeria subterranea Schw., Syn. N. Am. 1162.

Xylaria subterranea Sacc., Syll. 1281.

The specimens are filiform, simple, and attached to the matrix by a thin, felt-like subiculum. The stromata are 4-5 cm. in length and 1-2 mm. in diameter, rough from the scattered, papilliform ostiola, the lower portion is blackish and fertile, the upper portion grayish and sterile. The perithecia are subglobose, $\frac{1}{3}$ - $\frac{1}{2}$ mm. in diameter and are unequally crowded or scattered over the stem. The asci are cylindrical, 8 spored, with abundant paraphyses, and measure (*p. sp.*) 75-85x5 microns. The spores are uniseriate, oblong to elliptical, attenuated at the ends, brown, and measure 10-12x4-5 microns.

XYLARIA HYPOXYLON (Linn.) Grev.

Clavaria Hypoxylon Linn., Flora Suec. Ed. II, p. 457

Clavaria hirta Batsch., Elench Cont., I, p. 229

Clavaria cornuta Bull., Champ. tom. I, p. 193

Valsa digitata Scopoli, Flora Carniol. II, p. 389

Sphaeria cornuta Hoff., Veg. crypt. I, p. 11

Sphaeria digitata Bolton, Fungi Hal. III, p. 130

Sphaeria ramosa Dicks., Plant. crypt. Brit. IV, p. 27

Xylaria Hypoxylon, Grev., Flora Edin., p. 355

The stromata of these specimens are simple to variously branched, cylindric to compressed, black, $\frac{3}{4}$ -4 $\frac{1}{2}$ cm. high, and pointed and sterile at the apex; heads somewhat larger and differing from the stipe in that they are roughened by the more or less prominent, ovate, papilliform ostiola, and the interior is of a white fibrous material; stipes $\frac{1}{4}$ - $\frac{1}{2}$ of the length of the stroma, generally cylindrical, with a brownish, woolly-tomentose base, more or less simple with branching in or at the base of the fertile head. The perithecia are generally thickly crowded, $\frac{1}{3}$ - $\frac{1}{2}$ mm. in diameter, globose to slightly compressed, and more or less erumpent. The asci are cylindrical, long stiped sometimes $\frac{1}{2}$ length of the ascus, (p. sp.) 75-80x5 $\frac{1}{2}$ -8 microns, and 8 spored. The spores are obliquely uniseriate, fusoid, inequilateral, obtuse at each end, light brown to brownish-black to black, and 9-14x4 $\frac{1}{2}$ -6 microns (12-16x5-6, in E. & E.).

