KOR. JOUR. MICROBIOL. Vol. 7, 91~106 (1969)

Ulmus americana L. 목재에서 발견된 곰팡이

沈 正 子

(서울여자대학 식품영양학과)

Lignicolous fungi on *Ulmus americana* L.*

Jung Ja SHIM

(Dept. of Food and Nutrition, Seoul Woman's College)

ABSTRACT

From a review of the literature it was found that 96 species of fungi have been reported as occurring on the wood of *Ulmus americana* L., the American elm. In an intensive study of the fungi growing on one American elm log, 60 species were found. Only one had been reported previously on American elm. A second fungus proved to be a hyperparasite of a slime mold.

Three members of the Fungi Imperfecti could not be identified and is believed that they may constitute new taxa.

In the past, Basidiomycetes constituted the main group of fungi on American elm wood according to the literature. The Fungi Imperfecti were the largest group found in this study in that over half of the species found are imperfect fungi.

All of the species encountered in the study were illustrated.

INTRODUCTION

All wood is subject to fungal attack. Any wood that is moist enough long enough will rot, because the fungi that cause this rot are ever present. Although numberous species belonging to the Myxomycetes, Phycomycetes, Ascomycetes, and Fungi Imperfecti are found on wood, the members of the Basidiomycetes constitute the most common wood-attacking fungi (Ainsworth, 1963).

There have been a great many notations in the literature concerning dead wood as a habitat for fungi. In a majority of cases, the particular type of wood involved is not reported.

To the knowledge of the writer, no studies concerning the fungus flora of one particular fallen tree have been carried out. The purpose of this study was to determine the different species of fungi that could be found on one particular log during the Summer and Fall of one year. In addition, woodchips from the log were placed in moist chambers during the following Winter.

No attempt to determine the frequency of

* 이 논문은 저자가 Western Illinois대학원에서 쓴 석사학위 논문 중에서 발췌한 것임을 밝힌다.

occurrence of species was made. No successional patterns were determined.

In 1892, Ellis and Everhart listed eleven species of Pyrenomycetes as occurring on the wood of species of *Ulmus*. No particular species of elm were listed for *Calonectria Chlorinella, Massaria ulmi, Eutype Iudibunda, Crytovalsa Nitschkei, Fenestella vestita, Valsaria melastroma, Diatrype tumida, Anthostoma gastrinum*, and *Hypoxylon effusum*. However, it was noted that *Pyrenophora zabriskieana* and *Hypoxylon caries* were found on *Ulmus americana*.

In his paper on *New and Rare British Fungi*, Plowright (1896) reported *Dinemasporium bispidulum* on dead elm wood.

In his monograph of *The North American Telephoraceae*, Burt (1915) reported *Sebacina calcea* on the bark and wood of dead branches of elm. In 1917, he listed *Coniophora vaga* as occurring on *Ulmus americana*. *Hymenochaete corticolor* was listed on elm (Burt, 1918) and *Stereum cinerascens* was listed on logs and fallen limbs of elm (Burt, 1920). Burt (1925) reported *Peniopora admirabilis* and *P. caudida* on decaying wood of *Ulmus* sp. He also reported *Corticium crustaceum* and *C.roseum* on elm logs (Burt, 1926).

In 1921, Overholts listed *Peniophora cinerea* on *Ulmus americana* wood and *Polyporus conchifer* on the dead branches of *Ulmus* sp.

Linder (1929) in *A Monograph of the Helicosporous Fungi Imperfecti* listed *Helicoma limpidum* as occurring on old wood of elm and *H. minutissimum* on decaying elm bark.

May (1930) reported *Graphium ulmi*, the imperfect state of *Ceratocystis ulmi*, on *Ulmus americana* in Ohio. According to Glubczynski (1965), Morris collected *Graphium ulmi* on *Ulmus americana* in McDonough County, Illinois, in 1960.

Hughes (1949) reported *Sporoschisma mirabile* and *Helminthosporium rousselianum* on unknown species of elm wood. Later, *Camposporium cambrense* (Gughes, 1950) and *Ceratosporium fuscescens* (Hughes, 1951a) were reported from elm wood. Two more species of the Fungi Imperfecti, *Melanopsamella inaequalis* and *Chaetopsis grisea*, were noted as occurring on elm by Hughes (1951b).

Seaver (1942) reported the occurrence of *Urnula Geaster* on *Ulmus crassifolia*. In 1951, he reported *Mollisia caespiticia* on *Ulmus* sp. and *Mollisia lilacina* on *Ulmus americana*.

Johnson (1952) in a study on the fleshy fungi of West-central Illinois, reported *Polyporusconchifer* on dead elm branches in McDonough County.

In his treatise on *The Polyporaceae of the United States, Canada, and Alaska*, Overholts (1953) noted the occurrence of 51 species on the wood of *Ulmus* spp. The fungi listed were *Fomes annosus, F. ohiensis, F. fraxinophilus, F.fraxineus, F.connatus, F. geotropus, F.igniarius, F.conchatus, F.densus. F. marmoratus, F. applanatus, Lenzites betulitna, L. rabea, Daedalea confragosa, D. quercina, D. unicolor, D. ambigua, D. farinacea, Trametes sepium, T. mollis, T. malicola, Favolus alveolaris, Polyporus lucidus, P. biennis, P. sulphureus, P. frondosus, P. squamosus, P. picipes, P. arcularius, P. semipileatus, P. tephroleucus, P. resinosus P. fumidiceps, P. rigidus, P. zonalis, P. Spraguei, P. galactinus, P. spumeus, P. biformis, P. pargamenus, P. versicolor, P. hirsutus, P. pubescens, P. maximus, P. dichrous, P. adustus, P. fumosus, P. hydnoides, P. gilvus, P. radicatus*, and *P. cuticularis*.

In 1953, Mason and Ellis reported *Stysanus fuscus* on *Ulmus* sp. Ellis(1958) listed *Spori-*

desmium altum and S. *densum* on *Ulmus* sp. In 1959, Ellis reported *Bactrodesmium arnaudii* on *Ulmus* sp., B. *spilomeum* on *Ulmus campestris*, *Stigmina compacta* on *Ulmus montana*, and *S. pulvinata* on *Ulmus campestris*.

Hughes (1960) noted the occurrence of the imperfect fungus, *Conoplea sphaerica* on Ulmus sp.

In addition to the species listed here as occurring on *Ulmus americana*, the American elm, the United States Department of Agriculture Host Index(1960) listed 65 more species of fungi on American elm. The fungi listed were *Aleurodiscus griseo-canus*, *A. oakesii*, *Armillaria mellea*, *Botryosphaeria ribis*, *Camarops microspora*, *Carpenterella molinea*, *Ceratostomella ulmi*, *Collybia velutipes*, *Coniothyrium* spp., *C. radicicola*, *Cytospora ambiens*, *C. carbonacea*, *Cytosporina Indibunda*, *Daldinia concentrica*, *Diaporthe eres*, *Diplodia* spp., *D. ulmi*, *Dothiorlla ulmi*, *Endothia gyrosa Eutypella acoparia*, *E. stellulata*, *E. tumida*, *Fomes scutellatus*, *Fusarium oxysporum*, *F. scirpi* var. *compactum*, *Ganoderma curtisii*, *Helicobasidium purpureum*, *Marasmius spp.*, *Melanconis sudans*, *Nectria cinnabarina*, *N. coccinea*, *N. galligena*, *Nummularia clypeus*, *N. repanda*, *Phoma* sp., *Phomopsis* sp., *Phymatotrichum omnivorum*, *Physalospora fusca*, *Phytophthora cactorum*, *P. inflata*, *Pleurotus ostreatus*, *P. ulmarius*, *Polyporus admirabilis*, *P.delectans*, *P. dryadeus*, *P. fragans*, *P. lacteus*, *P. tulipiferus*. *P. unitus*. *Prosthecium ulmi*, *Schizophyllum commune*, *Septogloeum parasiticum*, *Sphaeropsis ulmicola*, *S. fasciatum*, *S. purpureum*, *S. subpileatum Thyronectria chlorinella*, *Ustulina vulgaris*, *Valsa ambiens*, *V. sordida*, *Verticillium* sp., *V. rhizophagum*, *Xyiarea hypoxylon*, *X. mali*, and *X. polymorpha*.

In 1963b, Morris listed *Phaeoisaria* sp., on the bark of *Ulmus americana*. Morris (1966) described a new fungus imperfectus. *Phragmographium ulmi*, on *Ulmus americanana*.

Hesler and Smith (1965) listed *Crepidotus Iundellii* and *C. subluteus* as occurring on elm wood in North America.

In 1966, Booth noted the occurrence of *Cylindrocarpon ianthothele* and *C. destructans* var. *crussum* on the wood of *Ulmus* sp.

MATERIALS AND METHODS

Specimens used in this study were obtained from a log located at the Alice L. Kibbe Life Science Station of Western Illinois University. The Station is located between two towns, Warsaw and Hamilton, and lies on the banks of the Mississippi River in Hancock County, Illinois. The writer spent the entire Summer of 1967 at the Station.

The log from which the specimens were collected was located in a wooded area approximately 50 meters West of Frank House at the Station. The log was approximately 13 meters in length and 1.15 meters in circumference at the broadest part of the main trunk and branched twice to make three boughs on the upper part. The log was decorticated and decaying. The log was identified as *Ulmus americana* (American elm) by means of keys for the identification of woods by Stover (1946) and Esau (1960). The area around the log was relatively dense with deciduous trees. They were *Ulmus fulva* (red elm), *Robinia pseudo-acacia* (black locust). *Quercus velutina* (black oak), *Juglans nigra* (black walnut), *Carya ovata*(shagbark hickory), *Cercis canadensis* (red bud), and *Celtis occidentalis* (hackberry).

The collections of the specimens used in the study were made during three different time periods. The first specimens, nos. I to 116, were collected during the Summer from June 20th to August 10th in 1967. The collections of the second time period, nos. 117 to 127, were made in the Fall of 1967. The remainder of the specimens, nos. 128 to 148, were those obtained from wood chips which were collected during the Winter and placed into moist chambers.

The petri dishes as moist chambers were sterilized for two hours in the hot air oven at 150°C. before they were used. The knife used to cut off pieces of wood was sterilized by flame before each cut. Then, a couple of pieces of wood were placed into each sterilized petri dish and covered with 10~15 m*l*. of sterile, distilled water.

After one or two weeks the petri dishes were examined under the dissecting microscope for the presence of fungi.

Semi-permanent mounts were made of the Ascomycetes and the Fungi Imperfecti. The slides were prepared in the following manner. Each fungus was observed through a dissecting microscope and two or three representative samples were removed and placed in a drop of lactophenol containing cotton blue on a slide. A cover glass was placed over the specimens and sealed with clear fingernail polish along the edges. Temporary water mounts of the Myxomycetes were prepared.

Observations were made under a calibrated microscope. All mononematous and synnematous Fungi Imperfecti and the asci of Ascomycetes were measured under the low power lens (100X) with each ocular division equal to 10 microns and the high power lens (430X) with each ocular division equal to 2.5 microns. All spores and capillitia of the Myxomycetes, ascospores of the Ascomycetes, and conidia of the Fungi Imperfecti were measured under the oil immersion lens (970X) with each ocular division equal to 1 micron. A plastic ruler was used to measure the size of the fruiting bodies of the Basidiomycetes.

The *Mycetozoa of North America* by Hagelstein (1944) and *The Myxomycetes* by Macbride and Martin (1934) were used in the identification of the Myxomycetes. *The North American Pyrenomycetes* by Ellis and Everhart (1892) and the *Common Fleshy Fungi* by Christensen (1966) were used in the identification of the Ascomycetes and Basidiomycetes, respectively. *The Illustrated Genera* of *Imperfect Fungi* by Barnett (1960) was used as a basis for the identification of imperfect genera. Other books and original papers were used as required in the identification of species.

The illustrations were reproduced on Vinyltronic stencils by a Gestefax Junior copier.

RESULTS

MYXOMYCETES FROM AMERICAN ELM WOOD

Arcyria carnea G. Lister in Journ. Bot. 59:92. 1921.

Plate I, Fig. 1 a, b, c,

Collected 19 July 1967, JJS No. 74.

Arcyria cinerea (Bull.) Pers., Syn. Meth. Fung., p. 184. 1801.

Plate I, Fig. 2 a, b, c,

Collected 23, August, 1967, JJS No. 121.

Arcyria denudata (L.) Wettstein in Verh. Zool. Bot. Ges. Wien 36, 585. 1886.

Plate I, Fig. 3 a, b, c,

Collected 3 August 1967, JJS No. 103b.

Arcyria incarnata pers. in Obs. Myc. L: 58. 1796.

Plate I, Fig. 4—a, b, c,

Collected 3, August, 1967, JJS No. 104b.

Ceratiomyxa fruticulosa (Muell.) Macbr., N. A. Slime-Molds, p. 18. 1899.

Plate II, Fig. 1—a, b, c,

Collected 20, June, 1967, JJS No. 2a.

Comatricha aequalis Peck in Rept. N.Y. State Museum 31:42. 1879.

Plate II, Fig. 2—a, b, c,

Collected 20, June, 1967, JJS No. 2d.

Comatricha typhoides (Bull.) Rost., Versuch Syst. Mycetozoen, p. 7, 1873.

Plate II, Fig. 3—a, b, c,

Collected 27, June, 1967, JJS No. 45a.

Craterium leucocephalum(Pers.) Ditm., Sturm's Deutsch. Fl. Pilze, p. 121, 1813.

Plate II, Fig. 4—a, b, c,

Collected 20, June, 1967, JJS No. 5.

Dictydium cancellatum (Batsch) Macbr., N.A. Slime-Molds, p. 172, 1899

Plate III, Fig. 1—a, b, c,

Collected 20, June, 1967, JJS No. 4.

Echinostelium minutum deBary, Rost., Monografia, p. 215, 1875.

Plate III, Fig. 2—a, b, c,

Collected 28, November, 1967, developed in moist chamber 14 December 1967, JJS No. 136.

Fuligo megaspora Sturgis in Col. Coll. Pub. Sci. Ser. 12:443. 1913.

Plate III, Fig. 3—a, b, c,

Collected 7, July, 1967, JJS No. 66.

Hemitrichia clavata (Pers.) Rost., Versuch Syst. Mycetozoen, p. 14, 1873.

Plate III, Fig. 4—a, b, c,

Collected, 22, June, 1967, JJS No. 19.

Hemitrichia stipitata (Massee) Macbr., N.A. Slime-Molds, p. 207, 1899.

Plate IV, Fig. 1—a, b, c,

Collected 20, June, 1967, JJS No. 11.

Hemitrichia vesparium (Batsch) Macbr., N.A. Slime-Molds, p. 203, 1899.

Plate IV. Fig. 2-a, b, c.

Collected 22, June, 1967, JJS No. 25.

Physarum nucleatum Rex in Proc. Acad. Nat. Sci. Phila. 1891:389. 1891.

Plate IV, Fig. 3-a, b, c.

Collected 20, June, 1967, JJS No. 3.

Stemonitis fusca Roth in Roem. Mag. Bot. 2:26. 1787.

Plate IV, Fig. 4-a, b, c.

Collected 23, July, 1967, JJS No. 79.

Stemonitis pallida Wingate, Macbr. N.A. Slime-Molds, p.123, 1890.

Plate V. Fig. 1-a, b, c.

Collected 3, August, 1967, JJS No. 107.

ASCOMYCETES FROM AMERICAN EIM WOOD

Ceratostoma sp.

Plate V, Fig. 2-a, b, c.

Collected 2, August, 1967, JJS No. 102.

Hypoxylon perforatum (Schw.) Sacc. in Sylloge fungorum 1:375. 1882.

Plate V, Fig. 3-a, b, c.

Collected 11, September, 1967, JJS No. 125a.

BASIDIOMYCETES FROM AMERICAN ELM WOOD

Crepidotus mollis (Fr.) Staude, Die Schwamme Mitteldeutsch., p. 71, 1857.

Plate V, Fig. 4-a, b.

Collected 20, June, 1967, JJS No. 7.

Cyathus stercoreus (Schw.) deT. in Saccarod,

Sylloge fungorum 7:40. 1888.

Plate VI, Fig. 1-a, b.

Collected 20, June, 1967, JJS No. 6.

Inocybe rimosa

Plate VI, Fig. 2.

Collected 25, June, 1967, JJS No. 32.

Pleurotus sp.

Plate VI, Fig. 3.

Collected 23, September, 1967, JJS No. 124.

FUNGI IMPERFECTI FROM AMERICAN ELM WOOD

Arthrobotrys oligospora

Plate VI, Fig. 4-a, b.

Collected 28, November, 1967, developed in moist chamber 6, December, 1967, JJS No. 130.

Bispora punctata

Plate VII, Fig.1 -a, b.

Collected 26, July, 1967, JJS No. 84.

Bispora sp.

Plate VII, Fig. 2-a, b.

Collected 28, November, 1967, developed in moist chamber 2, February, 1968, JJS No. 140.

Brachysporium britannicum Hughes in Naturalist, Lond. 1951:48. 1951.

Plate VII, Fig. 3-a, b.

Collected 28, November, 1967, developed in moist chamber 12, December, 1967, JJS No. 134.

Cacumisporium capitulatum (Corda) Hughes in Can. J. Botany 36:743. 1958.

Plate VII, Fig. 4-a, b.

Collected 27, June, 1967, JJS No. 45b.

Catenularia cuneiformis (Richon) Mason

Plate VIII, Fig. 1-a, b.

Collected 5, August, 1967, JJS No. 120.

Chalara longissima Grov.

Plate VIII, Fig. 2-a, b.

Collected 6, August, 1967, JJS No. 109.

Cephalosporium sp.

Plate VIII, Fig. 3-a, b.

Collected 23, November, 1967, developed in moist chamber 31, March, 1968, JJS No. 141.

Dendryphiopsis atra (Corda) Hughes in Can. J. Botany 31:655. 1953.

Plate VIII, Fig. 4-a, b.

Collected 1, August, 1967, JJS No. 100.

Diplocladium penicilloides Saccardo in Sylloge fungorum 4:177. 1886.

Plate IX, Fig. 1-a, b.

Collected 26, June, 1967, JJS No. 42a.

Diplococcium spicatum Grove in J. Bot., Lond. 23:167. 1885.

Plate IX, Fig. 2-a, b.

Collected 28, November, 1967, developed in moist chamber 4, March, 1968, JJS No. 143.

Endophragmia uniseptata M.B. Ellis in Mycol. Pap. C.M.I. 72:28. 1959.

Plate IX, Fig. 3-a, b.

Collected 28, November, 1967, developed in moist chamber 7, December, 1967, JJS No. 132.

Geotrichum candidum

Plate IX, Fig. 4-a, b.

Collected 3, August, 1967, JJS No. 104.

Graphium calicioides (Fr.) Cooke & Massee in Grevillea 16:11. 1887.

Plate X, Fig. 1-a, b, c.

Collected 22, June, 1967, JJS No. 12.

Hansfordia togoensis Hughes in Mycol. Pap. C.M.I. 43:18. 1951.

Plate X, Fig. 2-a, b,

Collected 16, August, 1967, JJS No. 117.

Harpographium fasciculatum Saccardo in

Michelia 2:33. 1880.

Plate X, Fig. 3,-a, b, c.

Collected 22, June, 1967, JJS No. 23.

Helminthosporium fusiforme Corda in Icones fung. 1:194. 1837.

Plate X, Fig. 4-a, b.

Collected 5, August, 1967, JJS No. 107.

Helminthosporium sp.

Plate XI, Fig. 1-a, b.

Collected 28, November, 1967, developed in moist chamber 15 March 1968, JJS No. 145.

Nematoctunus haptocladis Drechsler in Mycologia 38:19. 1946.

Plate XI, Fig. 2-a, b.

Collected 28, November, 1967, developed in moist chamber 6, December, 1967, JJS No. 130.

Phaeoisaria sp.

Plate XI, Fig. 3-a, b.

Collected 16, August, 1967, JJS No. 88.

Piricularia sp.

Plate XI, Fig. 4-a, b.

Collected 7, August, 1967, JJS No. 114, Collected 28, November, 1967, JJS No. 147.

Rhinotrichum laevisporium (Cooke) Sumstine in Mycologia 3:49. 1911.

Plate XII, Fig. 1-a, b.

Collected 25, July, 1967, JJS No. 83.

Sepedonium subochraceum B. & C.

Plate XII, Fig. 2-a, b.

Collected 7, July, 1967, JJS No. 67.

Sporoschisma saccardoi Mason & Hughes apud Hughes in Mycol. Pap. C.M. 1. 31:20. 1949.

Plate XII, Fig. 3-a, b.

Collected 6, August, 1967, JJS No. 111.

Sporodesmium adscendens Berkeley in Ann. Nat. Hist. 4:291. 1840.

Plate XII, Fig. 4-a, b.

Collected 28, November, 1967, developed in moist chamber 4, March, 1968, JJS No. 142.

Sporodesmium bambusicola M.B. Ellis in Mycol. Pap. C.M. I. 70:34. 1958.

Plate XIII, Fig. 1-a, b.

Collected 29, September, 1967. JJS No. 126.

Sporidesmium densum(Sacc. & Roum.) Mason & Hughes apud Hughes in Can. J. Botany 31:618. 1953.

Plate XIII, Fig. 2-a, b.

Collected 28, November, 1967, developed in moist chamber 12, December, 1967, JJS No. 135.

Sporotrichum canescens Speg. in Fung. Argent. pug. 2: 41.

Plate XIII, Fig. 3-a, b.

Collected 1, August, 1967, JJS No. 101.

Stilbum cellum Morgan (Nomen nudum)

Plate XIII, Fig. 4-a, b, c.

Collected 26, June, 1967. JJS No. 41.

Stilbella tomentosa (Schrad. ex Fr.) Bresad. in Ann. Mycol. 1:129. 1903.

Plate XIV, Fig. 1-a, b, c.

Collected 20, July, 1967, JJS No. 76.

Streptothrix sp.

Plate XIV, Fig. 2-a, b.

Collected 23, August, 1967, JJS No. 120.

Tharoopama trina Subramanian in J. Indian Bot. Soc. 35:85. 1956.

Plate XIV, Fog. 3-a, b, c.

Collected 20, June, 1967, JJS No. 1.

Trichoderma lignorum (Tode) Hartz

Plate XIV, Fig. 4-a, b.

Collected 26, June, 1967, JJS No. 42b.

Xenosporium berkeleyi (Curtis) Pirozynski apud Deighton and Pirozynski in Mycol. pap. C. M.I. 105:27. 1966.

Plate XV, Fig. 1-a, b.

Collected 6, August, 1967, JJS No. 108.

Unknown No. 1.

Plate XV, Fig. 2-a, b, c.

Collected 26, July, 1967, JJS No. 85.

Unknown No. 2.

Plate XV, Fig. 3-a, b.

Collected 28, November, 1967, developed in moist chamber 6, December, 1967, JJS No. 128.

Unknown No. 3.

Plate XV, Fig. 4-a, b.

Collected 28, November, 1967, developed in moist chamber 14, December, 1967, JJS No. 133.

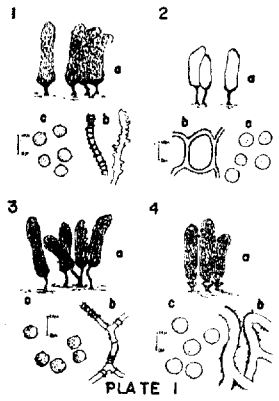

PLATE I

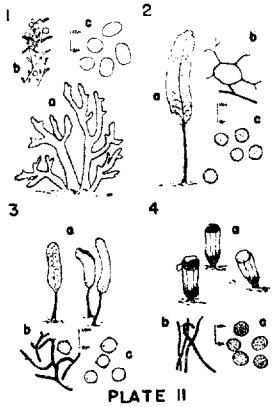

PLATE II

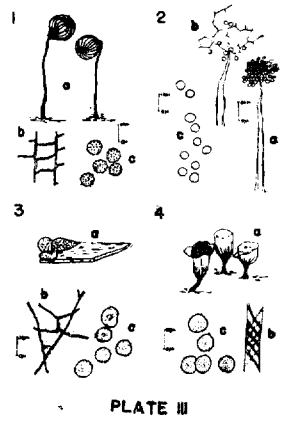

PLATE III

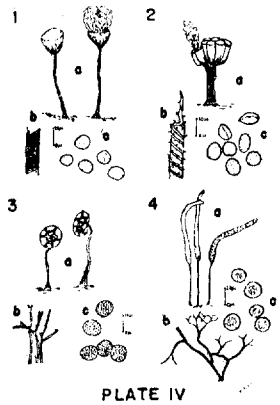

PLATE IV

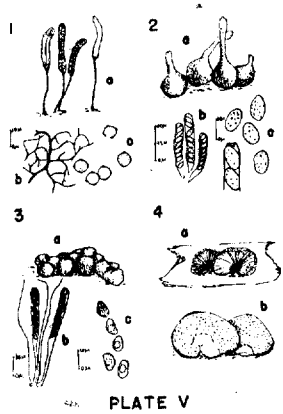

PLATE V

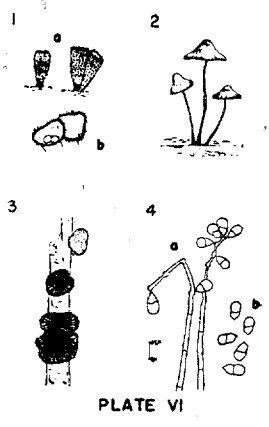

PLATE VI

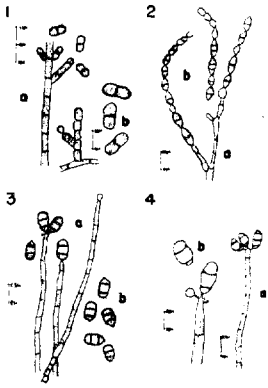

PLATE VII

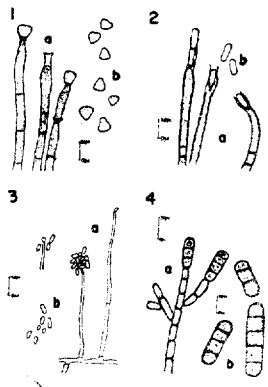

PLATE VIII

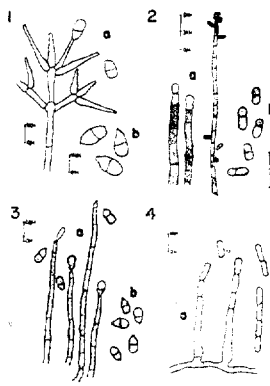

PLATE IX

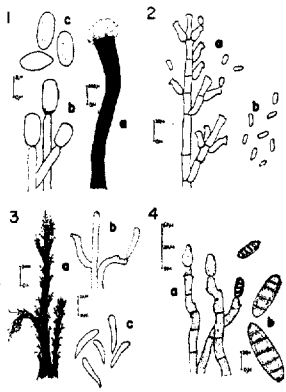

PLATE X

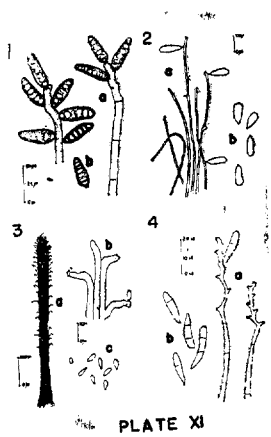

PLATE XI

PLATE X

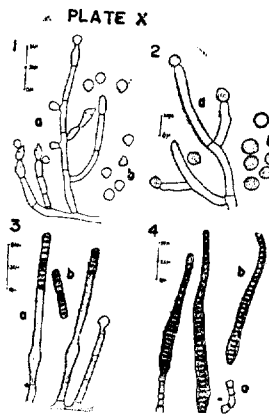

PLATE XII

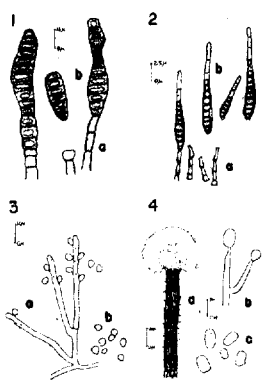

PLATE XIII

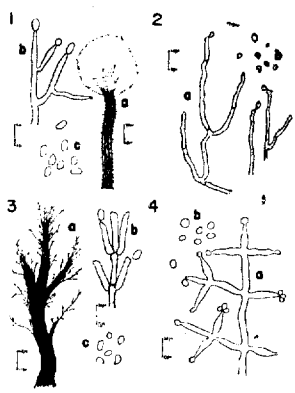

PLATE XIV

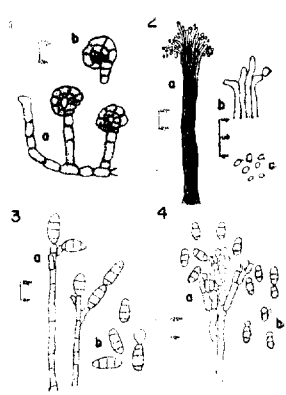

PLATE XV

PLATE I

Fig. 1. *Arcyria carnea* G. Lister
a. sporangia
b. portion of capillitium
c. spores

Fig. 2. *Arcyria cinerea* (Bull.) Pers.
a. sporangia
b. portion of capillitium
c. spores

Fig. 3. *Arcyria denudata* (L.) Wettstein
a. sporangia
b. portion of capillitium
c. spores

Fig. 4. *Arcyria incarnata* Pers.
a. sporangia
b. portion of capillitium
c. spores

PLATE II

Fig. 1. *Ceratiomyxa fruticulosa* (Muell.) Macbr.
a. exosporangia
b. details of a single column of a sporangium
c. spores

Fig. 2. *Comatricha aequalis* Peck
a. sporangium
b. portion of capillitium
c. spores

Fig. 3. *Comatricha typhoides* (Bull.) Rost.
a. sporangia
b. portion of capillitium
c. spores

Fig. 4. *Craterium leucocephalum* (Pers.) Ditm.
a. sporangia
b. portion of capillitium
c. spores

PLATE III

Fig. 1. *Dictydium cancellatum* (Batsch) Macbr.
a. sporangia
b. portion of capillitium
c. spores

Fig. 2. *Echinostelium minutum* de Bary
a. sporangium
b. portion of capillitium
c. spores

Fig. 3. *Fuligo megaspora* Sturgis
a. aethalium
b. portion of capillitium
c. spores

Fig. 4. *Hemitrichia clavata* (Pers.) Rost.
a. sporangia
b. portion of capillitium
c. spores

PLATE IV

Fig. 1. *Hemitrichia stipitata* (Massee) Macbr.
a. sporangia
b. portion of capillitium
c. spores

Fig. 2. *Hemitrichia vesparium* (Batsch) Macbr.
a. sporangia
b. portion of capillitium
c. spores

Fig. 3. *Physarum nucleatum* Rex
a. sporangia
b. portion of capillitium
c. spores

Fig. 4. *Stemonitis fusca* Roth
a. sporangia
b. portion of capillitium
c. spores

PLATE V

Fig. 1. *Stemonitis pallida* Wingate
a. sporangia
b. portion of capillitium
c. spores

Fig. 2. *Ceratostoma* sp.
a. perithecia
b. asci
c. ascospores

Fig. 3. *Hypoxylon perforatum* (Schw.) Saccardo
a. perithecia
b. asci
c. ascospores

Fig. 4. *Crepidotus mollis* (Fr.) Staude
a. habit on wood
b. basidiocarps

PLATE VI

Fig. 1. *Cyathus stercoreus* (Schw.) deT.
a. habit
b. periodioles in basidiocarps

Fg. 2. *Inocybe rimosa*
basidiocarps

Fig. 3. *Pleurotus* ip.
basidiocarps

Fig. 4. *Arthrobotrys oligospora*
a. conidiophores with attached conidia
b. conidia

PLATE VII

Fig. 1. *Bispora punctata*
a. conidiophores with attached conidia
b. conidia

Fig. 2. *Bispora* sp.
a. conidiophores with attached conidia
b. conidia

Fig. 3. *Brachysporium britannicum* Hughes
a. conidiophores with attached conidia
b. conidia

Fig. 4. *Cacumisporium capitulatum* (Corda) Hughes
a. conidiophores with attached conidia
b. conidia

PLATE VIII

Fig. 1. *Catenularia cuneiformis* (Richon) Mason
a. conidiophores with attached endoconidia
b. endoconidia

Fig. 2. *Chalara longissima* Grov.
a. conidiophores with attached endoconidia
b. conidia

Fig. 3. *Cephalosporium* sp.
a. conidiophores with attached conidia
b. conidia

Fig. 4. *Dendryphiopsis atra* (Corda) Hughes
a. conidiophores with attached conidia
b. conidia

PLATE IX

Fig. 1. *Diplocladium penicilloides* Saccardo
a. conidiophore with attached conidium
b. conidia

Fig. 2. *Diplococcium spicatum* Grove
a. conidiophores with attached conidia
b. conidia

Fig. 3. *Endophragmia uniseptata* M.B. Ellis
a. conidiophores with attached conidia
b. conidia

Fig. 4. *Geotrichum candidum*
a. conidiophores with developing conidial chains
b. conidia

PLATE X

Fig. 1. *Graphrum calicioides* (Fr.) Cooke & Massee.

a. synnema
b. conidiophore tips with attached conidia
c. conidia

Fig. 2. *Hansfordia togoensis* Hughes
a. conidiophores with attached conidia
b. conidia

Fig. 3. *Harpographium fasciculatum* Saccardo
a. synnema
b. conidiophore ends
c. conidia

Fig. 4. *Helminthosporium fusiforme* Corda
a. conidiophores with attached conidia
b. conidia

PLATE XI

Fig. 1. *Helminthosporium* sp.
a. conidiophores with attached conidia
b. conidium

Fig. 2. *Nematoctunus haptocladis* Drechsler
a. conidiophores with attached conidia
b. conidia

Fig. 3. *Phaeoisaria* sp.
a. synnema
b. conidiophore tips with attached conidia
c. conidia

Fig. 4. *Piricularia* sp.
a. conidiophores with attached conidia
b. conidia

PLATE XII

Fig. 1. *Phinotrichum laevisporium* (Cooke) Sumstine
a. conidiophores with attached conidia
b. conidia

Fig. 2. *Sepedonium subochraceum* B.&C.
a. conidiophores with attached conidia
b. conidia

Fig. 3. *Sporoschisma saccardoi* Mason & Hughes
a. conidiophores with attached endoconidia
b. endoconidia

Fig. 4. *Sporodesmium adscendens* Berkeley
a. conidiophore
b. conidium

PLATE XIII

Fig. 1. *Sporodesmium bambusicola* M. B. Ellis
a. conidiophores with attached conidium
b. conidium

Fig. 2. *Sporodesmium densum* (Sacc. & Roum.) Mason & Hughes
a. conidiophores
b. conidia

Fig. 3. *Sporotrichum canescens* Sheg.
a. conidiophores with attached conidia
b. conidia

Fig. 4. *Stilbum cellum* Morgan (nomen nudum)
a. synnema
b. conidiopheores with attached conidia
c. conidia

PLATE XIV

Fig. 1. *Stilbella tomentosa* (Schrad. ex Fr.) Bresad.
a. synnema
b. conidiophores with attached conidia
c. conidia

Fig. 2. *Streptothrix* sp.
a. conidiophores with attached conidia
b. conidia

Fig. 3. *Tharoopama trina* Subramanian
a. synnema
b. conidiophore tips with attached conidia
c. conidia

Fig. 4. *Trichoderma lignorum* (Tode) Hartz
a. conidiophores with attached conidia
b. conidia

PLATE XV

Fig. 1. *Xenosporium berkeley* (Curtis) Pyrozynski
a. conidiophores with attached conidia
b. conidium

Fig. 2. Unknown No. 1.
a. synnema
b. conidiophore tips
c. conidia

Fig. 3. Unknown No. 2.
a. conidiophores with attached conidia
b. conidia

Fig. 4. Unknown No. 3.
a. conidiophores with attached conidia
b. conidia

DISCUSSION

More than 148 specimens were collected from an American elm log. A total of 60 species representing 43 genera of fungi were identified. The distribution among the groups of fungi was as follows: 10 genera and 17 species of Myxomycetes, 2 genera and 2 species of Ascomycetes, 4 genera and 4 species of Basidiomycetes, and 27 genera and 34 species of Fungi Imperfecti. Three more species of the Fungi Imperfecti remain unidentified.

Previous to this study, 96 fungi had been reported as utilizing the wood of the American elm as a substratum. Of the 96 species, 29 are Ascomycetes, 48 are Basidiomycetes, and 17 are Fungi Imperfecti.

In 1892, Ellis and Everhart listed two species of the Ascomycetes as occurring on *Ulmus americana*. Overholts (1921) reported a member of the Thelephoraceae of the Basidiomycetes as occurring on American elm. The causal organism of Dutch Elm Disease was reported for the first time on American elm in the United States by May in 1930. Seaver (1951) reported an Ascomycetes on American elm. According to the latest host index of the United States Department of Agriculture (1960), there are 88 species of fungi (28 species of Ascomycetes, 44 species of Basidiomycetes, and 16 species of Fungi Imperfecti) that are known to occur on American elm. Recently, Morris (1963 b, 1966) reported two species of the Fungi Imperfecti as occurring on the wood of the American elm.

Most of the fungi which were identified from the American elm log used in this study have been found previously on wood other than that of the American elm.

All 17 species of Myxomycetes collected in this study have been reported from wood of unknown species by Hagelstein (1945) and Macbride and Martin (1934). *Ceratostoma* sp. and *Hypoxylon* which are Ascomycetes have been reported from unidentified wood by Overholts (1921). According to Christensen (1966), *Pleurotus* sp. and *Cyathus stercoreus* are also known touse wood as substrata, but the wood is unidentified.

Some of the Fungi Imperfecti reported in this study as occurring on American elm have been reported on substrata other than wood. Drechsler (1937, 1947) listed *Arthrobotrys oligospora* and *Nematoctunus haptocladis* as parasites of free-living terricolous nematodes. In 1951c, Hughes found *Hansfordia togoensis* on dead leaves and described it as a new species. According to Carmichael (1957), the fungus *Graphium candidum* is ubiquitous in dairy products, soil and saprobic or pathogenic in the human breathing and gastro-intestinal tracts. Gilman (1957)

reported *Trichoderma lignorum* from the soil and Ellis (1958) found *Sporodesmium bambusicola* on the dead culms of *Bambusa vulgaris*. According to Zalokar (1962), *Stilbum cellum* was found on *Stereum* sp. by Morgan in 1900. Morris (1963) reported species of *Stilbella* on myxomycetes fruiting bodies such as *Hemitrichia*, *Trichia*, and *Arcyria*. During this study, *Stilbella tomentosa* was found on *Arcyria* sp. which was on American elm.

According to Barnett (1965), species of *Piricularia* are chiefly parasitic on grasses and species of *Sepedonium* are parasitic on fleshy fungi such as *Boletus*.

Only one fungus, *Phaeoisaria* sp., among the 60 species of fungi identified during this study has been reported previously from the wood of the American elm.

Before this study, more species of Basidiomycetes had been reported on the American elm than any other group of fungi. In this study, the Fungi Imperfecti proved to be the most common. Slightly over half of the species encountered were members of the Fungi Imperfecti.

During the study, three Fungi Imperfecti which could not be identified were encountered. One of these, Unknown No. 1, is synnematous, black with hyaline tips on the conidiophores and possesses one-celled, hyaline conidia. The fungus is very similar to species of *Graphium*. However, the synnematal heads in *Graphium* are mucoid while in this fungus they are dry. Unknown No. 2 has dark conidiophores which are branched and 3-septate, dark conidia which are catenulate. The fungus is similar to *Dendryphiopsis atra*, but differs in possessing catenulate conidia and having a different type of branching of the conidiophores. Unknown No. 3 has dark, 3-celled conidia and dark, dichotomously branched conidiophores. The fungus appears similar to species of *Penicillium* in the branching of conidiophores, but differs markedly in matters of color, shape, and septation of conidia.

It is believed that the three unknown fungi found constitute new genera of the Fungi Imperfecti. Further study will be necessary, however, before they can be described as new.

The total number of species of fungi that are now known to occur on the wood of the American elm is 154.

ACKNOWLEDGMENTS

The author wishes to thank her advisor, Dr. Everett F. Morris, for all of the time spent in guidance and criticism during the course of this study and also for proposing this problem and providing some of the references.

Additional thanks are due Dr. R.D. Henry for his help in identification of the wood. The author also wishes to thank him and Dr. P. Nollen for their time spent in reading this thesis and for their very welcome suggestions.

摘 要

한 *Ulmus americana* L. 목재에서 60종의 곰팡이를 채집, 분류하였다. 그중 59종은 처음으로 *Ulmus americana* L. 목재에서 발견되었고 이들 곰팡이는 각각 Myxomycetes 17종 Basidiomycetes 4종, Ascomycetes 2종과 Fungi Imperfecti 34종으로 밝혀졌다. Fungi Imperfecti 3종

은 지금까지 기재된 바 없는 미기록종으로 발표되었다. 목재에서 자라는 곰팡이의 群으로서는 Basidiomycetes가 그 數的인 면에서 우수한 것으로 알려져 왔으나 이번 연구에서는 Fungi Imperfecti가 중요한 群으로 나타났다.

REFERENCES

1. Ainsworth, G.C., 1963. Ainsworth & Bisby's Dictionary of the Fungi. 5th Ed. Commonwealth Mycological Institute, Kew, Surrey.
2. Barnett, H.L., 1960. Illustrated Genera of Imperfect Fungi. 2nd Ed. Burgess Publishing Co., Minneapolis.
3. Booth, C., 1966. The genus *Cylindrocarpon*. *Mycol. Pap.* C. M. I., **194**, 1-56.
4. Burt, E.A., 1915. The Thelephoraceae of North America. V. *Ann. Mo. Bot. Gard.*, 2, 731-770.
5. Burt, E.A., 1917. The Thelephoraceae of North America. VIII. *Ann. Mo. Bot. Gard.*, 4, 237-269.
6. Burt, E.A., 1918. The Thelephoraceae of North America. X. *Ann. Mo. Bot. Gard.*, 5, 177-372.
7. Burt, E.A., 1920. The Thelephoraceae of North America. XII. *Ann. Mo. Bot. Gard.*, 7, 81-248.
8. Burt, E.A., 1925. The Thelephoraceae of North America. XIV. *Ann. Mo. Bot. Gard*, 12, 213-356.
9. Burt. E. A., 1926. The Thelephoraceae of North America. XV. *Ann. Mo. Bot. Gard.*, 13, 173-354.
10. Carmichael, J.W., 1957. *Geotrichum candidum*. *Mycologia*, **49**, 820-830.
11. Christensen, C.M., 1966. Common Fleshy Fungi. Burgess Publishing Co., Minneapolis.
12. Drechsler, C., 1937. Some Hyphomycetes that prey on free living terricolous Nematodes *Mycologia*, 29, 446-552.
13. Drechsler, C., 1941. Some Hyphomycetes parasitic on free living terricolous Nematodes. *Phytopathology*, 31, 773-802.
14. Ellis, J.B., and B.M. Everhart, 1892. The North American Pyrenomycetes. Published by Ellis & Everhart, Newfield, New Jersey. (Reprinted by the Johnson Reprint Corp., 1966.)
15. Ellis, M.B., 1958. *Clasterosporium* and some allied *Dematiacceae Phragmosporae*. I. *Mycol. Pap. C. M. I.*, **70**, 1-89.
16. Ellis, M.B., 1959. *Clasterosporium* and some allied *Dematiaceae Phragmosporae*. II. *Mycol. Pap. C.M.I.*, **72**, 1-75.
17. Essau, K., 1960. Anatomy of Seed Plants. John Wiley an Sons, Inc., New York.
18. Gilman, J.C., 1957. A Manual of Soil Fungi. 2 nd Ed. Iowa State College Press, Ames.
19. Glubczynski, E. P., 1965. A Taxonomic Study of the Genus *Graphium* Cbrda. Unpublished Master's Thesis, W.I.U.,
20. Hagelstein, R., 1944. The Mycetozoa of North America. Published by the Author, Mineola, N.Y.
21. Hesler, L.R., and A.M. Smith., 1965. North American Species of *Crepidotus*. Hafner Publishing Co., N.Y. and London.
22. Hughes, S. J., 1949. Studies on Micro-Fungi. II.The genus *Sporoschisma* Berkeley & Broome and a Redescription of *Helminthosporium rousseliarum* Montagne. *Mycol. Pap. C.M.I.*, 31, 1-33.
23. Hughes, S. J., 1950. Studies on Micro-Fungi. III. *Mastigesporium*, *Camosporium*, and *Ceratophorum*. *Mycol, Pap. C. M.I.*, 36, 1-43.
24. Hughes, S. J., 1951a. Studies on Micro-Fungi. VI. *Ceratosporium*, *Hirudina* and *Hipporcrepidium*. *Mycol. Pap. C.M.I.*, 39, 1-24.
25. Hughes, S. J., 1951b. *Stachylidium*, *Gonytrichum*, *Mesobotrys*, *Chaetopsis* and *Chaetopsella*. *Trans. Brit. Mycol. Soc.*, 34, 551-576.
26. Hughes, S. J., 1951c. Studies on Micro-Fungi IX. *Calcarisporium*, *Verticicladium*, and *Hansfordia* (Gen. Nov.). *Mycol. Pap. C.M. I.*, 43, 1-25.
27. Hughes, S.J., 1960. *Conoplea* Pers, and

Exosporium Link. *Can. J. Bot.*, **38**, 559-696.

28. Johnsonson, M. M., 1952. Check List of Fleshy Fungi Collected in Westcentral Illinois. Trans. Illinois Acad. Sci., 45, 27-30.
29. Linder, D.H., 1929. A Monograph of the Helicosporous Fungi Imperfecti. *Ann. Mo. Bot. Gard.*, 16, 229-388.
30. Macbride, T.H., and G.W. Martin., 1934. The Myxomycetes. The Macmillan Co., N.Y., 339 p.
31. Mason, E. W., and M.B. Ellis., 1953. British species of *Periconia*. *Mycol. Pap. C.M. I.*, 56, 1-127.
32. May, C., 1930. The Dutch elm disease in Ohio, *Science*, 72, 142-143. (non videmus)
33. Morris, E.F., 1963a. The Synnematous Genera of the Fungi Imperfecti. Western Ill. *Univ. Ser. Biol. Sci.*, 3, 1-143.
34. Morris, E.F., 1963b. Three *Hansfordia* like Stilbellaceous genera. *Am.Mildland Natualist*, 69, 99-105.
35. Morris, E.F., 1966 Studies on the Synnematous Fungi Imperfecti. I. *Mycopath. et Mycol. Appl.*, 28, 97-101.
36. Overholts, L.O., 1921. Some New Hampshire Fungi. *Mycologia*, 13, 24-37.
37. Overholts, L.O., 1953. The Polyporaceae of the United States, Alaska, and Canada. University of Michigan Press, Ann Arbor.
38. Plowright, C.B., 1896. New and Rare British Fungi. *Trans. Brit. Mycol. Soc.*, 1, 53-64.
39. Seaver, F.J., 1942. The North American Cup-fungi (Operculates). Supplemented Edition. Published by the Author, N.Y.(Reprinted by Rafner Publishing Co., N.Y., 1961)
40. Seaver, F.J., 1951. The North American Cup-fungi (Inoperculates) Published by the Author, N.Y. (Reprinted by Hafner Publishing Co., N.Y.)
41. Stover, E.L., 1946. A Key to the Genera of Common Woods. *Trans. Illinois Acad. Sci.*, 39, 65-66.
42. United States Department of Agriculture., 1960. Index of Plant Diseases in the United States. Agriculture Handbook No. 165, Crops Research Division, Agricultural Research Service. Washington, D.C.,
43. Zalokar, R.S., 1962. A Preliminary Study of the Genus *Stillbella*. Unpublished Master's Thesis, W. I. U.,