

# THE PARASITIC FUNGI OF OHIO PLANTS<sup>1</sup>

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Several thousand species of fungi, about 170 species of bacteria, many viruses, nematodes, and other agents cause disease in plants. Recent estimates by the United States Department of Agriculture (1954) indicate that the annual loss in the United States attributed to these diseases is around three billion dollars. In Ohio the annual loss due to plant diseases, based on 1950 prices, is estimated to be 100,000,000 dollars.

There are many examples of diseases which are or have been the limiting factor in the successful production of a crop in one or more areas of Ohio. A few examples include potato late blight, tomato late blight, barley powdery mildew, corn leaf blight, sweet corn bacterial wilt, peach and plum brown rot, cherry leaf spot, grape black rot, fire blight of pear, apple scab, sugar beet leaf spot, rose black spot cucurbit bacterial wilt, alfalfa bacterial wilt, soybean root rot, *Helminthosporium* blight of oats, and clover anthracnose. Flax culture in Ohio was eliminated in the 1800's largely because of the seriousness of fusarium wilt and the cultivation of pears in the state is seldom profitable because of the fire blight disease. Virus diseases are the most important factors to be considered in raspberry culture in Ohio.

The plant pathologist has a need for more exact information regarding the distribution of the parasitic fungi. Such information would enable him to identify plant diseases more readily and to plan research projects and control programs. Plant science as a whole, is certain to profit from a more precise knowledge of the geographical distribution, ecology, and habitats of the fungi.

## HISTORICAL SUMMARY

The first list of the fungus flora of Ohio was published in 1849 as a part of a *Catalogue of Plants, Native and Naturalized, Collected in the Vicinity of Cincinnati, Ohio, During the Years 1834-1844*. This catalogue was prepared by Thomas G. Lea (1849) and included 1,050 plants of which 319 were fungi. Twenty to thirty of these would today be considered plant pathogens; however, at the time, fungi were not generally recognized as causing plant disease. In 1878, A. P. Morgan's *Flora of the Miami Valley* was published and included a list of fungi but no parasitic species (Morgan, 1878).

Beginning in the late 1880's several persons were active as collectors of parasitic fungi and in some instances, studied fungi as incitants of disease. In 1889 Frederica Detmers was appointed Assistant Botanist at the Ohio Agricultural Experiment Station in Columbus and during the next few years she reported on many diseases of fruit and vegetable crops, and prepared two lists of the rust fungi of Ohio (Detmers, 1892, 1893). In 1894, A. D. Selby became Botanist at the Ohio Agricultural Experiment Station, now at Wooster, and contributed greatly to our knowledge of plant pathology. Even before his appointment to the Station staff, Selby (1893) had prepared a list of Ohio Erysiphaceae. One of his more important publications, and one of the first of its kind in the United States was a handbook of plant diseases prepared in 1900 and revised in 1910 (Selby, 1900, 1910).

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W. A. Kellerman was elected Chairman of the newly organized Department of Botany and Forestry at The Ohio State University in 1891. From then until his death in 1908, he collected extensively, adding many specimens of parasitic fungi to the herbarium at the University. Kellerman and Werner (1893) prepared the Botany section of Volume 7 of the *Report of the Geological Survey of Ohio* which included a complete list of the known Ohio fungi with 1000 species listed of which about 250 are parasitic. From 1901 to 1905 Kellerman published and issued the *Ohio Fungi Exsiccati*. This was issued in ten fascicles and included descriptions of 200 species of fungi, most of which are plant parasites.

Edo Claassen collected plants in Cuyahoga and nearby counties of northern Ohio from 1895 to the early 1920's. In the 1890's Claassen (1896a, 1896b, 1897a, 1897b, 1899a, 1899b) published four lists of powdery mildew fungi and two lists of Uredinales of the area.

F. L. Stevens (1896a, 1896b, 1897, 1898), an instructor at North High School in Columbus from 1894 to 1898, collected in central Ohio and prepared four lists of parasitic fungi.

Other collectors of Ohio parasitic fungi during this early period include W. H. Aiken, Cincinnati, E. E. Bogue, Ashtabula County, Thomas Bonser, Wyandot County, Moses Craig, C. M. Weed, L. C. Riddle and E. M. Wilcox, Columbus, and F. D. Kelsey of Oberlin and Toledo. Many of their collections are in herbaria at The Ohio State University, the Ohio Agricultural Experiment Station, Oberlin College, and the University of Cincinnati.

O'Kane (1910) prepared a paper on the powdery mildew fungi of Ohio with a list of the species and their host's as known at that time. Brain (1912) published a list of fungi from the vicinity of Cedar Point which included about 100 plant pathogens.

Since 1910 there have been many publications pertaining to plant diseases in Ohio and many additions to the herbaria of plant parasitic fungi. Most of these reports and collections have been by plant pathologists associated with the Department of Botany and Plant Pathology at the Ohio Experiment Station or The Ohio State University. However, not since the report of Kellerman and Werner (1893) has there been a comprehensive list of the Ohio fungi parasitic on plants.

#### SOURCES OF DATA

A list of the known parasitic fungi of Ohio plants has been prepared from: (1) herbarium collections, (2) published records, and (3) collections and observations of the author.

The collections in the herbaria at The Ohio State University, the Ohio Agricultural Experiment Station, and Oberlin College were studied. The fungi in the herbarium of the University of Cincinnati have been studied and enumerated by Cooke (1941, 1943).

Since 1940, the author has collected and identified, or observed and identified parasitic fungi from all counties in Ohio.

#### THE GENERA OF PARASITIC FUNGI IN OHIO

In the list which follows the arrangement of the fungus genera is alphabetical under the order to which they are referred. The arrangement of the orders within the classes of fungi and the placement of the genera in the orders, with but few exceptions, follows Ainsworth and Bisby (1950). As some bacteria are important plant parasites they are included and the genera of bacteria are those recognized by Elliott (1951). The number of Ohio species in each genus is indicated.

## SCHIZOMYCETES

## Eubacteriales

- Agrobacterium* (2)
  - Bacterium* (1)
  - Corynebacterium* (5)
  - Erwinia* (6)
  - Pseudomonas* (24)
  - Xanthomonas* (10)
- Actinomycetales
- Streptomyces* (1)

## PHYCOMYCETES

## Chytridiales

- Physoderma* (1)
- Synchytrium* (2)

## Plasmodiophorales

- Plasmodiophora* (1)
- Spongospora* (1)

## Saprolegniales

- Aphanomyces* (2)

## Peronosporales

- Albugo (Cystopus)* (5)
- Bremia* (1)
- Peronospora* (18)
- Phytophthora* (7)
- Plasmopara* (5)
- Pseudoperonospora* (1)
- Pythiogeton* (1)
- Pythium* (5)
- Sclerospora* (1)

## Mucorales

- Choanephora* (1)
- Mucor* (1)
- Rhizopus* (1)
- Spinellus* (1)
- Sporodinia (Syzygites)* (1)

## ASCOMYCETES

## Taphrinales

- Taphrina* (8)

## Myriangiales

- Elsinoe* (2)

## Dothideales

- Cymadothea* (1)
- Dibotryon* (1)
- Endothella* (1)
- Phyllachora* (5)
- Scorias* (1)

## Hemisphaeriales

- Asterina* (1)

## Erysiphales

- Apiosporina* (1)
- Erysiphe* (5)
- Microsphaera* (5)
- Phyllactinia* (2)

- Podosphaera* (3)

- Sphaerotheca* (4)

- Uncinula* (8)

## Hypocreales

- Balansia* (2)

- Claviceps* (2)

- Cordyceps* (2)

- Epichloe* (1)

- Gibberella* (2)

- Hypocrea* (1)

- Hypocreopsis* (1)

- Hypomyces* (3)

- Nectria* (2)

- Pseudonectria* (1)

- Thyronectria* (1)

## Sphaeriales

- Botryosphaeria* (1)

- Ceratostomella* (1)

- Cochliobolus* (1)

- Cryptodiaporthe* (1)

- Cryptosporella* (2)

- Diaporthe* (4)

- Didymella* (1)

- Didymellina* (1)

- Endoconidiophora* (2)

- Endothia* (1)

- Glomerella* (2)

- Gnomonia* (5)

- Gnomoniella* (1)

- Guignardia* (3)

- Leptosphaeria* (2)

- Linospora* (1)

- Mycosphaerella* (18)

- Nummularia* (1)

- Ophiobolus* (1)

- Physalospora* (1)

- Pleospora* (1)

- Pyrenophora* (3)

- Rosellinia* (1)

- Sphaerulina* (1)

- Ustulina* (1)

- Valsa* (2)

- Venturia* (3)

- Xylaria* (1)

## Phacidiales

- Coccomyces* (3)

- Elytroderma* (1)

- Hypoderma* (2)

- Hypodermella* (1)

- Lophodermium* (1)

- Rhytisma* (5)

## Helotiales

- Atropellis* (1)

- Cenangium* (1)

- Dasyscypha* (1)

*Diplocarpon* (2)  
*Fabraea* (2)  
*Monilinia* (1)  
*Pezizella* (1)  
*Pseudopeziza* (3)  
*Pyrenopeziza* (1)  
*Roesleria* (1)  
*Sclerotinia* (4)  
*Seaverinia* (1)  
*Septotinia* (1)  
*Stammaria* (1)  
*Stromatinia* (1)  
*Tympanis* (1)

## BASIDIOMYCETES

## Ustilaginales

*Cintractia* (1)  
*Doassansia* (1)  
*Entyloma* (7)  
*Graphiola* (1)  
*Melanopsichium* (1)  
*Schizonella* (1)  
*Sorosporium* (3)  
*Sphacelotheca* (5)  
*Tilletia* (5)  
*Urocystis* (6)  
*Ustilago* (16)

## Uredinales

*Aecidium* (1)  
*Cerotelium* (1)  
*Chrysomyxa* (1)  
*Coleosporium* (9)  
*Cronartium* (4)  
*Frommea* (1)  
*Gymnoconia* (1)  
*Gymnosporangium* (6)  
*Hyalospora* (1)  
*Kuehneola* (1)  
*Kunkelia* (1)  
*Melanpsora* (4)  
*Phragmidium* (5)  
*Pileolaria* (1)  
*Puccinia* (72)  
*Pucciniastrum* (7)  
*Ravenelia* (2)  
*Tranzschelia* (3)  
*Uredinopsis* (1)  
*Uromyces* (27)

## Tremellales

*Eocronartium* (1)  
*Herpobasidium* (1)

## Agaricales

*Armillaria* (1)  
*Boletus* (1)  
*Collybia* (1)

*Cyphella* (1)  
*Exobasidium* (1)  
*Fomes* (7)  
*Ganoderma* (1)  
*Hericium* (1)  
*Pellicularia* (1)  
*Pholiota* (1)  
*Pleurotus* (1)  
*Polyporus* (11)  
*Steccherinum* (1)  
*Stereum* (3)  
*Thelephora* (1)

## FUNGI IMPERFECTI

## Sphaeropsidales

*Actinopelte* (1)  
*Amerosporium* (1)  
*Ascochyta* (13)  
*Botryodiplodia* (1)  
*Cicinnobolus* (1)  
*Coniothyrium* (6)  
*Cytospora* (3)  
*Darlucia* (1)  
*Dendrophoma* (1)  
*Diplodia* (4)  
*Dothichiza* (1)  
*Dothiorella* (2)  
*Dothiostroma* (1)  
*Fusicoccum* (1)  
*Gloeodes* (1)  
*Leptothyrium* (1)  
*Macrophoma* (2)  
*Macrophomina* (1)  
*Phleospora* (5)  
*Phoma* (9)  
*Phomopsis* (9)  
*Phyllosticta* (48)  
*Piggotia* (1)  
*Plenodomus* (1)  
*Pyrenochaeta* (1)  
*Septoria* (95)  
*Sphaeropsis* (5)  
*Sporonema* (2)  
*Stagonospora* (5)

## Melanconiales

*Actinonema* (1)  
*Colletotrichum* (13)  
*Coryneum* (2)  
*Cylindrosporium* (8)  
*Eniomsporium* (1)  
*Gloeosporium* (18)  
*Marssonina* (10)  
*Melanconium* (1)  
*Monochaetia* (1)  
*Myxosporium* (1)

<i>Pestalotia</i> (5)	<i>Myrothecium</i> (1)
<i>Septogloeum</i> (1)	<i>Nigrospora</i> (1)
<i>Septomyxa</i> (1)	<i>Oidium</i> (1)
<i>Sphaceloma</i> (4)	<i>Ovularia</i> (1)
Moniliales	<i>Penicillium</i> (2)
<i>Alternaria</i> (12)	<i>Piricularia</i> (1)
<i>Aspergillus</i> (1)	<i>Polythrincium</i> (1)
<i>Botrytis</i> (7)	<i>Pseudocercospora</i> (1)
<i>Cephalosporium</i> (2)	<i>Ramularia</i> (23)
<i>Cercospora</i> (82)	<i>Rhynchosporium</i> (1)
<i>Cercospora</i> (4)	<i>Scolecotrichum</i> (1)
<i>Chalara</i> (1)	<i>Sepedonium</i> (1)
<i>Cladosporium</i> (5)	<i>Septocylindrium</i> (1)
<i>Curvularia</i> (1)	<i>Spondylocladium</i> (1)
<i>Cylindrocladium</i> (1)	<i>Stemphylium</i> (3)
<i>Didymaria</i> (1)	<i>Stigmina</i> (1)
<i>Epicoccum</i> (1)	<i>Thielaviopsis</i> (1)
<i>Fusarium</i> (8)	<i>Trichoderma</i> (1)
<i>Fusicladium</i> (5)	<i>Trichothecium</i> (1)
<i>Graphium</i> (2)	<i>Tuberculina</i> (1)
<i>Helminthosporium</i> (13)	<i>Verticillium</i> (1)
<i>Heterosporium</i> (2)	<i>Volutella</i> (1)
<i>Kabatiella</i> (2)	Mycelia Sterilia
<i>Microstroma</i> (1)	<i>Papulospora</i> (1)
<i>Monilochaetes</i> (1)	<i>Rhizoctonia</i> (3)
<i>Myceliophihora</i> (1)	<i>Sclerotium</i> (2)

## DISCUSSION AND SUMMARY

The complete list of parasitic species and their host plants, too extensive to include here, will be published elsewhere. A summary of the study discloses 985 species and varieties of parasitic fungi and bacteria on Ohio plants with over 2100 combinations of host and parasite. Included among the parasites in Ohio are 49 bacterial species, 44 species of downy mildew fungi, 27 of powdery mildew fungi, 47 species of smut fungi, 150 of rust fungi, 48 species of *Phyllosticta*, 82 species of *Cercospora* and 95 species of *Septoria*. The fungus with the largest number of susceptibles is *Erysiphe cichoracearum* DC. ex Merat with 51. The host with the largest number of pathogens is *Pyrus malus* L. with 30. Forty three species of fungi are reported in Ohio for the first time and 72 pathogens are reported for the first time on a particular host.

The number of known species of fungi is reported from 34,000 to more than 100,000 and the basis for most of these estimates is the approximately 80,000 entries in the compilation by Saccardo (1882-1931). The estimates vary depending upon the author's concept of a species and according to their estimate of the number of synonyms in Saccardo and their estimate of the number of species described since the last volume of Saccardo. In most text-books on botany the number of known species of Spermatophyta is given from 160,000 to 225,000. Bisby (1933), and Martin (1951) believe that when the fungus flora is well known the number of fungus species will equal or exceed the number of species of seed plants. In many smaller geographical areas there are now known 2 to 3 times as many fungus species as seed plants. In Manitoba, Bisby, Buller and Dearness (1929) report about twice as many fungi as seed plants. Lind (1913) reports 3324 species of fungi from Denmark compared with 1400 Spermatophytes. Bisby and Ainsworth (1943) estimate 6000 valid species of fungi in Britain while 2362 Spermatophytes and Pteridophytes are known.

In Ohio the vascular flora is well known and approximately 2500 native and naturalized vascular plants have been enumerated. There is no comprehensive, recent list of the Ohio fungi, saprophytic and parasitic, but it is estimated that there are at least 2400 reported species and that this represents not more than 50 per cent of the fungus flora of the area.

Parasitic fungi may be present in an area for many years causing little loss. Then, when new varieties (genotypes) of crop plants are introduced or when the cultivation of the crop is intensified or when cropping sequences are altered, these parasitic fungi may become the limiting factors to successful cultivation of that crop. *Helminthosporium turcicum* Pass., a leaf parasite of corn, was reported in Ohio by Selby (1900) and from then until 1939 it was seldom mentioned in reports or discussions of corn pathology in Ohio. In 1939 *H. turcicum* was reported as a major pathogen of certain corn hybrids and the factor limiting their cultivation in parts of Ohio (Ellett, 1943). It is important that plant pathologists, geneticists, agronomists, and horticulturists working together in the development and introduction of new crops and crop varieties be cognizant of the pathogens, minor or major, of these crops.

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