The Genus Rosellinia in Indiana.

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In this paper it is the author's purpose to present the genus Rosellinia as found in Indiana. Limited means for collecting and the unfavorable weather conditions during the past year for the growth of this class of fungi render an exhaustive treatise on the genus Rosellinia impossible. Only those species that have been found in Indiana, together with their descriptions and an account of their habits and habitat have been included. A description of some of the more common parasitic species has also been appended.

There are now over one hundred seventy species described, the most of them being saprophytic. As in other genera of the Pyrenomycetes, Rosellinia has a vegetative phase which is found in the substratum or host. The white thread-like mycelium may readily be found in decaying logs and stumps. There are, however, some species that seem to flourish in wood that is quite firm. In most cases the actively parasitic stage is found on the roots and consists of a great abundance of white mycelium which does the greatest harm to the plant. This mycelium growing into the root system stops up the xylem cells, prevents the roots and rootlets from performing their functions, thus finally starving the plant to death.

The fruiting parts of Rosellinia do not develop until late in the season, the conidial stage being found in late summer or early autumn, with the perfect or ascigerous stage following and maturing in late fall or early winter. The perithecia with their abundant asci and filiform paraphyses are found in good condition for collecting from October to February. The spring rains and warm weather, together with the frost action during the winter, cause the perithecia to disintegrate rapidly when spring comes. Most of the specimens at hand were collected during the early winter months.

In Rosellinia the perithecia are more or less crowded or gregarious and superficial, but often having the base sunken in the matrix. Perithecia ovate to sub-globose, papilliate, sub-carbonaceous, black, bare

or bristly, with a distinct ostiolum. The asci are cylindrical, eight spored. Spores continuous, broadly ovate, elliptical, oblong or fusiform, brown or black, with or without hyaline appendages. Paraphyses filiform. Stroma tomentose, often wearing off with age and exposing the perithecia as round, brownish black heads with their papilla-like ostiola in the center.

In studying the species of Rosellinia we are confused at times when we find forms which closely resemble certain forms of the genus Hypoxylon. In such cases a clear distinction seems impossible, yet these two genera are clear cut in their separation by botanists, being separated on the ground of the presence of a stroma in Hypoxylon, and the absence of a distinct stroma in Rosellinia. To anyone that has made a study of either of these two genera, the superficiality of this basis of separation is quite evident. Students of the genus Hypoxylon know that the perithecia of certain forms become scattered, and especially with age, the stroma is wanting.

The genus Rosellinia is placed under the *Sphæriaceæ* by both Lindau and Ellis and Everhart. This separates it widely from Hypoxylon. Saccardo puts it under the brown spored one-celled forms of *Xylariaceæ* along with Hypoxylon. The author likes this position on account of the great similarity of spores, asci and perithecia, as well as the above mentioned similarity of forms where the absence of stromata is noticeable.

Variation within a given species often makes it almost impossible to formulate a key that will hold in all cases. In order to eliminate this difficulty the species are made to run in two ways. The species *R. subiculata* for example has in the earlier stage a decided waxy sulphur-yellow subiculum and the perithecia are scattered, but as it grows older the subiculum finally disappears so that one might readily confuse it with other species that never have a subiculum. The ascis and spore measurements are probably the most constant and reliable in forming a basis for a key. The second key, it is hoped, will prove helpful in determining any doubtful species that do not run satisfacorily in the key of external characteristics.

The accompanying figures from photographs will assist in deterimining the species. In order to get the greatest contrast possible, time exposures were made in a subdued light and a special contrast developer was used.

The description of species have been adapted for the most part from

the original descriptions as given by Ellis and Everhart in "North American Pyrenomycetes", and Saccardo's "Sylloge Fungorum." Practically all of the descriptions have been rewritten and additional data added from specimens at hand. All measurements are original. Where asci and spore measurements by Ellis and Everhart differ, their figures are also given.

KEY TO SPECIES.

(Based on external characteristics.)

I. Perithecia large (¾-1½ mm.), seated on a subiculum.
  A. Subiculum usually prominent.
    1. Brown or purplish brown, persistent.....1. *R. aquila*
    2. Sulphur-yellow, evanescent .....6. *R. subiculata*
  B. Subiculum scanty.
    1. Dark brown, perithecia crowded.....2. *R. medullaris*
    2. Black, perithecia confluent .....3. *R. mammiformis*
  C. Subiculum wanting, perithecia more or less scattered.
    1. Base glandular-roughened .....4. *R. glandiformis*
    2. Not glandular-roughened .....5. *R. mutans*

II. Perithecia small (⅓-½ mm).
  A. Perithecia gregarious, often crustaceous, not bristly.7 *R. pulveraceæ*
  B. Perithecia usually scattered, bristly, dark brown....8. *R. ligniaria*

(Based largely on microscopic characteristics.)

A. Perithecia large (¾-1½ mm).
  B. Spores more than 18 microns long.
    C. Asci more than 150 microns long.....1. *R. aquila*
    CC. Asci less than 150 microns.
      D. Asci 7-8 microns wide.....2 *R. medullaris*
      DD. Asci 8-10 microns wide.....3. *R. mammiformis*
  BB. Spores less than 18 microns long.
    C. Asci more than 95 microns long.....4. *R. glandiformis*
    CC. Asci less than 95 microns.
      D. Perithecia ½-⅔ mm. .....5. *R. mutans*
      DD. Perithecia ¾-1 mm .....6. *R. subiculata*

AA. Perithecia small (⅓-½ mm).
  B. Asci more than 70 microns long.....7. *R. pulveraceæ*
  BB. Asci less than 70 microns long.....8. *R. ligniaria*

1. *R. aquila* (Fr.) De Not.
   Sphæria aquila Fr.
   Sphæria byssiseda Meckl.
   Rosellinia aquila De Not.

Perithecia large, globose, 1-1.25 mm. in diameter, gregarious, crowded or sometimes confluent, with a distinct black, conic-papilliform ostiolum; dark brown at first with a thin tomentose coating, finally becoming bare. Subiculum rather thick and prominent, dark to purplish brown, nearly enveloping the perithecia at first but finally disappearing to a greater or less extent. Outer walls of the perithecia thick, brittle and carbonaceous. Inner wall coriaceous. Asci long, cylindrical (p sp.) 10-12.5 x 165-190 microns. Spores uniserrate, oblong, brown, 10-11 x 22.5-27.5 microns. (E & E) gives asci (p sp.) 8-10 x 100-130 microns. Sporidia 6-9 x 16-27 microns, with or without a short, obtuse, hyaline apiculus, 2-2.5 microns long at each end.

Common on decaying and fallen limbs, near Bloomington, Ind. Specimens at hand are on Fagus, Acer, Quercus and Juglans.

2. *R. medullaris* (Walls) Ces. & De Not.
   Sphæria medullaris Walls.
   Rosellinia medullaris Ces. & De Not.
   Rosellinia macouniana E. & E.

Perithecia more or less erumpent, large 1-1.5 mm. in diameter, ovate to sub-globose, covered at first with a pruinose-pubescent coat of a dull red or brick color, becoming black with age: loosely adnate, apex convex to conic-papilliform, surface dirty-roughened with a finely powdered sooty covering; very fragile. Wall double and intermediate in thickness between R. aquila and R. thelena. Subiculum slight.

Spores 7.5-12 x 20-25 microns. E. & E. give asci (p sp.) 7-8 x 100-120 microns. Sporidia 6-7 x 19-20 microns; ovoid, somewhat acute, brown, broader but not pointed as in R. mammiformis.

On Cercis canadensis and Juglans, Monroe County, Ind.

On examining a great number of perithecia the most of them were found to contain a white, granular mass such as described in R. medullaris by Saccardo, but close observation showed this material to be a fine powder of wood that had been brought into the perithecia from the bottom by a small larva that probably feeds upon the contents of the perithecia.

3. *R. mammiformis* (Pers.) Ces. & De Not.

Sphæria mammiformis Pers.

Hypoxylon mammæformæ Berk.

Hypoxylon globulare (Bull.) Fekl.

Rosellinia mammiformis Sacc.

Perithecia gregarious, crowded or confluent, globose, large, 1-1.5 mm. in diameter, fragile, black and bare but not shining. Ostiolum abrupt, palilliform.

Asci (p sp.) 8-10 x 100-115 microns (E. & E).

Spores 10-12 x 20-25 microns, oblong, elliptical, sometimes slightly curved. E. & E. give sporidia 7-9 x 19-25 microns, without any distinct apiculus. It can be easily dsitinguished from R. aquila by the blacker, thinner walled and more fragile perithecia and the lack of a decided subiculum.

On bark of Acer, near Bloomington, Ind.

4. *R. glandiformis* E. & E.

Perithecia scattered, the base sunk in the wood about one-fourth, ovate-globose, roughened with glands, with a reinforcement around the lower half similar to the cup of an acorn. This thickening is, however, sometimes reduced to a mere granular coat. Ostiolum papilliform, small, sometimes obsolete, the apex being evenly rounded.

Asci not present in specimens at hand. E. & E. give (p sp.) 8-10 x 100-114 microns; paraphyses abundant. Spores 7-10 x 13.75-17.5 microns. E. & E. give 7-8 x 14-15 microns. Common on Loriodendron Juglans and Fraxinus, Monroe County, Indiana.

5. *R. mutans* (C. & P.) Sacc.

Sphæria mutans C. & P.

Rosellinia mutans Sacc.

Perithecia more or less crowded or gregarious, rather small, about .5-.75mm. in diameter, at first clothed with a thin, tawny, evanescent tomentum, finally becoming smooth, black and shining; mostly globose with a papillate ostiolum. In the specimen at hand the region about the ostiola showed a distinct tendency to depress.

Asci subcylindrical (p sp.) 6.5-7.5 x 80-92.5 microns.

Spores uniserrate, elliptical, brown, 4.25-5.5 x 9-12.5.

Common on decaying Juglans, near Bloomington, Indiana.

6. *R. subiculata* (Schw.) Sacc.

Sphæria subiculata Schw.
Hypoxylon subiculosum Berk.
Rosellinia subiculata Sacc.

Perithecia thin, usually gregarious or crowded but often more or less scattered in the early stages; globose, brownish-black and shining, mostly superficial, about .75-1 mm. in diameter. Ostiolum small and papilliform. Perithecia seated on a sulphur-yellow, waxy-pruinose subiculum which disappears with age leaving the black, shining perithecia closely resembling R. mutans.

Asci cylindrical (p sp.) 6.25 x 90 microns.

Spores inequilateral, elliptical, brown, 5-6.25 x 10-12.5.

Ellis and Everhart give asci 6-7 x 80-90. Spores 5-5.5 x 10-12 microns.

Common on Quercus, Loriodendron, and other rotten deciduous wood near Bloomington, Ind., and Jolietville, Ind.

7. *R. pulveracea* (Ehr.) Fekl.

Sphæria pulveracea Ehr.
Sordaria Friesii Niessl.
Rosellinia pulveracea Fekl.
Rosellinia Friesii Niessl.
Sphæria millegraria Schw.
Sphæria transversalis Schw.

Perithecia very small and minutely roughened, about $\frac{1}{4}$ mm. in diameter, densely gregarious, often forming a continuous crustaceous layer or scattered and tending to follow the check marks in the wood. Ostiolum papilliform, soon perforated.

Asci cylindrical (p sp.) 9-10 x 70-75 microns.

Spores elliptical, brown, 7.5-8.75 x 11-13.25 microns. E. & E. give asci 10-12 x 60-70 microns. Sporidia 6-9 x 8-15 microns, mostly 7-8 x 10-12.

Common on water beech and sycamore near Joiletville, Ind. Normally found on decorticated wood while it is yet more or less firm.

8. *R. ligniaria* (Grev.) Nke.

Sphæria ligniaria Grev.
Rosellinia ligniaria Sacc.

Perithecia gregarious or crowded, sometimes forming a crust similar to R. pulveraceæ and in some cases tending to follow the check marks in

the wood. Perithecia ovate-conical, very black and superficial, about ¼ mm. in diameter, clothed with very minute black bristles about 20-30 microns in length.

Asci (p sp.) 8-10 x 65-70 microns.

Spores 7-8.75 x 10-14 microns.

Common on Fraxinus and Ostrya near Bloomington, Ind. Found on decorticated wood and underneath loosened bark.

Rosellinia as a Parasite.

Unlike Hypoxyllon and Nummularia, Rosellinia is of great economic importance on account of several of its species being active parasites. Of the one hundred seventy species now described, at least eight are known to be injurious and destructive to living plants. No doubt many other species will be found to be parasitic when a more thorough study is made of them. The following is a brief account of some of the most destructive species:

Rosellinia quercina Hart. Perithecia scattered, seated on a black mycelium, black globose, about 1 mm. in diameter. Asci sub-cylindrical, eight spored, 8-10 x 160-170 microns. Spores brown, acute at both ends, 6-7 x 28 microns.

This species is called the oak root fungus, and attacks the roots of seedling oaks that are from one to three years old. The mycelium spreads rapidly through the ground from one plant to another and is especially destructive during warm, damp weather. This mycelial form was formerly referred to a special genus, Rhizoctonia. The effects of the fungus are first shown by the wilting and drying of the leaves near the top, the lower ones following in order until the whole plant is killed. If a seedling so affected is pulled up and the roots examined, a fine, thread-like mass of white mycelium will be found completely enveloping the roots. The tap root will have dark ovoid bodies about the size of a pin head where the lateral roots join. The tap root is often quite rotten where the mycelium has enveloped it, and especially in the neighborhood of the black tubers. Numerous black sclerotia are found on the surface of the dead roots. The strands of mycelium readily penetrate the young rootlets not yet protected by a layer of periderm and may kill the plant in from ten to fifteen days. Slender hyaline conidiospores are usually found near the base of the stem and on the adjoining soil. Later the perithecia are formed on the dense mass of mycelium covering the superficial roots.

Rosellinia aquila (Fr.) De Not. This species attacks many kinds of trees but is probably best known for its activity on mulberry roots. As a rule the trees are killed by the dense mycelium enveloping the roots. The mycelium penetrates every part of the root and is especially abundant in the medullary rays. When the host is quite dead the dark brown perithecia are found crowded together on the brownish velvety patches that previously bore the conidia. The conidial form of this species is known as Trichosporium fuscum. This is one of our most common species, and a description is found elsewhere in this paper.

Rosellinia necatrix (Hart.) Berl. This fungus produces a disease known as the "white root rot." This species is, however, rather rare in this country. One of the peculiar characteristics of the disease is its power of attacking practically every plant with which it comes in contact. It is especially disastrous in vineyards, orchards, etc. Some of its more common victims are vines, fruit trees, oaks, maples, beeches, pines, beans, potatoes and beets.

The mycelium of this fungus travels underground and attacks the rootlets, killing them and gradually working its way up to the larger roots and from them to the body of the plant proper. Here in some instances it breaks through the cortex as a white fluffy mass of mycelium. Sclerotia are formed on the exposed parts of the infected roots, which give rise to dark, bristle-like conidiophores which bear numerous conidia at their tips. Globose swellings on the exposed portions of the mycelium are sometimes formed, which, according to Viala, are capable of emitting mycelium which forms a new plant. The ascigerous stage has been discovered by Viala, appearing only on trees that are well decayed.

Rosellinia radiciperda Mass. This is the cause of the disease known as the "New Zealand write root rot" and is very closely allied to the fungus causing the "white root rot" of Europe, *R. necatrix*. It attacks the roots of the apple, peach, pear, etc., and also such plants as docks, ferns, sorrel, cabbage and potatoes. Sometimes the trees are killed here and there, but often whole areas are swept away.

The white filamentous mycelium attacks the roots and the bark just under the ground. This eventually gives rise to sclerotia which later produce the conidial stage. Next the mycelium becomes dark colored and gives origin to the black globose pycnidia containing stylophores. The ascigerous stage is found on dead tree trunks and stumps that have been dead for considerable length of time.

Rosellinia ligniaria (Nitschke) has been found to attack living ash trees by Mr. W. Carruthers.

Rosellinia massinkii (Sacc.) is reported by Halstead on hyacinth bulbs.

Rosellinia bothrina (B. & Br.) Sacc. is the cause of the tea root rot.

Rosellinia echinata (Mass.) is reported on almost all kinds of trees and shrubs.

The works most freely drawn upon regarding parasitic species are the following:

Hartig—Unters. Forsbot. Inst. Münschen.

Hartig—Diseases of trees.

Massee—Kew Bulletin (1816).

Massee—Diseases of Cultivated Plants and Trees.

Viala—Mon. du Pourridié des Vignes et des Arbres Fruitiers.

Prillieux—Malad. des Plantes.

Wright—Journal Mycol. 5, p. 199.

All species figured and described in this paper have been verified by Dr. Charles H. Peck, or compared with specimens in the New York State Museum by H. D. House, acting State Botanist of New York. I take this opportunity to express my thanks for their assistance.

For valuable material and aid in formulating this paper, I am greatly indebted to Prof. J. M. Van Hook of Indiana University.

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EXPLANATION.

A Bausch and Lomb Microtessar 72 mm. lens was used in making all photographs. All figures are twice natural size.

Plate I.

Figure 1. R. aquila.

Figure 2. R. medullaris.

Figure 3. R. mammiformis.

1

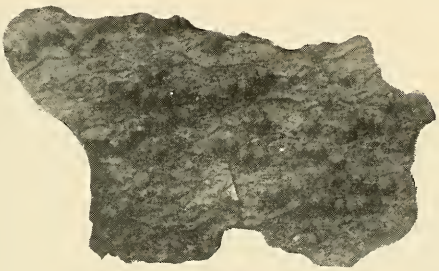

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PLATE II.

Figure 4. R. glandiformis.

Figure 5. R. mutans.

Figure 6a. R. subiculata, old stage showing crowded condition of the perithecia and the absence of the subiculum.

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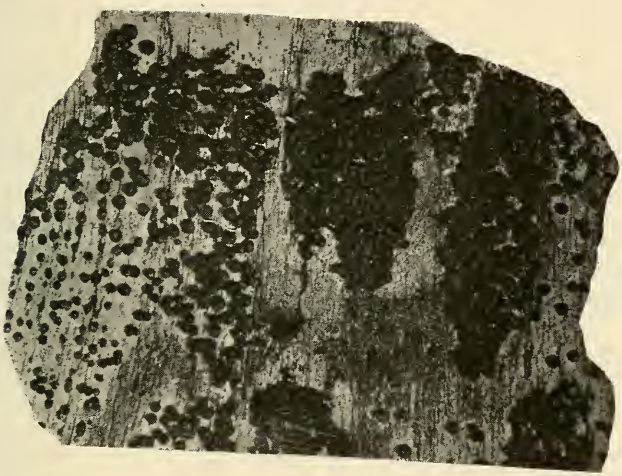

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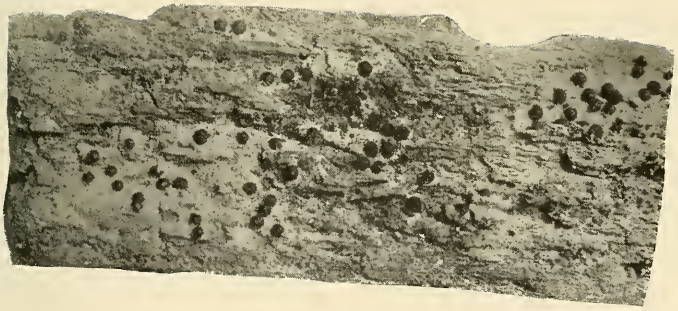
6a

PLATE III.

Figure 6b. R. subiculata, young stage showing scattered perithecia seated in a sulphur yellow subiculum.

Figure 7. R. pulveracea.

Figure 8. R. ligniaria, showing crustaceous form resembling R. pulveracea.



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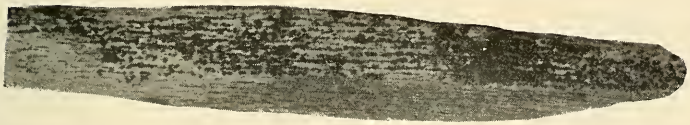

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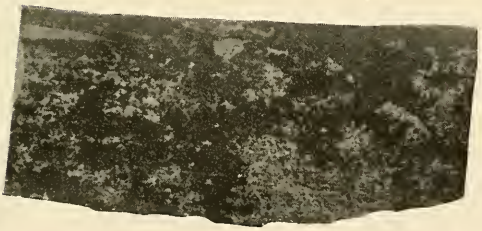

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