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SOME OBSERVATIONS ON SYCAMORE BLIGHT AND ACCOMPANYING FUNGI.

J. P. ANDERSON.

Last spring (1913) the Sycamore blight (*Gnomonia veneta* (Sacc. & Speg.) Kleb.) was very prevalent and destructive in the vicinity of Ames. All the large trees along Squaw creek looked as though the young foliage and growth had been killed by frost except a few tufts in the extreme tops of the trees. Young trees several years planted suffered somewhat, but none to the extent that the large trees did. About one-half of these young trees showed some traces of the disease. During August the effects of its ravages were noted in eastern Nebraska and at Lamoni, Decatur county, Iowa. Doctor Pammel also reported it as destructive in Madison county, and in Decatur county at Leon.

The extreme destructiveness of the disease aroused considerable interest in it, and at the suggestion of Dr. L. H. Pammel, head of the Department of Botany at the Iowa State College at Ames, the writer undertook an investigation and he here wishes to acknowledge the help and suggestions received from Doctor Pammel. The plan was to make this investigation a thorough one but owing to a change of plans this could not be done. A few observations are hereby submitted hoping that they may be of interest to mycologists. It is to be hoped that at least part of the work originally planned may be carried out later. In making plate cultures for the purpose of isolating the fungus many other fungi occurred, including species of *Penicillium*, *Mucor*, *Aspergillus*, *Monilia*, *Macrosporium*, *Alternaria*, *Coniothyrium*, *Cephalothecium*, and several unidentified forms. *Cephalothecium roseum* proved very troublesome on all material kept in the damp chambers. *Coniothyrium mixtum* Fuckl., *Cytospora platani* Fuckl. and *Massaria platani* Ces. are found very commonly on twigs that have been killed by the blight. These will each receive brief consideration later in this paper.

Gnomonia veneta (Sacc. & Speg.) Kleb.

Plate VII, Figs. 1-4.

According to Edgerton¹ there are four conidial forms and an ascigerous stage connected with this fungus. The conidial forms are as follows:

1. The conidia may be borne in acervuli under the cuticle on short conidiophores. Long known as *Gloeosporium nervisequum* (Fuckel) Sacc.

2. The conidia may be borne in acervuli under the epidermis on long conidiophores. This has been known as *Gloeosporium platani* (Mont.) Oud.

3. The conidia may be borne in pustules on the twigs, being then known as *Myxosporium valsoideum* (Sacc.) All. and *Discula platani* (Peck) Sacc.

4. Pycnospores may be borne in cleistocarpous pycnidia on old leaves on the ground. This stage has been named *Sporonema platani* Bäumler, and *Fusicoccum veronense* C. Massalongo.

The acervuli on the leaves are found in the summer and fall. The fungus attacks the leaf veins and from these spreads out into the surrounding tissue. The acervuli are 100 to 300 μ in diameter. The spores are generally described as 10 to 14x4 to 6 μ , but the spores examined from leaves gathered in the fall and from cultures on agar were quite constant in size and about 10x4 $\frac{1}{2}$ μ . The spores from material gathered in the spring showed more variation, but the average size was about the same.

The fungus attacks the petioles as well as the leaves and twigs. It seems probable that the mycelium travels down the petiole and from there enters the young stem. When the leaves fall the twigs of the current season's growth may appear perfectly healthy. But later, and especially toward spring, the presence of the disease is manifest. These diseased twigs may remain alive and send out young leaves, but when the leaves are about one-third grown they wither and die quite suddenly, owing to the cutting off of the source of supplies for growth. This is what gives the trees the appearance of blight and gives rise to the popular name. The twig figured in Plate VII, Fig. 4, is very typical, although many twigs show a much more extensive diseased area. In many cases a large portion of the twig is thus diseased. This *Myxosporium* or *Discula* stage may be found at any season of the year and is the one causing most destruction, as the annual loss of the greater part of the young foliage every spring cannot help but seriously weaken the tree.

The pycnidial or sporonema stage develops during late winter or very early spring on leaves that have been kept moist over winter. The stroma bearing the conidia continues to grow until it has surrounded the developing spores. As observations were discontinued about the first of the year, this stage was not observed. The ascigerous stage was not observed for the same reason.

The ascigerous stage develops on the fallen leaves that have wintered in the open. The perithecium is described as being subglobose, or slightly flattened, 150 to 200 μ in diameter, with the upper side elongated into a

beak. Asci long clavate 48 to 60x12 to 15 μ , generally bent at right angles near the base. Ascus 8-spored; spores hyaline, 14 to 19x4 to 5 μ , straight or slightly arcuate, unevenly 2-celled, the upper being several times as long as the lower one.

For further literature on this interesting species, the reader is referred to the excellent papers by Edgerton¹, Klebahn², and Von Tavel³.

Coniothyrium mixtum Fuckel.

Plate VII, Figs. 5 & 6.

What appears to be this species was found to be quite common on twigs of the sycamore killed by the blight. It is also found on twigs killed by other causes. The pycnidia vary from 150 to 250 μ in diameter, are nearly globose to much depressed, with a rather thick hymenium and short conidiophores. Spores are produced in abundance, fulgineous, appearing brown when in masses; about 7x4x4 μ .

Cytospora platani Fuckl.

Plate VII, Figs. 7-12.

I have placed the forms examined promiscuously in this species, although the spores are about 50 per cent longer than the measurements given by Saccardo⁴. While this fungus is common on twigs of sycamore killed by blight, it is relatively more abundant on young trees that have died from the effects of transplanting. The stroma, as ordinarily found, are from 1 to 3 mm. in diameter. At first they are entirely covered by the epidermis, but later break through. When placed in a damp chamber the spores are forced out in light yellow, wormlike masses. At first the pycnidia are subglobular or slightly angular in outline, with the hymenium bearing conidiophores on all sides. Later the pycnidium enlarges, becomes very irregular and with a conical beak. The spores are decidedly allantoid, 10 to 12x3 to 4 μ , and produced in very great abundance.

Massaria platani Ces.

Plate VIII.

This fungus is common near the base of sycamore twigs killed by the blight. It is not universally present and it is not probable that the two have any organic connection. Around Ames I have found the *Massaria* on one-third to one-half of the blight-killed branches. It seems never to develop far from the live wood, which indicates that it requires con-

¹Edgerton, C. W. The physiology and development of some anthracoses. *Bot. Gazette* 45: 367-408, 1908.

²Klebahn, H. Untersuchungen über einige Fungi imperfecti und die zugehörigen Ascomycetenformen. *Jahrb. Wiss. Bot.* 41: 515-558, 1905.

³Tavel, Franz von. Contributions to the history of the development of the Pyrenomycetes. *Jour. Myc.* 5: 53-58, 113-123, 181-184. 1889.

⁴Saccardo, P. A. *Syllage Fungorum* 3: 267.

siderable moisture. It may be seen as black dots underneath the epidermis of the twig. These dots are one-half to one millimeter in diameter. Sometimes they are very thickly placed, and at other times quite scattered. When closely placed they may be connected by fungus hyphæ so as to almost appear to be in a stroma. The larger ones are perithecia, while the smaller ones are pycnidia.

The specimens examined conform exactly with the description given by Saccardo⁵, but differ considerably from the description given by Ellis and Everhart.⁶ The perithecia are depressed globose, three-fourths of a millimeter or more in diameter. Asci 8-spored, 240x42 to 60 μ . Spores 55 to 60 x about 20 μ , 5-septate, inequilaterally didymous, the upper and larger portion being 3-septate, the lower portion uniseptate. The spores are brown and surrounded by a hyaline gelatinous envelope. Paraphyses abundant, filiform.

The pycnidial stage has been known as *Hendersonia desmazierii* Mont. The pycnidia are smaller than the perithecia, being scarcely one-half millimeter in diameter. They are also much flatter, the diameter being 3 to 4 times the height. The conidia are dark colored, 3-septate, 40 to 45x14 to 16 μ .

Under favorable conditions, such as exist in a moist chamber, both conidia and ascospores are exuded in black masses. I have found both forms in the same mass, which indicates that the pycnidium may, under favorable conditions, be transformed into a perithecium by enlargement, thickening of walls, and the arising of paraphyses and asci in the place of conidiophores. While evidence on this point is not conclusive, it is further supported by the fact that a twig, on being examined, showed only pycnidia, while after being in a damp chamber a few weeks most of the bodies proved to be perithecia. These perithecia seemed to occupy the positions previously occupied by the pycnidia.

Ellis and Everhart⁶ give all the measurements too small to apply to any of the specimens examined. They also speak of the ascospores as being 3 to 6 (mostly 3 to 5)-septate. All of the fully mature ascospores examined were uniformly 5-septate, while all the mature conidia were 3-septate. Both are olive-brown in color.

The ascospores and conidia germinate by sending out a germ tube from one or more of the cells, most often from one end cell. The mycelium is at first light brown, later becoming dark brown and much branched. Attempts to isolate the fungus were unsuccessful for the reason that the mycelium is slow growing and the plates were overrun by rapid growing fungi. One unidentified form of very rapid grow-

⁵Saccardo, P. A. *Syllage Fungorum* 2: 6.

⁶Ellis, J. B., and Everhart, B. M. *North American Pyrenomycetes*, 403.

ing fungus made more growth in one hour while under observation than *Massaria* did in two days.

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DESCRIPTION OF PLATES.

Plate VII.

Gnomonia veneta (Sacc. & Speg.) Kleb.
(*Gloeosporium nervisequm* (Fckl.) Sacc.)

- Fig. 1. Portion of the under surface of a leaf of sycamore (*Platanus occidentalis*) showing pustules of the fungus. Leaf gathered October, 1913. Slightly enlarged.
- Fig. 2. Section through a pustule. x 150.
- Fig. 3. Spores. x 550.
- Fig. 4. Myxosporium stage on twig. A leaf scar is shown where young growth had started but had been killed by the fungus. x $1\frac{1}{4}$.

Coniothyrium mixtum Fuckl.

- Fig. 5. A pycnidium. x 150.
- Fig. 6. Spores. x 550.

Cytospora platani Fuckl.

- Fig. 7. Portion of a twig showing stromata and the wormlike spore masses being pushed out of some of them. x $1\frac{1}{2}$.
- Fig. 8. Stroma with wormlike spore mass. Somewhat enlarged.
- Fig. 9. A stroma more enlarged.
- Fig. 10. Section of a stroma with three pycnidia, only a portion of one pycnidium being shown. x 150.
- Fig. 11. A large, irregular pycnidium. A cone-shaped beak is arising from the center. x 150.
- Fig. 12. Spores. x 550.

Plate VIII.

Massaria platani Ces.

- Fig. 1. Several perithecia growing close together and connected by fungus threads and almost appearing as if in a stroma. x 12. The small body at the right is a young pycnidium.
- Fig. 2. A perithecium. x 65.

- Fig. 3. A young ascus. x 150.
- Fig. 4. Nearly mature ascus. x 150.
- Fig. 5. A fully mature ascus. x 150.
- Fig. 6. A young ascospore. x 550.
- Fig. 7. Nearly mature ascospore. x 550.
- Fig. 8. Fully mature ascospore. x 550.
- Fig. 9. A pycnidium (*Hendersonia desmazierii* Mont.). x 150.
- Fig. 10. Two mature conidia. x 550.
- Fig. 11. Two conidia germinating. x 275.

All drawings are original.

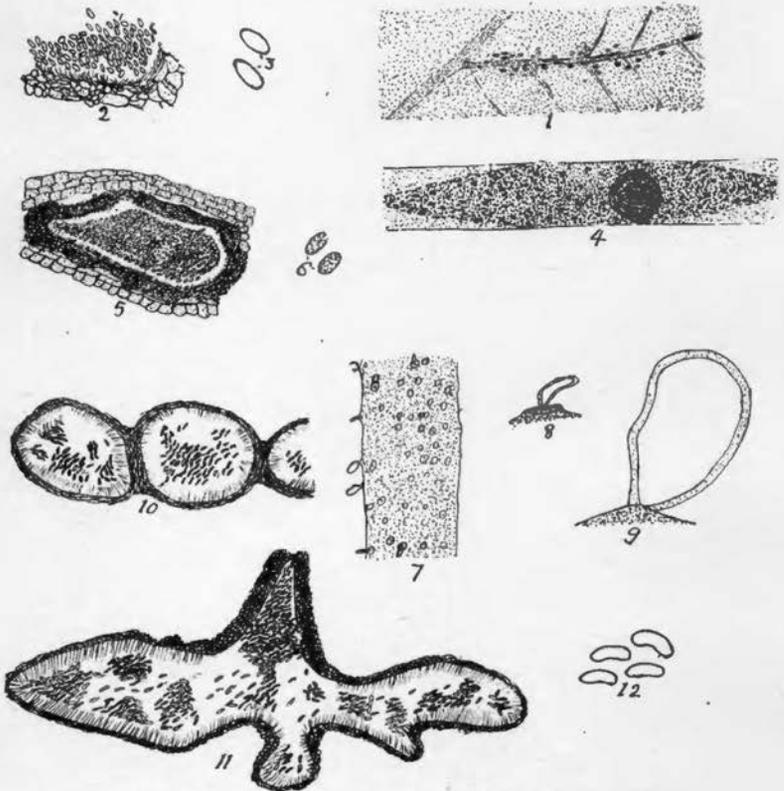


PLATE VII. Drawings of Sycamore blight and other fungi.

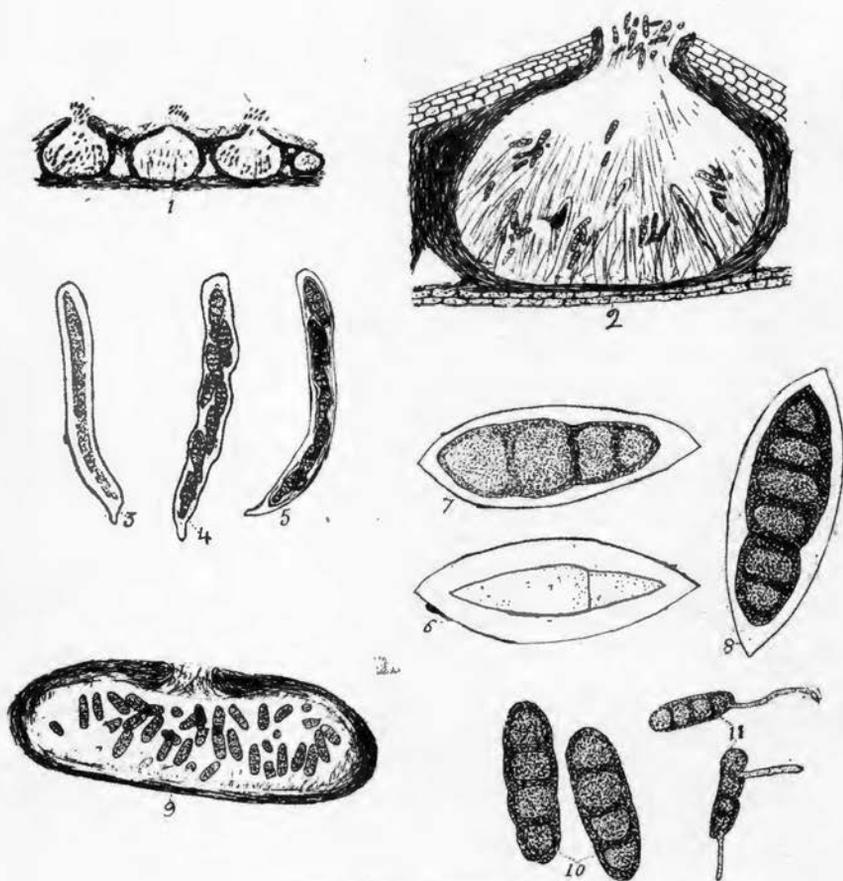


PLATE VIII. *Massaria platani*.