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OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

APPLE TREE ANTHRACNOSE

A New Fungous Disease.

A. B. Cordley.

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SOME PRELIMINARY NOTES

ON

APPLE TREE ANTHRACNOSE.

These few notes are issued to call the attention of growers to a serious disease of apple trees; to indicate the nature of the disease and how it is propagated; and to suggest methods for its control.

The disease is new only in the sense that its cause has never before been described. For several years past the apple orchards of the Pacific Northwest, including western Oregon, Washington and British Columbia have suffered more or less seriously from the attacks of this disease which has been known locally as "canker," "dead spot" or "black spot." In fact the ravages of the disease have been so serious the past season that persons prominent in horticultural affairs have expressed the conviction that the apple growing industry of the above mentioned regions is threatened with destruction. While not in any sense agreeing with this pessimistic view, we realize that the disease is a serious one and several months ago undertook the problem of discovering its cause, and, if possible, a satisfactory remedy for it. As a result of our work up to the present time, the first problem has been solved and we believe we can offer a reasonably satisfactory solution of the second.

AN UNDESCRIBED DISEASE.

Although of considerable importance, the disease seems to have been almost entirely overlooked and nothing of importance concerning its nature has been published. Some months ago Mr. Paddock of the New York Experiment Station at Geneva, discovered that a fungus which causes the well known "black rot" of apples and quinces, is also the cause of a disease of apple bark which he named "canker." At the time we were in hopes that Mr. Paddock's discoveries would explain the cause of our somewhat similar western disease but only a cursory examination was needed to show that

this is not the case; and recently I have had, with Mr. Paddock, the privilege of comparing the two diseases with the result that we were both convinced that they are entirely distinct. Further study also convinced me that the disease is a new one and that it is caused by an undescribed species of fungus for which I have proposed the name *Glœsporium malicorticis*.

COMMON NAME OF THE DISEASE.

As stated above the disease has been known locally as "canker," "dead spot" and "black spot." Ordinarily it is best to accept a common name when once established in any locality, but in this particular instance we believe that confusion in the designation of the disease in future can best be prevented by adopting for it an entirely new name. The term "canker" is most commonly used in European works on plant diseases to designate injuries to the bark which are caused by various species of *Nectria*. In the eastern United States it has been applied, by Mr. Paddock, to a disease of apple bark which is caused by a *Sphæropsis*. To apply the same name to a disease which is caused by a fungus entirely different from either of these would only lead to confusion. "Dead spot" and "black spot," the two other names which are sometimes used, are applied not only to the disease under consideration but also to diseased areas which are due to various other agencies, such as sunscald, the pear blight bacillus, etc. In view of these facts and in order to avoid confusion, we shall propose for the disease the somewhat unwieldy name of APPLE TREE ANTHRACNOSE. Although somewhat cumbersome, the name seems appropriate from the fact that the fungus which causes it, *Glœsporium malicorticis*, is closely related to numerous other fungi of economic importance which have quite generally been designated as anthracnoses.

NATURE OF THE INJURY.

Apple tree anthracnose attacks principally the smaller branches —those under two or three inches in diameter—although it also occurs upon the larger ones and on the trunks of young trees. It appears first in fall, soon after the autumn rains begin, as small, irregular, sometimes slightly depressed, brown areas of the bark. During the fall and winter months it spreads but slowly; but with the advent of warmer weather in spring, growth takes place rapidly until,

under favorable conditions, the disease may invade an area several inches in diameter. Such areas under observation at Corvallis the past season ceased to enlarge late in May, and early in June the first evidence of spore formation was noted. At that time the diseased areas were dark brown in color, markedly depressed, and in most instances limited by ragged, irregular fissures which separated the dead from the surrounding living tissues. These dead spots vary in size from those not more than one-half inch in diameter to extensive areas two or three inches wide by six or eight inches long. Occasionally a single area completely girdles a branch, thus killing at once its distal portion; but more commonly only a dead spot occurs from which in the course of a few months the bark sloughs off, leaving an ugly wound which requires several years to heal. When these wounds are at all numerous the branches are exceedingly rough and disfigured and are moreover greatly weakened.

CAUSE OF THE DISEASE.

Apple tree anthracnose is caused by a fungus which belongs to the genus Gloesporium. It is therefore one of the imperfect fungi—so-called simply because the perfect form, if it has one, is not known. If a recently anthracnosed spot be examined carefully, it will be seen to be covered by minute projections. These are known as the acervuli and they contain the spores of the fungus. At Corvallis the past season they began to appear early in June. At first they were noted as small conical elevations of the epidermis which were scattered irregularly over the diseased area. By the end of June these elevations had increased considerably in size and in a few instances the overlying epidermis had been ruptured so as to expose to view the cream colored mass of spores, which, however, soon became dark colored. During July, August and September these acervuli became more and more abundant and by the beginning of October a very large proportion of them had burst open for the purpose of discharging their spores. Spores which were collected late in June were immature and could not be induced to germinate. Others which were gathered in July were also mostly immature, but in October I obtained an abundant supply of mature spores which germinated very readily. The mass of spores in each acervulus can be easily seen with the unaided eye but the individual spores are so small that they can only be seen by the aid of

a good microscope. They average about 6 x 24 microns and are single celled, hyaline or with a greenish tinge, elliptical, curved or geniculate and coarsely granular. Sections through a mature acervulus show, under the microscope, a sub-epidermal stroma from which arise comparatively long, closely compacted basidia, on the ends of which the spores are born. It is the growth of this underlying mass that finally ruptures the epidermis over it and thus sets free the spores.

HOW THE FUNGUS WORKS.

As stated above, the spores mature, and the acervuli burst open to set them free in late summer and early fall. Thus exposed, the spores are doubtless distributed by the rains and winds and possibly to some extent by birds, insects and other agencies. A vast majority of the spores thus distributed undoubtely fall in uncongenial places and fail to develop; but occasionally one lodges in a suitable place on the bark of some limb. We found in our work that such spores germinated readily at a temperature of 22° c (72° F), but that at a temperature of 29° c (84° F) germination was indefinitely delayed. It therefore seems certain that the spores do not germinate during the summer when the delicate germ tube would be killed by the extreme heat and by lack of moisture; but as we have seen that mature spores are present in immense quantities early in October, and probably considerably earlier, it is fair to assume that they start to germinate soon after the cool fall rains begin. Whether the mycelium of the germinating spore penetrates the cuticle of the apple bark or whether it gains access to the inner tissues through some slight crevice has not been determined as yet. However, after gaining access to the living tissues the mycelium ramifies through them absorbing the nourishment upon which it grows, and killing the surrounding cells. During the winter, as previously stated, the growth of the fungus and the consequent spread of the disease is slow, but in spring the mycelium takes on a renewed activity which is shown by the rapid spread of the disease. In May or early in June, the fungus reaches the fruiting stage and from that time all its energies are devoted to the production of spores and the diseased areas cease to spread. Whether the mycelium, having accomplished the object of its existance, the accumulation of nourishment for the production of spores, then dies,

or whether it merely enters a resting stage to be again stimulated to renewed activity by the fall rains, has as yet not been determined, although it has an important bearing upon the means to be employed in controlling the disease as will be shown later.

THE FUNGUS THE CAUSE OF THE DISEASE.

We have stated above that the disease is caused by the fungus *Glœsporium malicorticis*. It may be of interest to the orchardist to know upon what evidence we base the assertion. It is not necessary to give at this time all details of the work which have led us to the conclusion. In brief, however, spores were induced to grow in artificial cultures. As they germinated they were examined under the microscope, their positions carefully marked, and when they had developed to such an extent that they could be seen by the unaided eye, they were separated from all other growths and transferred to tube cultures. This process was repeated many times and in different ways to eliminate all sources of error. When convinced that no other living organism was present in the tube cultures a number of sections of apple limb were inoculated with this "pure culture" of the fungus. In about a week after these inoculations were made, slightly discolored areas were observed about several of the points of infection, and in three weeks these areas had developed all the characteristics of the disease as seen in nature; being brown, distinctly depressed and separated from the surrounding living portions by the irregular ragged fissures. Having thus succeeded in producing the disease by inoculating with the fungus we are justified in asserting that the fungus is the cause of the disease.

REMEDIES.

Before any experiments in controlling the disease could be intelligently undertaken, it was necessary to know something of its nature. Having shown that it is caused by a certain fungus, the question of most interest is, can it be controlled? And, if so, how? My absence from the state, while studying the fungus itself, necessarily prevented me from conducting any experiments in controlling it, but from what I now know of the disease I believe that I may safely assert that it can be controlled. We have seen that the spores are developed and probably distributed during the late summer and fall months and that they undoubtedly germinate after

the fall rains begin. It is also known that bordeaux mixture and other copper compounds prevent the germination of the spores of most fungi. We therefore infer that if the trees be thoroughly sprayed with bordeaux mixture or with the ammoniacal solution of copper carbonate, once soon after the fall rains begin and again as soon after the leaves fall as possible, the germination of the spores will be largely prevented and the spread of the disease be thereby checked. It is not expected that such a process will exterminate the disease, but it is believed that it will so reduce its ravages that it can no longer be considered a menace to the apple growing industry. For the latter of the two applications mentioned above bordeaux mixture, winter strength, should be used. For the former bordeaux, summer strength, may also be used, but if fruit is on the trees it would be better to use the ammoniacal solution of copper carbonate. Whichever spray is used should be thoroughly applied and applied as soon as possible after the fall rains begin. The fungus cannot be destroyed by sprays after it has once entered the tissues of its host.

In addition to the sprayings recommended, we should advise owners of young orchards or orchards but little diseased, to carefully cut out and paint over with strong bordeaux all anthracnosed spots that may be observed. As stated in a preceding paragraph, it is possible that the mycelium of the fungus in the dead area of bark, after resting through the summer, may be stimulated to renewed activity by the fall rains and thus itself be an additional means of propagating the disease. Should this be the case, which we are at present inclined to doubt, spraying will not be entirely efficient in preventing the spread of the disease. For the present at least, or until the above supposition can be proved or disproved, it will be advisable to supplement the sprayings by using the knife wherever practicable. Old, badly diseased orchards can best be renovated by pruning severely and spraying thoroughly.

A. B. CORDLEY.

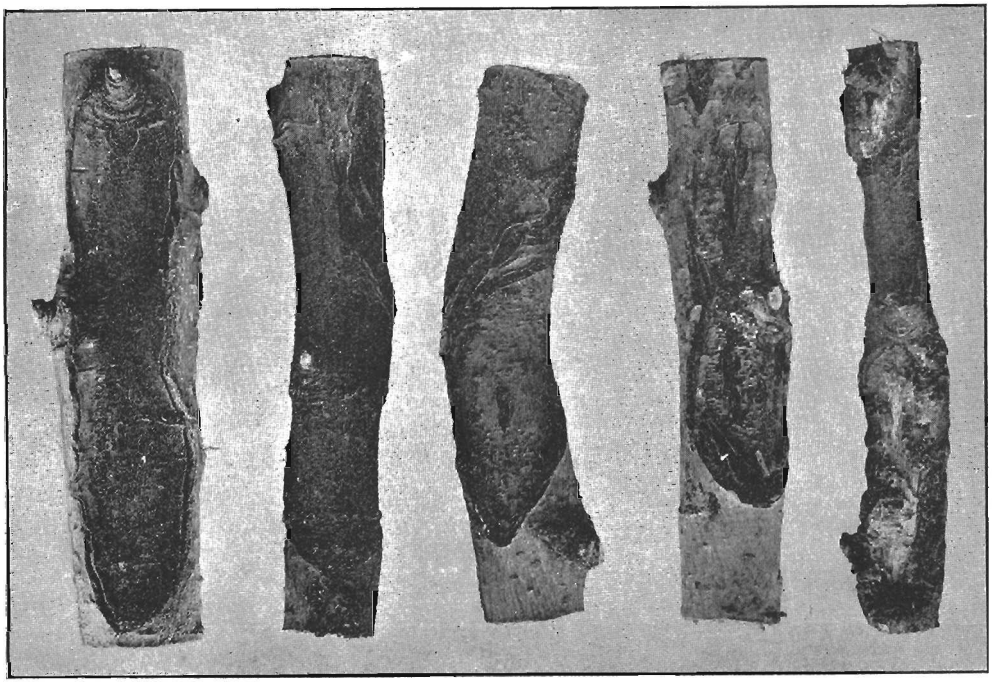


PLATE I.

Explanation of Plates.

PLATE I.—Reproduction from photograph of characteristic cases of Apple Tree Anthracnose.

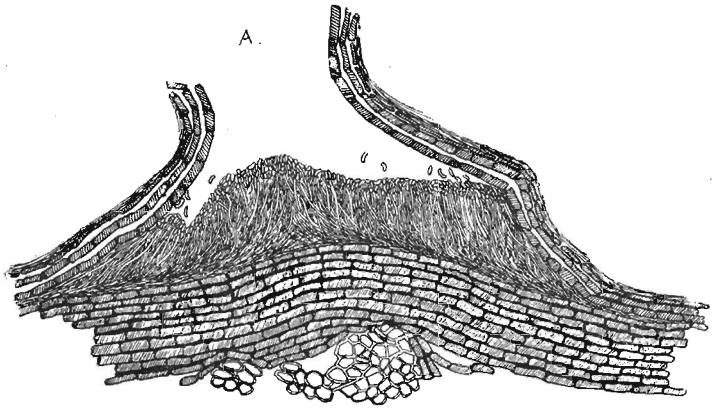
PLATE II (A). Vertical section through an acervulus (semi-diagrammic.)

(E). Camera lucida sketch of germinating conidium, showing position and germination of secondary conidia.

PLATE III (B). Group of conidia highly magnified.

(C). Group of germinating conidia showing germ tubes.

(D). Later stage of growth, showing development of secondary conidia.



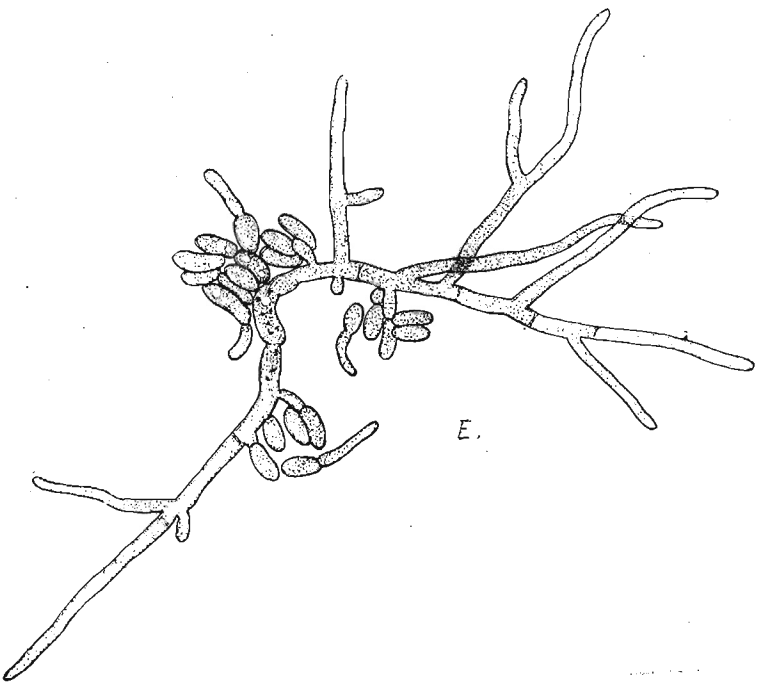
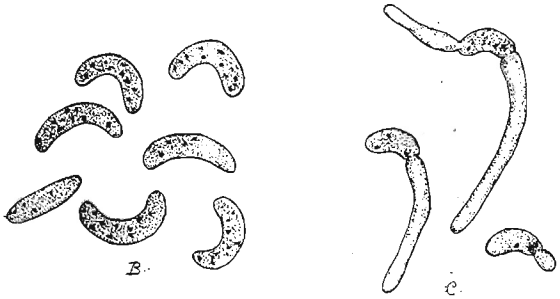


PLATE II.



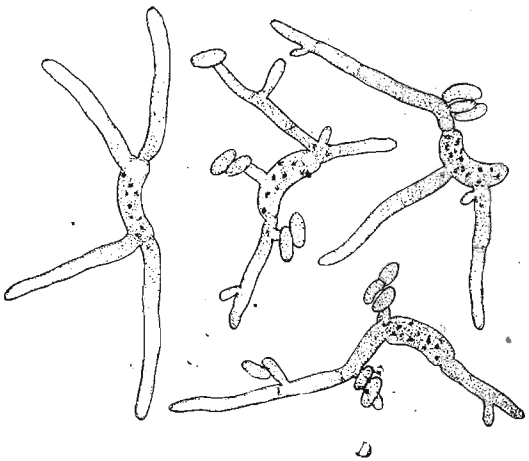


PLATE III.

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No. 57, 1899—Brown Rot ..... Cordley
No. 58, 1899—Rose Culture in Oregon ..... Coote
No. 59, 1899—Sugar Beet Experiments of 1898 ..... Shaw
No. 60, 1900—Apple Tree Anthracnose ..... Cordley

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