INTRODUCTION

Probably no plant disease or insect pest has ever aroused so much interest in Florida as citrus canker has. The cotton boll weevil is gradually spreading over the western part of the state where cotton is grown, but has caused no general alarm. The dreaded Mediterranean fruit fly has been in the neighborhood of our southern limits for a number of years; still there has been no concerted effort to effectually guard against the danger this enemy threatens to the state at large. The whitefly came, and has been accepted as an unavoidable evil, and is a constant drain on the citrus industry. Citrus scab, foot rot and other plant diseases have been liberally donated by our neighbors or foreign countries; and the Florida farmers have accepted these with a forbearance that is remarkable.

With the introduction of this new disease—citrus canker—there has been an awakening, especially among the citrus growers, and this awakening has resulted in a growing sentiment in favor of putting the citrus industry on a higher plane, especially in regard to protection against diseases and insects. This sentiment is not confined wholly to the citrus growers, for many farmers, and those having interests closely allied to agriculture, are beginning to realize that adequate protection is necessary to prevent the enormous losses that occur annually to the agricultural products of the state through the agency of insects and diseases. This is a question that concerns the state as a whole, and not only certain classes or individuals. Whatever seriously affects one important industry in the state will affect, in some degree, the others. In citrus canker the citrus-growers have had a warning, in concrete form, of the danger they are continually exposed to. The vegetable-growers have many serious pests to contend with at present, and there are others more serious that may come later. Even the general farmer has his share of trouble with plant diseases and insects. Thus the fight against such pests is a common cause which should be supported by the combined efforts of all concerned, with the view of obtaining more and better protection against these enemies.

The fight that Florida is making against citrus canker is a heroic one, especially in Dade county, where the disease first appeared. The growers of this section and their loyal supporters are to be highly commended for their untiring efforts and determination to wipe this disease out of existence. They have labored against odds, against opposition, and in face of many obstacles that have seemed almost unsurmountable. But their efforts have not been and will not be in vain. Other states are watching with interest the campaign against this disease. If the growers succeed in completely eradicating canker from the infected districts, they
will have achieved one of the greatest undertakings in the history of plant diseases. This will mean a great deal to the state of Florida, and will be an object lesson to other states.

Activities against this disease are not confined to Florida alone. In some of the other States where the disease is found our example of complete eradication is being followed, and it is to be hoped that in the near future citrus canker will be eliminated from the United States. Then with the co-operation and support of the Federal Government, which is now taking an active part in the work, and adequate State crop-pest laws, neither citrus canker nor any other similar pest will again be able to establish itself in Florida.

NATURE AND SYMPTOMS

In considering the nature of citrus canker the following features illustrate the more prominent characters of the disease. It is very infectious and spreads easily and rapidly from infected to healthy trees. It is capable of infecting all parts of the tree at any stage of growth. Canker once formed on the tree are persistent and do not disappear naturally. The disease does not respond to the ordinary methods of control.

Usually the disease forms a typical spot by which it can be easily recognized. These spots are generally circular in outline, brown in color, very much thickened, with one or both surfaces broken, exposing an inner mass of spongy dead cells. The spots may vary in diameter from one-sixteenth to one-fourth of an inch. Infections are most evident on the leaves, young shoots, and fruits; although, as already stated, the disease may attack any part of the tree and at any stage of growth. Fruits, leaves, young shoots, the bark on larger branches and trunks, and even the bark on exposed roots, have been collected showing infections. The young and tender growth is more susceptible to attacks than the old and more matured growth. Mature cankers formed in the bark of the larger branches and trunks are usually more irregular in shape and larger than the spots on leaves. The specimens and photographs I have at hand will give you a better idea of the appearance of the disease than any written description I may attempt.

VARIETIES ATTACKED

Practically all the well known species and varieties of citrus are attacked by the disease, with the possible exception of the kumquat. So far, the disease has not been reported on the kumquat in Florida. It attacks the grapefruit severely, and here the growers have suffered the greatest loss. Citrus trifoliata is attacked as severely as the grapefruit. This, however, is not so important, for if the disease was confined to Trifoliata alone, we would have a much easier problem to handle. While the disease is apparently not so severe on the other citrus varieties, the effects are injurious enough to warrant our taking every precaution to keep the least susceptible varieties free from attacks. Attacks on the sweet orange may be mild now, but in the course of a few years the disease may perhaps become as severe on this variety as it is on the grapefruit at present.
According to the observations of Dr. Berger and Mr. Frank Stirling, aside from the grapefruit and trifoliata, the other citrus varieties are susceptible to the disease about in the order named: Key Lime, Navel Orange, Sweet Orange, Satsuma, Tangerine, Mandarin, King Orange and Lemon.

CAUSE

(Note: A few days after this paper was read, new facts regarding the cause of citrus canker came to light, and in order to avoid confusion and bring the information on this disease up to date, it seems advisable to omit that part of the original discussion relating to the cause and substitute instead our more recent information on this subject.)

Recent experiments of my own and the work of Miss Hasse, of the Bureau of Plant Industry, show that citrus canker is caused by a species of bacteria rather than by a fungus.

In the paper as read before the Society the writer gave as the cause of this disease a species of fungus which was classed as one of the Phyllostictas. Some infection experiments of my own in which typical canker spots were produced from a single spore colony of the fungus (Fla. Expt. Sta. Bul. 124, p. 39), and the work of Dr. F. A. Wolf and A. B. Massey of Alabama (Ala. Agrl. Expt. Sta. Cir. 27, pp. 99 and 100), formed the basis for this opinion. The constant association of this fungus with canker infections, collected from widely separated areas, has also added weight to the fungus theory.

I have pointed out, however, that most of my infection experiments have given negative results and in only a few cases have I been able to produce typical canker spot with cultures of this fungus. This difficulty finally led me to suspect that bacteria were probably concerned in the development of the disease. Some experiments were made to determine this a few days previous to the meeting of the Horticultural Society in Tampa. Some small citrus trees in pots were inoculated with spores of the fungus, a combination of the fungus and bacteria isolated from a canker spot, and the bacteria alone. The trees thus treated were examined on Saturday following the Tampa meeting, and the results were convincing that bacteria were primarily the cause of the disease. Where the bacteria were used alone and in combination with the fungus, typical canker spots were developing. The following Monday information was received from the United States Department of Agriculture to the effect that Miss Clara H. Hasse had some time previously discovered that citrus canker was caused by a species of bacteria which she had described and named as Pseudomonas citri. A short account of the work and a description of the organism was published in the April number of the Journal of Agricultural Research.

Infection experiments are being continued with this organism and in every case so far young citrus foliage that has been inoculated with cultures of the bacteria have developed canker infections. The work has not progressed far enough at present to permit of any detailed report.

I regret that my discovery of the cause was not made sooner, however, this new information does not change the canker situation in the least. The fact that citrus canker is caused by a species of bacteria rather than by a fungus does not make
any material change in our present method of handling this disease. Any practical method of control other than eradication, seems as hopeless now as before, for bacterial diseases do not yield to any treatment except complete destruction of the infected parts.

Just why this particular fungus should occur so generally in the canker infections is rather difficult to explain. It is probable that it plays a secondary part in the development of many canker spots. Further investigation will determine this.

**DISSEMINATION**

Warm humid weather favors a rapid development of the disease, and thus it is more destructive during the rainy season. It is active, however, for the greater part of the year, especially in the southern part of the State where weather conditions are more favorable. It is spread mainly by some carrier. Insects, birds, other animals, and man, coming in contact with infected foliage that is wet with dew or rain, may easily carry the disease to healthy trees.

**INJURY FROM THE DISEASE**

The injury from this disease may be considered as two-fold. The most apparent injury results from the spotting of the fruit, making it unsalable. Since the disease spreads so rapidly and may attack the fruit at any age, practically all fruits on a badly infected tree would soon be reduced to culls. Canker does not cause a rotting of the fruits, or affect the interior of mature fruits, other than opening the way for rot-inducing fungi which may enter and cause decay. Fruits that are badly attacked when young are apparently stunted and fail to develop.

That the disease injures the tree seriously is evident. What the ultimate effect of the disease on the tree might be we do not know at present, for we have not had badly infected trees under observation long enough to tell. Our observations show that where trees are badly attacked there is a falling of the younger leaves and a perceptible stunting of the young twigs. Continued defoliation by the disease would finally result in the death of the tree, or soon render it worthless.

The serious nature of citrus canker can not be doubted by any one who has had experience with it, or who has seen its work. There has been some difference of opinion regarding the drastic methods of treatment employed against it, but since we are dealing with an unusual disease, drastic measures are necessary to stamp it out. This is by far the most serious disease of the grapefruit that has ever appeared in the State, and it will shortly ruin the industry if allowed to spread. Let us examine some of the reasons why it is more serious than some of the other citrus diseases.

First: It attacks all parts of the grapefruit tree; the leaves, fruit, young shoots, and bark on larger branches and trunks, and even the exposed roots.

Second: It does not yield to treatment with any of the known fungicides or any other so far as we know.

Third: The disease is able to grow and spread throughout the entire year.

Fourth: It is impossible to locate and remove all the infections that occur on the larger branches and trunks of dis-
eased trees, so pruning and cutting out of diseased parts are not practicable.

Fifth: The rapidity with which the disease spreads during favorable weather makes it difficult to handle even when the infected trees are destroyed.

Sixth: The persistent nature of the cankers in the bark of trunks and larger branches forms an ever-present source from which the disease is spread.

CONTROL

The most effective method of controlling this disease at present may be summed up in the one word, eradication. Citrus canker does not yield to treatment with any of the known fungicides, and the ordinary methods of combating fungus diseases will not apply to this one. Since the disease is so dangerous, it is folly to temporize with it. Being confined to comparatively small areas of the citrus section, the most logical thing to do is to completely eradicate it while it is possible to do so. A few months or a year of delay may mean that the fight is lost. Eradication will call for the complete destruction of all infected trees within the State. This will cause considerable loss to many growers, and probably no little expense to the State, but the amount spent now for the eradication of this disease will be nothing in comparison to the losses it will cause a few years hence, if it becomes generally distributed over the State.

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ON THE FIRING LINE BEFORE CITRUS CANKER

Frank Stirling, Miami, Fla.

Mr. President, Ladies and Gentlemen:

After nearly twelve months of constant endeavor, day by day, in touch with the situation, we, who have been "on the firing line and in the trenches before citrus canker," are compelled to acknowledge that we are up against a foe well worthy of our steel.

The story, how it has been and is being handled, should certainly be interesting to the Florida growers of citrus fruits. The facts now known regarding this plant disease show it to be so virulent, so subtle and insidious, that one is almost led to believe it to be The Father of Evil himself. Eleven months' experience with it in the field teaches us that it can be conquered only by using the most heroic methods. (Note Bulletin 124, Fla. Expt. Sta.).

We still have just as much, possibly more, respect, or fear, of this disease as we have ever had. With some, the impression has prevailed that the disease was due to weather and soil conditions and would soon disappear of itself and hence was not worthy of serious attention. Some folks have said that this alarm, which has been sent out by the Inspector of Nursery Stock and the Florida Growers and Shippers League, was uncalled for, that canker would turn out to be of a far