Diseases of the fig tree and fruit

Claude Wilbur Edgerton
Agricultural Experiment Station

OF THE

Louisiana State University
and A. & M. College

Baton Rouge

Diseases of the Fig Tree and Fruit

by

C. W. Edgerton, Plant Pathologist

(Technical Bulletin)

1911
Ramires-Jones Printing Co.
Baton Rouge, La.
Louisiana State University and
A. & M. College

Louisiana State Board of Agriculture
and Immigration

EX-OFFICIO.

GOVERNOR JARED Y. SANDERS, President.
HENRY L. FUQUA, Vice-President of Board of Supervisors.
CHAS. SCHULER, Commissioner of Agriculture and Immigration.
THOMAS D. BOYD, President State University.
W. R. DODSON, Director Experiment Stations.

MEMBERS.

R. S. MOORE, St. Bernard.
HENRY GERAC, Lafayette.
JOHN T. COLE, Monroe.

W. R. DODSON, A. B., B. S., Director, Baton Rouge.
HAMILTON P. AGEE, B. S., Assistant Director, Audubon Park, New Orleans.
S. E. McCLENDON, B. S., Assistant Director, Calhoun.
FRIEND C. QUEREAU, M. S., Ass't Director, Rice Exp. Station, Crowley.
W. E. CROSS, Chemist, Audubon Park, New Orleans.
W. G. TAGGART, B. S., Assistant Chemist, Audubon Park, New Orleans.
R. E. GRAHAM, B. S., Assistant Chemist, Audubon Park, New Orleans.
WM. G. OWEN, B. S., Bacteriologist, Audubon Park, New Orleans.
J. K. McHugh, Secretary and Stenographer, Audubon Park, New Orleans.
J. E. HALLIGAN, B. S., Chemist, Baton Rouge.
A. F. KERR, M. S., Assistant Chemist, Baton Rouge.
R. BAUS, B. S., Assistant Chemist, Baton Rouge.
R. G. FULLER, B. S., Assistant Chemist, Baton Rouge.
R. G. TILLERY, M. S., Assistant Chemist, Baton Rouge.
G. D. CAIN, B. S., Assistant Chemist, Baton Rouge.
ROGER P. SWIRE, Treasurer, Baton Rouge.
J. B. GARRETT, B. S., Entomologist, Baton Rouge.
G. L. TIEBOUT, B. S., Horticulturist, Baton Rouge.
C. W. EDGERTON, Ph. D., Plant Pathologist, Baton Rouge.
E. W. KERR, M. E., Professor Mechanical Engineering, Baton Rouge.
H. A. NADLER, B. S., Assistant Mechanical Engineering, Baton Rouge.
HARRY MORRIS, D. V. M., Assistant Veterinarian and Bacteriologist.
J. T. TANNER, B. A., Secretary and Stenographer, Baton Rouge.
WALTER McCLENDON, Farm Manager, Baton Rouge.
EWELL CAMP, Mailing Secretary, Baton Rouge.
IVY WATSON, Farm Manager, Calhoun.
E. J. WATSON, Horticulturist, Calhoun.
HENRY STAPLES, in charge of Dairy, Baton Rouge.
T. J. WEAVER, Gardener, Baton Rouge.
Diseases of the Fig Tree and Fruit

Of all of the fruits grown in the southern states, there is no other so common or so widely disseminated as the fig. In the southern tier of states, where there is no harm from freezes, not only does every farmer and planter have his own fig trees, but also nearly every resident of the towns and cities eats the fruit from his own trees. There is no other fruit so well adapted to the region and no other which grows so readily and produces such an abundance of fruit. The failure of a fig crop is almost unknown, and the excess of fruit that is allowed to rot and go to waste cannot be estimated.

While the fruit is so abundant and so easily raised, little has been done with it from a commercial standpoint. While the fruit is peddled around the streets in the southern cities, and in very few places is sold to canneries, the largest amount of it is merely raised for home use. But it is only a matter of time when more will be made of the fig industry. While the nature of the fruit prevents it from being shipped to any extent in the fresh state, it can be used to good advantage both by the canner and the confectioner. No other fruit can be made into such excellent canned products as the fig and if these could be placed on the market at reasonable prices, in a few years there would be a heavy demand for them. In a few places in the south, this is being done at present, as, for instance, in certain parts of Texas, where the Magnolia fig is being raised. But still the industry is so small as yet that the large majority of the people of the country do not know the taste of a preserved fig.

Then the use of the fig by candy makers will certainly become quite important. During the past winter, imported crystallized figs were selling in New Orleans for seventy-five cents per pound. There seems to be no reason why just as good candy could not be made of the southern figs and placed on the market with a good profit at a lower cost. This being the case, why is it necessary to import this at such a price when we have the figs and sugar at home? And if these products could be sold at a reasonable price, there would soon be a good growing demand for them.
But the fig tree, along with everything else that is alive, has its enemies. While these are to a considerable extent overlooked at present, on account of the abundance of the fruit, there are some which cause considerable damage and will be of much economic importance when there is more made of the fig industry. It is the object of this bulletin to describe the diseases of the fig that are known in this state and to give the results of three years' study and observation upon them. Exceptional opportunities for the study of these troubles were at hand on account of the fairly large fig orchard that was growing on the Experiment Station grounds in close proximity to the laboratory. As the orchard contained a number of varieties, it also gave a chance to study the resistance of the different ones to the diseases.

There are at least eight distinct diseases of the fig tree in Louisiana, as follows: Fig Anthracnose, Fig Canker, Limb Blight, Rust, Soft Rot, Die-back of Twigs, Leaf Spot, and Nematode Root Galls. These will be taken up individually in the following pages. Of course, besides these, there are many troubles due to insects, such as the fig borer, but these will not be considered in this bulletin. Some of the diseases, as the anthracnose, soft rot, and rust, are sometimes very destructive, while some of the others, as the die-back of the twigs and the leaf spot, are of very little importance economically.

---

THE FIG ANTHRACNOSE.

The fig anthracnose is a disease of the fig fruit causing it to rot and to become worthless. It is caused by the same fungus which produces the very destructive bitter rot of apples in most of the apple regions—namely, *Glomerella fructigena* (Clinton) Sacc.* This fungus has been known upon apples, grapes, and some other fruits for many years, but its presence upon figs seems not to have been noticed until recent years. The first specimen of this disease that I have seen or have heard of is one which is now deposited in the Bureau of Plant Industry Collection.

---

*In the use of technical names, the author has followed the rules of the Brussels Congress, as he understands them.*
tions at Washington, D. C. This specimen has the following label:

Cavara-Fungi Longobardiae Exsiccati, No. 250.

In fructubus Fici caricae Novocomi.

Prof. M. Mariani legit Autumno. Received July, 1896.

In Louisiana, the trouble has been known for at least five years, and it probably has been present for a much longer time. During the past three years, the disease has been carefully observed and studied, and the results embodied in this bulletin.

Since this study was begun, Stevens and Hall (9) have observed the conidial stage in North Carolina and have described it as a new species, Colletotrichum caricae Stev. & Hall. However, as there seems to be no morphological or physiological difference between this anthracnose and the one common on apples, the earlier and well-known name is used in this bulletin.

THE DISEASE ON THE FRUIT.

On the fruit, the appearance of the disease is not always the same. It may appear in the form of definite localized sunken lesions (Plate II, Figs. 1 and 2), or there may be a general rot of the whole fruit. However, these two forms can only be looked upon as extremes of the same thing, as there are all gradations between them. The lesions are in most respects similar to those formed upon the apple by the same fungus. The lesions, which are sunken discolored spots on the surface of the fruit, are at first small, but rapidly increase in size and bear, as a rule, many pink, slimy masses of spores. If the fruit does not become diseased until it nearly reaches maturity, it will generally drop off the tree, shortly after the lesions begin to develop. However, if the disease attacks the fruit in a young stage of its development, it will frequently cause a drying up of the latter while it is still on the tree. These hard dried mummies (Plate I, Fig. 1) hang on the trees for some time, part of them being still on the trees when the next crop sets in the following spring. The fungus remains alive on these mummies and is continually producing spores.

LIFE HISTORY OF THE FUNGUS.

In a general way, the fungus follows the same course of development as it does upon the apple. On the fig fruit, there are produced in abundance the small pink fruiting pustules or
acervuli. An acervulus consists of a small amount of pseudo-parenchymatous tissue, upon which are borne the small parallel conidiophores. The latter first form underneath the epidermis of the fig, but later this becomes ruptured, allowing the conidiophores to become exposed. The spores are borne singly at the ends of the conidiophores. While only one spore is developing at a time on a conidiophore, the development is so rapid that in a very short time there is a considerable mass of them above the acervulus.

The spores are in general cylindrical or slightly elliptical, hyaline, and slightly granular. A clear nucleus is always visible near the center of a fresh spore. Long, black setae are also very often present in the acervuli, as is also the case with most other anthracnoces. In some instances, these are abundant, while in others, they are practically lacking.

The spores which develop on the lesions on the fruits are carried in various ways to other fruits and to other parts of the tree. Perhaps the most common method of dissemination is by means of water. The spores are imbedded in a mucilaginous matrix which is very soluble in water. Rain, or perhaps even dew, separates the spores and carries them down to other fruits. When a spore comes in contact with a fruit where sufficient moisture is present, germination results, and the germ tube is forced through the epidermis. Further growth of the fungus causes a disintegration of the fig tissue and produces again the typical anthracnose lesion.

The leaf petioles and leaf blades occasionally also become infected with the disease, but the spots and lesions on these parts are not very abundant. The fungus also grows on dead parts of the fig tree, in wounds in the trunk, and in old cankers on the branches which were originally formed by the fig canker fungus, the next disease to be discussed in this bulletin. The anthracnose, however, is not able to produce cankers by itself on branches of the fig tree, as it does on apple trees. But its ability to grow and fruit on dead parts of the host is of great aid in keeping itself alive during periods when the fruit is not abundant on the trees. These dead parts of the tree and the mummies which hang on until spring are the principle sources of infection for the new crop of fruit.
Another stage of the fungus, the perithecial or complete stage, develops occasionally. Just what the factors are that tend to develop this stage are not known. I have collected it on old fig mummies in the winter time and I have also had it to develop in pure culture in the laboratory. The perithecia (Plate II, Fig. 3, and Plate III, Fig. 1) are membraneous, subglobose to pear-shaped bodies containing asci. These seem to be absolutely identical with the perithecia which develop on apples, and in cultures taken from apples. On the fig mummies, some of the perithecia were either entirely on the surface, some were partially imbedded in the host tissue and others only had the beak protruding from the surface. On artificial media, the perithecia develop in masses similar to most of the other forms. The perithecia are very variable in shape and size, and the length of the beak is also variable.

CULTURAL WORK.

The fungus has been cultured many times from different parts of the host plant and in different seasons. The cultural characters, while more or less variable (Plate I, Fig. 2), are as far as can be told, identical with the apple form. Acervuli and spores are produced freely in culture on a wide range of media. The secondary spores or appressoria also develop abundantly with the right conditions.

The acid limit for growth is about +38 by Fuller's scale. The alkali limit has not been determined, but the fungus makes a fair growth at −14. However, the growth in media testing −14 is not nearly as strong as in media with less alkali.

Continued growth of the fungus on artificial media seems to change the cultural characters in many cases, and also to cause it to deteriorate and run out. After it has grown for some time in the laboratory on culture media, the spore formation, especially in pustular form, will gradually decrease, while there will be an increased growth of a weak floccose mycelium. The rapidity of growth will also decrease in time. These old cultures are not nearly as good for inoculation and other experiments, as cultures but a generation or so removed from the fig. In inoculation experiments, slower infection is obtained, and in many cases an infection which is not characteristic of the anthracnose, though the production of spores on the fruit shows that the fungus is really present.
ARTIFICIAL INOCULATIONS.

The disease has been readily produced many times artificially, both on the trees in the orchard, and on fruit in a moist chamber in the laboratory, by introducing some of the spores from a pure culture underneath the epidermis of the fruit. It has also been produced in a moist chamber by placing some of the spores in a drop of water on the uninjured epidermis.

Cross inoculations with this fungus and other anthracnoses have also been tried. The fig anthracnose has been used to inoculate other fruits and plants, while other anthracnoses have been used to inoculate the fig. Briefly the results of some of these experiments are as follows:

On November 25, 1910, half-grown figs were gathered and placed in moist chambers in the laboratory and were inoculated with anthracnoses from the following sources: Fig (two cultures, one from fig fruit and the other from a dead branch); Melilotus indica stem (This had caused a stem rot of the Melilotus); Cotton; Silver maple leaf (This had caused a blight of the maple leaf); and Pepper. The anthracnose from the fig, maple leaf, and pepper took rapidly on the figs producing a rot and abundant spore formation. The culture from the fig fruit and from the dead branch showed some difference, inasmuch as the fig fruit strain produced a black definite sunken lesion, while the other produced a general rot. But all gradations between these two extremes have been obtained from different cultures which have been used during the past three years. The form from Melilotus stem, which perhaps is more like the bean anthracnose than other forms, took very slowly on the fig and did not produce spores until nearly a month after the inoculation. The cotton form also took very slowly, not showing any spore formation until nearly a month after the inoculation.

On December 28, 1910, some apples were procured and placed in moist chambers in the laboratory and inoculated with a number of different anthracnoses, obtained from the following hosts: Fig, apple, cotton, pepper, Populus deltoides, Silver maple, clover, bean, and Melilotus indica. These inoculations were examined frequently and on January 27, 1911, the final notes were taken. The ones that had formed lesions perfectly typical of the bitter rot were as follows: Apple, fig, pepper, and maple. The ones that had produced no infection whatever were: Cotton,
clover, Melilotus, and bean. The strain from *Populus deltoides* produced a slightly decayed rotten spot but no acervuli. This culture was one that was producing perithecia abundantly on culture media, and showed characters slightly divergent in perithecial formation from the typical bitter rot organism.

In the summer of 1910, a large number of cotton flowers were inoculated with anthracnose cultures from cotton and figs. While the bolls developing from the cotton anthracnose infected flowers showed an infection of about 40%, the bolls from the fig anthracnose infected flowers showed none.

Other experiments to prove the identity of the fig and apple anthracnoses were tried frequently, using both apples and figs, and both apple and fig anthracnoses, and in all cases the results with the two forms were identical. Infection was even obtained in moist chamber on apples by placing spores of the fig anthracnose in drops of water on the uninjured epidermis.

**Varietal Resistance.**

The different varieties of figs show great variation in the matter of resistance to the anthracnose. Some varieties are attacked so severely that the whole crop is ruined, while other varieties show little or no infection. The variety on the station grounds which rotted the worst with this disease was one which unfortunately could not be determined. The original label had been lost and no one remembers the name. This variety was one that produces two crops, the first very early in the spring. During two seasons, this variety hardly matured a single fig. The relative susceptibility of the other varieties in the station orchard was about as follows:

1. *Quite severely affected.* Madeleine, New French.
2. *Some infection.* Drop d’Or, Honche de Bray, Osborne’s Prolifice.
3. *Very little or none.* Mission, Brunswick, Reine Blanche, White Ischia, De Constantine, Celeste.

The above classification was made from a single year’s observation and may not stand the test of a number of years. But three years’ observations have shown such varieties as the Reine Blanche and the Celeste to be quite resistant. Many other fig varieties had been removed from the station fig orchard before notes were taken on the relative susceptibility of the different
ones. Most of the ones removed were poorer varieties, some being inferior fruit and some rotting so badly with the anthracnose that they were worthless.

CONTROL.

No experimental work on the control of the disease has been conducted. But there are certain points which should be borne in mind by anyone contemplating raising figs on a large scale. The control of this disease on susceptible varieties would be very hard to accomplish. Perhaps the frequent use of some good spray would decrease the anthracnose rot to some extent, but it is very doubtful if spraying would be a paying proposition on account of the large rainfall which we have in this state. Perhaps the best method to keep this disease in check with susceptible varieties would be the careful removal of all sources of infection. This would include the removal of all of the old dried up fig mummies on the trees in the fall, and also the careful cutting away of all of the dead limbs and twigs.

But the most practical means of control is by the use of resistant varieties. Fortunately, the Celeste fig, the one that is most frequently planted, is very resistant. Unless a man has some good reason for growing some of the other figs, it would be much better for him to confine himself to the Celeste, Reine Blanche, or to some of the other fairly resistant varieties. Some of these varieties are a sure crop, producing some fruit no matter what the season may be.

THE FIG CANKER:

The fig canker is a disease which has been under observation at the Louisiana station for about three years. It is an entirely new disease, the causative organism, *Tubercularia fici* Edgerton, having been just described (2). The trouble is known at present only in the vicinity of Baton Rouge, but more than likely it is present in other regions also. The disease is characterized by the shrinking and drying out of the tissue surrounding a fruit scar, accompanied by an increased growth of the healthy surrounding tissue (Plate VII, Fig. 2), and followed later by a dropping out of the dead part, leaving an open wound in the branch (Plate V, Fig. 1). The cankers are perfectly characterized at all stages in their development. At first, the tissue surrounding a fruit
scar turns slightly darker in color and shrinks. Frequently at
this time these cankers or lesions will show a number of small
pink spots on their surface, which are in reality the fruiting
pustules of the fungus which causes the disease (Plate VI, Fig.
1). While this diseased portion is small at first, it gradually
spreads out in all directions until the branch may be from one-
half to two-thirds girdled. Rarely does the disease entirely girdle
the branch, because the latter generally dies before the disease
has progressed that far. However, if the twig is not more than
half girdled, it generally is not killed, and so the scars of cankers
may be seen on branches of all sizes.

In the healthy tissue surrounding the canker, generally there
is an increased growth, so that in many cases from a short dis-
tance away the canker has the appearance of a knot on the
branch. The tree tries to heal over the wound caused by the
canker, but is never very successful in doing it. Scavenger
beetles and a number of saprophytic fungi and bacteria get into
the dead wood of the canker and prevent the healing over of the
wound.

A longitudinal section of a cankered branch (Plate V, Fig. 2)
shows that the fungus which causes the disease has penetrated
and killed the bark, cambium, and part of the wood. The dis-
eased portions assume a dark color. The illustration shows
three diseased twigs, with a healthy one on the right for com-
parison. On all of these twigs, the cankers were still young, as
an older canker will show still more discoloration.

As the canker grows older, the dead tissue cracks and finally
with the aid of scavenger beetles and other insects, falls out,
leaving an open wound which sometimes extends nearly to the
center of the branch (Plate V, Fig. 1). These large open
wounds may be seen on branches which are two or three inches
in diameter, several years after the fungus which caused the
disease originally is dead. These later stages are very promi-
inent and easily observed, but the young stages will be overlooked
if not carefully searched for.

The fungus seems to gain an entrance to the fig branch in
the fruit scar alone, and this infection takes place within less
than a year after the development of the fruit. However, as
the fungus is not a rapid grower, the canker does not appear
for several months after it has really gained an entrance to the
host tissue. As the fruit is borne on the first year wood, the canker does not form until that portion of the twig is in its second year. The cankers develop all through the spring, summer, and fall, or from March to September.

The fungus forms cushions of pseudoparenchymatous tissue on the surface of the cankers (Plate IV, Fig. a), these sometimes beginning their development underneath some of the layers of cells of the host and finally breaking through (Plate III, Figs. 2, 3, 5), and sometimes forming directly on the surface (Plate III, Fig. 4). These cushions are very irregular in shape and size. Sometimes the surface is rounded and smooth and sometimes it is very irregular (Plate III, Fig. 2). On these cushions on small narrow conidiophores, the small, elliptical, hyaline spores are developed, these being cut off singly from the ends of the conidiophores. At the time the spores are developing, the pustules are a light pink in color. Long papillose, hyaline setae also develop quite abundantly in the pustules (Plate IV, Figs. a and b).

The fungus was obtained in pure culture and carefully studied. Infection experiments were carried through, as described in a previous paper (2), and conclusive proof that this fungus was the cause of the disease was obtained.

CONTROL OF DISEASE.

While this disease does not cause much damage at present, there is a chance that it may become more destructive as more is made of the fig industry. The disease causes the death of many of the young branches, and weakens others so that they are frequently broken by the wind. The cankers also provide dead tissue upon the trees upon which the anthracnose is able to grow and keep up infection from year to year. Furthermore, the dead tissue forms a place of entrance for the limb blight fungus and perhaps also heart rots. The damage done is sufficient to undertake means of eradication.

The eradication of the disease, it is believed, can be accomplished by the careful cutting out and burning of the diseased branches. If the trees are gone over once or twice a year and the diseased branches cut out and destroyed, very little trouble can be expected from this trouble or from any other branch or twig disease.
THE LIMB BLIGHT.

The limb blight of the fig tree, which also seems to be a new disease, is characterized by the bright salmon-colored fructifications which cover the branches and by the sudden wilting and dying of the leaves on the affected portions (Plate VII, Fig. 1). This disease is due to one of the higher fungi, known to botanists as Corticium laetum Karsten. The fungus generally gains a foothold in the tips of branches that have been killed by the fig canker or by fig borers. While it grows on the dead wood at first, it readily grows out on the living branches and out on the living twigs. It kills these living portions, and consequently causes a wilting and dying of the leaves. The wilting usually takes place at about the same time as the fructifying layer forms on the branches, though occasionally the bright colored fructifying layer precedes the wilting. This bright colored layer on the branches is very characteristic and the disease cannot be confused with any other.

This disease has been seen at Baton Rouge and New Orleans, in Louisiana, and also specimens have been received from Hattiesburg, Mississippi, the latter being sent by Dr. R. P. Hibbard of the Mississippi Station. The disease has also been observed on apple branches at Baton Rouge, producing a disease very similar to the one on the fig.

APPEARANCE OF DISEASED BRANCH.

If a branch on which the disease is developing rapidly is carefully studied, the following points can be readily observed. The most prominent part, of course, is the bright colored fructifying layer which covers a portion of the branch. However, outside of this, and in the direction the disease is progressing, will be seen an area which is slightly darker in color than the normal bark. This region is also diseased, though the fructifying layer of the fungus has not as yet developed. If the twig is split at this point, one can see that the meristem, or that part of the twig which lies between the bark and the wood proper, is somewhat darker in color than the normal healthy twig. The bark itself looks nearly normal. If now a twig is split where it is covered with the fructifying layer, it will be seen that the disease extends half way or even more to the pith. The wood is, however, only slightly discolored. The cambium layer has become consid-
erbaly disintegrated, so that the bark very readily separates from the wood. In older diseased portions, the bark dries out, causing the fungus fruiting layer to become checked and cracked.

CHARACTERS OF FUNGUS.

The fructifications of the fungus are composed of a loose network of hypae within and a more dense layer of basidia on the outside, the whole varying from 50-200 microns in thickness. The hyphal threads are of nearly the same size, averaging about five microns in diameter, with a maximum of about ten microns. The basidia are hyaline, club-shaped, and about 10-14 microns in diameter. The spores are subglobose to ovate, hyaline, granular, not guttulate, apiculate at point of attachment to the basidia, and about 12-16 x 10-13 microns in size.

CONTROL.

The treatment of this disease should be the same as for the fig canker. It is believed that the disease can be entirely eradicated by a careful cutting out and burning of the diseased branches.

THE SOFT ROT OF THE FIG.

The soft rot of the fig is a trouble which is well known to every one who has ever raised figs. The trouble occurs chiefly during rainy spells in the summer when the fruit is ripening. The fruit sours, becomes soft and rotten, and, finally, generally falls to the ground. At the time the fruit falls, it is generally so soft that it all goes to pieces when it strikes the ground.

The rot itself is generally due to a specific fungus, though there are a number of factors which govern the severity of the attack. The fungus is a very common black mold which grows on almost everything in almost every place, and known technically as *Rhizopus nigricans*. This is the same fungus which causes the foul smelling, soft rot in sweet potatoes, and it is also the same one which frequently grows on bread that has been kept too moist. In fact, it is so common on bread that it is often called "Bread Mold." While often there are other fungi and bacteria in figs that have the soft rot, I think that more than 90 per cent of the damage is caused by this black mold.
While this trouble may occur to some extent in any season, it is during the wet and rainy seasons that it is particularly bad. It is not uncommon at all, in a very wet spell during the ripening season, to see three-fourths of the figs on a tree soft and mushy and covered with this fungus. A rainy season produces a softer, more juicy fig, and one that frequently cracks near the end. With the spores of the fungus abundant in the air and on the trees, and with water on the figs sufficient for the germination of the spores, and with many of the figs already cracked, we have ideal conditions for the rot.

The fungus fruits readily on the fig while it is still hanging on the tree (Plate VI, Fig. 2). Long grey fungus threads grow out from the fig and bear small black fruiting bodies at their tips. These bodies, while small, can be readily seen with the naked eye.

The fungus has several methods of dissemination as follows:

1. The wind blows the spores out of the little black heads and carries them to other figs.

2. Insects visit the rotting fruit, get covered with the spores, and then carry them to other fruits. The Argentine ant is especially harmful in this way. These ants crawl over the trees, sometimes almost by millions, crawling on every limb, leaf and fig on the tree. If it were possible to keep these out of the trees much more fruit would be saved.

3. The affected fruit becomes very soft and watery and large drops of the juice collect on the bottom of the fruit and drop to other portions of the tree. In the photograph (Plate VI, Fig. 2) a large drop of this juice, which is nearly ready to fall, can be seen. As these drops contain spores, they are easily disseminated in this manner.

4. Rains wash the spores off the fruit to others below them.

Some of the fig varieties are attacked very severely by this trouble, while some of the others are quite resistant. Nearly all of the large soft skinned varieties are very susceptible, while the smaller figs like the Celeste and Reine Blanche are not so badly injured by the trouble.
There is very little that can be done to control this trouble, especially in those regions where the rainfall is large. But perhaps the loss can be decreased to some extent by following the suggestions given below:

1. Pick the figs very often, and do not allow any to hang on the trees after they are ready to pick.

2. Keep the ants out of the trees if possible. This is a difficult matter in large fig orchards, but where a man only has one or two trees on his lot and these are not in contact with any building or fence, it can be done. Perhaps the best way is by wrapping the tree trunks with something the ants will not cross, as fly paper or ant tape. Of course, this material would have to be renewed after every rain.

3. In planting the trees, use those varieties which are not particularly subject to the rot, unless there is some more important reason for using the others.

THE FIG RUST.

The fig rust is another trouble that is well known to all who have raised figs or seen them growing. This is the disease that usually causes a defoliation of the fig trees in the late summer or early fall. The leaves affected (Plate VIII) first show a number of small, raised, light salmon-colored pustules on the under surface. These increase in number until the leaf surface is practically covered. As the number of pustules become very large, the leaf begins to die, usually beginning near the margin. Later the leaf falls to the ground.

This disease is everywhere in Louisiana where the fig grows, and in probably every locality it causes a defoliation of the trees. Fortunately, however, the leaves do not usually become severely affected until the latter part of August or September, and the defoliation at this time does not seem to materially injure the crop. Occasionally the infection will come early enough to cause a shedding of some of the late figs, but this is rather unusual.

Just what effect the rust has on the vitality of the trees is hard to answer. The trees nearly always put out a fresh crop of leaves in the fall, but these are killed by the frost before they
are of much service. This early defoliation, year after year, would mean the death of some kinds of trees, but the fig does not seem to be much injured. The young leaves and shoots come out in the following spring with as much vigor as ever.

This disease has long been known to be due to a fungus known as *Uredo fici*, or *Physopella fici*. The complete life history of the fungus has never been worked out, as only the summer spore stage is known at present. How the fungus lives from year to year has not been thoroughly settled. The uredospores may live over the winter on old leaves on the ground, but if this is the case, it seems strange that the infection does not begin earlier in the season.

There is no treatment for this disease that can be recommended.

**THE LEAF SPOT DISEASE.**

The leaf spot is a disease of very little economic importance. It is characterized by the presence of dead spots of various sizes on the leaves. The appearance of these spots is quite characteristic. On the upper side of the leaf, the center of the spot has a light brown color, while there is a narrow outer zone of a very dark brown or even purplish brown. The under side of the spots is brown also, but more even in color. In shape, the spots may be round or irregular, depending more or less upon the position they occupy on the leaf. The spot spreads faster in the parenchyma or soft tissue of the leaf, and is very much retarded by the veins.

This trouble is also due to a fungus, a member of the genus *Cercospora*. Just what the species is, is somewhat questionable. Very recently Heald and Wolf (3) have described what appears to be the same thing as a new species, *Cercospora fici*. But our knowledge of the genus *Cercospora* is so limited that it is a hard matter to tell whether this is a new species or whether it is not one of the forms which has been previously described on some other host. In the south, the *Cercosporae* are very abundant; a large majority of the cultivated and wild plants having leaf spots produced by them. And many of these from different hosts are very similar and perhaps some of them are identical.
DIE-BACK OF TWIGS.

The die-back of twigs is also of very little importance. It is characterized by the dying of the tips of some of the twigs, it being most noticeable in seasons in which the soft rot has been particularly troublesome. Generally the twigs that die are those that have had figs rot and dry down on them. Fungi and bacteria working on this dead material gradually work back into the twig itself. A species of Phoma is frequently found on these dead twigs.

NEMATODE ROOT GALLS.

Nematode root galls are more or less abundant on the roots of fig trees, their number depending more or less upon the locality and soil condition. In the sandy regions, the trouble is sometimes quite severe, while in the heavier soils, it is of little importance. The trouble is very readily recognized by pulling up some of the roots. The galls are little nodules scattered along the roots. These contain little nematode worms which live on the tissue of the fig root. Sometimes these galls become very numerous and cause the host plant to have a very unhealthy appearance. This same parasite also forms galls on a large number of other plants, both cultivated and wild, as, for instance, the peach, cowpea, etc. In most parts of Louisiana, these galls cause but little trouble to the fig. In the Experiment Station orchard, the fig roots were fairly well covered, yet the trees themselves seemed thrifty.

As the nematode disease is a soil trouble, it is sometimes a difficult matter to grow other susceptible plants in close proximity to figs. Some Chayotes or Vegetable Pears were planted between the fig rows in the Station orchard and also some at some 200 yards distant. Those among the fig trees all died during the second summer with the nematode gall trouble, while those a little distance away remained healthy.

This disease can be controlled and the soil procured perfectly free from the nematodes by a careful rotation of crops for about three years, growing only those plants that are not affected. However, in all the alluvial and clay soils of the state, the trouble is hardly of sufficient importance to undertake this.
LITERATURE.

There is very little available literature on the subject of fig diseases. The following publications, some of which are referred to in this bulletin, include some notes on these troubles. Some other literature on diseases which we do not have in Louisiana have been omitted.

2. Edgerton, C. W. Two New Fig Diseases. Phytopathology 1:12-17. 1911.
7. Starnes, H. N. The Fig in Georgia. Georgia Agr. Exp. Station Bulletin 61. 1903.

EXPLANATION OF PLATES.

Plate I. The Fig Anthracnose. 1. Fig mummies hanging on the trees in the spring, all badly affected with the anthracnose. 2. Dilution culture from fig anthracnose spores showing the variation in the appearance of colonies from the same fig.

Plate II. The Fig Anthracnose. 1-2. The fig anthracnose as it appears on the fruit. 3. A peritheciium of the fig anthracnose, X 200.
Plate III. 1. Perithecia and acervuli of the fig anthracnose taken from fig mummies, X 45. 2-5. The fig canker caused by Tubercularia fici. 2. Longitudinal section of a sporodochium, X 50. 3. Transverse section of a sporodochium, X 50. 4. Small superficial sporodochium, showing the abundant setae, X 50. 5. Sporodochium, showing setae and conidiophores, X 228.

Plate IV. *Tubercularia fici, the fig canker fungus. a. Sketch of sporodochium, showing setae, conidiophores, and spore formation, X about 225. b. Portions of setae, showing characteristic markings, X 480. c. Spores, X 480. d. Germination of spores in potato agar, after 18 hours, X 480.

Plate V. The Fig Canker. 1. Old cankers on the branches. 2. Split branches, showing the effect on the wood. The branch on the right is healthy.

Plate VI. 1. Very young stages of the fig canker, the light color around the fruit scars being due to spore development. 2. The soft rot of the fig, caused by Rhizopus nigricans.

Plate VII. 1. The Limb Blight of the Fig, Corticium lactum, showing the fructifications of the fungus and the wilted and dried leaves on the upper branch. Much reduced. 2. The fig canker, caused by Tubercularia fici. Typical cankers. Natural size.

Plate VIII. The fig rust, Physopella fici, on a fig leaf.

*This plate was originally published in Phytopathology, Vol. I, p. 15; but the legend accompanying it did not give the correct magnifications. The plate was reduced in reproduction and, as the proof of the cut was not seen before publication, the error was not corrected. The magnifications given here are as they should be.
CITRUS CANKER

C. W. EDGERTON

During recent years a very infectious fungous disease of citrus fruits, receiving the common name of "citrus canker," has gained a foothold in several of the gulf states and is now causing considerable alarm among citrus growers. This disease has found its way into Louisiana as into the other gulf states and this bulletin is written to acquaint the citrus growers with the disease, the damage that it may cause, and with the work that is being done in an endeavor to control or eradicate it.

TREES ATTACKED.

The disease attacks all kinds of citrus plants. It seems to be particularly serious on grape fruit and Citrus trifoliata, but is also serious on sweet oranges and Satsumas and sometimes occurs to some extent on kumquats. Whether it occurs on any other host than Citrus is unknown at present and can only be answered after a thorough study of the disease.

EFFECT OF THE DISEASE.

The disease occurs on all tender parts of the host plant above ground, including the leaves, twigs and fruit. Dead spots or cankers are formed on all of these different parts. The appearance of these spots varies somewhat according to the part of the host upon which they are present. In general, these spots are at first light colored and raised, the surface frequently being dotted with small black pustules of the fungus which is supposed to be the cause of the disease. After the spots become older, the light colored membrane on the surface ruptures and falls off, exposing the dead, brown, corky tissue underneath. Frequently this corky tissue is marked by small cracks or fissures. Generally the margins of the spots show the remnants of the old light colored membrane which at first covered the whole diseased area.
On the leaves (Plate I, Fig. 1) the spots are more or less circular in shape and vary in size from very small up to a quarter of an inch in diameter. The spots do not always have the same appearance and it is sometimes difficult or almost impossible to