Cotton wilt

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OF THE

Louisiana State University
and A. & M. College,

BATON ROUGE.

COTTON WILT,

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Portion of Cotton Field Where the Loss from Wilt is About One-Fourth.
COTTON WILT.

CHARACTER AND DISTRIBUTION OF THE DISEASE.

Wilt, blackheart or black-root is a disease of cotton caused by a fungus \( \text{Neocosmospora vasinfecta} \) which lives in the soil of infected fields, and enters the cotton plant through one or more of its small roots. After gaining an entrance, the minute threads of the fungus grow upward in the water-carrying ducts of the plant, filling them and choking off the proper supply of water and food elements from the soil. This causes the leaves to wilt, turn yellow and drop off— one indication of the wilt disease. The fungus also produces a discoloration of the walls of the water vessels, so that the wood of the diseased plant is seen to be dark brown when the root or stem is cut across. This appearance is characteristic of this disease and gives it the names black-root and blackheart, by which it is commonly known in some localities.

The brown color of the wood serves to distinguish cotton wilt from cotton rust, an entirely different disease which is sometimes confused with the wilt. Rust is not caused primarily by any fungus, but is due to bad drainage, lack of vegetable humus in the soil, deficiency of potash, or to some other unfavorable condition of the soil.

Cotton wilt may attack a single plant here and there in a field, or the majority of the plants in a rather extensive area. The fungus spreads from root to root by the growth of its microscopic threads through the soil, where they feed upon decaying vegetable matter. Injuries to the roots of cotton, such as might be caused by deep cultivation, by the attacks of root-worms, etc., enable the fungus to make an easy entrance, and occasion a larger amount of loss from wilt than would otherwise occur. The fungus also produces in the soil, and more especially upon the dead cotton stalks, numerous spores which are microscopic in size and have an office similar to that of the seed of higher plants in multiplying and spreading the fungus, which is itself a plant of a very low order. During damp weather a pinkish coating made up of millions of these dust-like spores may be
seen on the surface of dead cotton stalks; these become dry, and the wind scatters them far and wide. The spores may be easily carried on the lint and seed, and it is possible that infection may be spread to distant localities in this way, although it has not been established that this is a usual mode of transmission. The writer has made numerous attempts to secure cultures of the wilt fungus from seed taken from badly wilted plants; until now the fungus has not been obtained from this source. Artificially, the fungus may be spread by means of dirt carried from an infected field on the feet of workmen, of stock, or on farming implements.

The wilt is first noticed when the cotton is putting on the first forms. Deaths from the disease become progressively more numerous until the crop is well matured. Attacked plants at times survive for a considerable time, even until the end of the season, but such plants have a characteristic dwarfed growth and abnormal appearance. At times a single limb wilts and dies, while the rest of the plant keeps its normal appearance for some weeks.

Besides cotton the fungus is known to attack only one plant, okra. It certainly does not attack other common crop plants, such as corn, cowpeas, velvet beans, oats, grasses, etc. Cowpeas are, however, subject to a similar wilt disease which is caused by a fungus very closely related to the one causing cotton wilt. But the cotton fungus can not affect cowpeas, and the cowpea fungus can not affect cotton. However, it is possible for both fungi to exist side by side in a particular spot; and both cotton and cowpeas will, of course, develop wilt on such doubly infected land.

The cotton wilt fungus lives over from season to season on decaying vegetable matter in the soil; but it seems to thrive best when it can lay hold on cotton. And so, when infected land is planted successively in cotton, losses from the wilt become greater from year to year. The converse practice of keeping cotton off the land results in a diminution of loss from wilt. But the fungus is not entirely eradicated by this procedure, certainly in one instance not by a seven years' rest of the land.

Cotton wilt is known to occur in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Texas and Louisiana.
Our records, which are at present necessarily very incomplete, show that the disease occurs in the following parishes in Louisiana: Caddo, Natchitoches, Rapides, Avoyelles, Pointe Coupee, Morehouse, Ouachita, Richland, Caldwell, Franklin, Catahoula, West Feliciana, East Feliciana, East Baton Rouge, and Tangipahoa. It can be safely assumed that the list is not even half complete. The disease is at its worst in the North Louisiana parishes, but the bluff lands east of the Mississippi and the Red River valley have a large amount. The fungus prefers a light sandy soil that is well drained, and its ravages may be as great in very fertile soils as in soils that are exhausted.

**METHODS OF CONTROL.**

The peculiar habits which the wilt fungus has of living and spreading in the soil, of entering the cotton plant through the roots, of growing well within the woody tissues of the plant, and of persisting in the soil for a seemingly indefinite period, all combine to make the wilt disease a particularly difficult one to combat by direct means. The methods which have been tried, and the degrees of success attending their use, are indicated in the following paragraphs.

*Use of Fungicides.*—From what has already been said regarding the nature of the disease, and the habits of the causative organism, it could not be expected that the spraying of cotton plants with fungicides would give relief. It might be supposed, however, that fungicides applied to the soil would accomplish the destruction of the fungus. Extensive experiments in which various fungicides were used in quantities so great as to prohibit their use in farm practice, either on account of the expense, or the injurious effect on the cotton itself, have demonstrated the utter impracticability of this method. It could not be seen that any fungicide reduced the amount of wilt appreciably.

*Destruction of Affected Plants.*—Every affected plant is a source of infection for other plants. Especially is this true of plants dying early in the season. An inspection of any wilt-sick field will show striking instances of the spread of the disease from plant to plant in a row, and from row to row in a larger area. Moreover, left over cotton stalks, with their decaying roots all full of the wilt fungus, are the best imaginable nurseries for it
during the winter. It is the part of wisdom to remove stalks completely and destroy them by burning as soon as the first signs of wilt appear. This is especially important early in the season and on lands in which the wilt is just beginning to gain a foothold; in such cases the practice is more feasible. The removal of stalks at the end of the season accomplishes a double purpose when the cotton grower is contending with wilt and weevils at the same time.

*Rotation of Crops.*—While the keeping of cotton off infected fields for even a long term of years does not completely stamp out the wilt disease, a rotation that rests the land from cotton has a most beneficial effect in checking the disease. The lands that have the most wilt are as a rule the ones that have been in cotton without a break for a long term of years. The usual three year rotation including oats, cowpeas, cotton, and corn and cowpeas, is an excellent one for the present purpose. If the land happens to be doubly infected with cotton wilt and cowpea wilt, cowpeas must be omitted, or the Iron cowpea, which is highly resistant to wilt, used.

A further complication may arise from the presence in sandy lands of the root-worm, which causes enlargements, known as the root-knot, on the roots of cotton, cowpeas, and a large number of other crop plants, but does not attack oats, corn, velvet-beans, or most grasses. Iron cowpeas are strongly resistant to root-knot as well as to wilt. Root-knot, like wilt, can be held in check by a rotation which brings in the susceptible crop, cotton, once in three years; and it differs from wilt in that it can be completely eradicated in a comparatively short time by keeping all susceptible plants off the land.

*Manuring.*—The wilt disease is not caused by soil conditions, as is rust, but by a fungus which may flourish in many types of soil varying very much in chemical composition and in physical properties. But the fungus has its preferences, as do higher plants, and is found more abundantly in light and sandy soils. The condition of the soil has another indirect bearing on the wilt problem growing out of the important part the soil plays in the production of vigorous cotton plants that can ward off disease. Along this line it has been shown that the use of stable
Manure on wilt-infested land results in a very marked decrease in the loss from wilt, as well as in the increase in the productiveness of the stalks generally. In our own tests, the average loss from wilt at the present writing, on an unmanured plot, is just twice as great as on a comparable lot which has received stable manure at the rate of thirty loads per acre. Moreover, the wilt is increasing more rapidly on the former plot than on the latter, and the end of the season bids fair to show a proportion of four or five to one. The plowing under of cowpeas and other leguminous crops has a similar though less marked beneficial effect—another reason for adopting a system of rotation of crops on wilt-sick land.

Commercial fertilizers do not give the same good results; nor do they tend to increase the amount of wilt.

With reference to stable manure, the caution must be given that the wilt fungus will grow luxuriantly in a barnyard when once it has gained entrance; and infected manure may be the means of spreading the disease to a previously healthful field.

The Use of Wilt Resistant Varities of Cotton.—The various varieties of cotton are susceptible to the wilt disease in very different degrees. For instance, in tests made by Mr. W. A. Orton, of the Department of Agriculture, Jackson showed the highest resistance, 45%; Eldorado was next highest with 23%; Hawkins Prolific was 14%; Excelsior was 10%; King, 8%, and Russell, 6%. The Georgia State Board of Entomology reports among others the following: Jackson, specially selected for resistance, 82%; Red Shank, 55%; Kings Improved, 35%; Excelsior, 22%; Russell Big Boll, 10%.

It will be seen that Jackson is far in the lead among upland cottons, of which about twenty-eight were included in the two tests reported. Our this season's tests along the same line, will extend the list, without, however, revealing any variety superior to Jackson in resisting powers.

This natural resistance of Jackson cotton has been further increased by careful selection carried on since 1900 by Mr. Orton, and the improved strain is sent out as Jackson Wilt-Resistant cotton. While this cotton is not entirely immune, it is very highly resistant. Our own tests of it this season confirm the conclusion of others that it is a very useful cotton for wilt infested districts,
and deserves a careful trial in such localities. The following is a brief description of the plant:

"The plant is nearly limbless, except for one or two large basal branches, erect, tall, bolls medium sized, clustered, seed small, gray. A very productive variety. The bolls open well, but hold the seed cotton firmly. For this reason it is never blown out of the boll by storms, and is also somewhat harder to pick than the big-boll varieties."

Mr. Orton has originated by selection another highly resistant cotton, to which the name Dixie has been given. In resistance and in productiveness it ranks below the Jackson. "The plant is somewhat of the Peterkin type, with numerous branches. The bolls are of medium size; color of seed variable. The variety should be further improved by selection for larger bolls and greater productiveness."

Unfortunately, neither of these most resistant varieties is sufficiently early in maturing the bolls to give promise of much usefulness in boll weevil districts. Triumph and King are both quite susceptible to wilt. The Department of Agriculture and the Louisiana Stations are giving attention to the matter of securing a resistant cotton suitable for planting in weevil infested districts.

The Louisiana Stations, through the courtesy of the Department of Agriculture, have been furnished with seed of Jackson and Dixie wilt-resistant cotton; this is being tested in a number of localities in the State this season. There will be a limited amount of seed for the same purpose next season. Interested parties may obtain further information regarding the matter by writing to the Agricultural Experiment Station, Baton Rouge.

In addition to this varietal difference in resistance to wilt, there is an individual difference in resistance apparent in any given variety. This may form the basis for obtaining, through careful selection, a strain of the particular variety which is more highly resistant than the variety generally. Something may be accomplished in this direction by simply gathering in one mixed lot seed from stalks that remain sound on wilted areas. While this is better than no selection at all, it is by no means the best method; and for the following reasons: (1) Not all stalks so remaining in a diseased area possess a high degree of inherent
resistance to the wilt. Some may even have been attacked by the wilt fungus, but so slightly as not to give external evidence of their condition; others may have escaped infection by accident, and not on account of any inherent power of resistance. (2) Of those stalks possessing a high degree of resistance, some will transmit the character more completely to the next generation than others. This individual difference in transmitting power must be taken into account in all careful breeding work. To test this power it is necessary to plant the seed from each plant separately, and to compare the progeny the next season, making further selections only from those lots that show the character most uniformly.

The procedure, then, to be followed in breeding cotton for wilt resistance is about as follows: The first season selection is made in a badly wilted area of, say, ten stalks that give indications of high resistance, and are in other ways satisfactory. These stalks are conspicuously marked with white cloths, and are tagged with consecutive numbers. The cotton from each is picked in a separate bag kept for the particular stalk, and numbered to correspond with it. For planting these small lots of seed, select a piece of land large enough for the purpose and having the wilt abundantly and evenly distributed through it, as indicated by the effect on this season’s crop. This may be called the “progeny plot.” Thoroughly prepare the land, and plant the seed from each stalk in a single row, in hills, three or four seed to the hill, and one hundred or more hills to the row. The seed may be planted in the lint if it is only lightly covered. During this second season the amount of wilt must be noted in each row, and the row showing greatest freedom from disease marked for further selections. In this row mark, number and pick separately the ten best plants, and test these ten lots of seed the next, or third, season by the “stalk-row” method in a progeny plot. The seed from the remaining ninety or more stalks of this best row is to be gathered in one lot, ginned without mixing with other seed, and planted by ordinary methods the third season in what may be termed an “increase plot,” from which seed may be had for general planting the next or fourth season. The seed from the nine rows other than the single best row of the second season is probably better than that taken indiscriminately from the field, and may be used for general planting the third season.
In outline form, the steps are these:

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<th>THIRD SEASON</th>
<th>FOURTH SEASON</th>
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<td>Selection of Plants</td>
<td>Progeny Test</td>
<td>Increase Plot</td>
<td>General Crop</td>
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<td>Selection of Plants</td>
<td>Progeny Test</td>
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This method appears somewhat complicated and slow; but the results obtained by its use make it a far better one than that of merely selecting haphazard from the general crop. The plan is one of general application in plant breeding, and has showed its worth with many crops besides cotton. It will well repay the care required in its execution.

The extensive distribution of cotton wilt in Louisiana, the increase in its destructiveness from year to year, and the impossibility of stamping it out directly, all render the wilt problem a serious one in this State. By prompt destruction of affected plants, by rotation of crops, by the use of stable manure, and by the planting of wilt-resistant varieties of cotton, the disease can be held in check.

The Louisiana Experiment Stations are conducting work along the lines of studying the life history of the wilt fungus, of introducing and testing varieties of cotton that have proved to be wilt-resistant in other States, of testing the relative resistance of good varieties of cotton, and of breeding from these with a view to obtaining strains that are both wilt-resistant and otherwise adapted to local conditions. A full report on this work will not be possible for some time. With the purpose of enlisting the interest of the cotton growers of the State in the work, this general summary of our knowledge concerning cotton wilt has been prepared.
Portions of Cotton Stalks Showing the Discoloration Produced in the Wood by the Wilt Fungus. The Two Pieces to the Right Are From a Sound Stalk.