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Diseases of Sugar Beets in Louisiana

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Diseases of Sugar Beets in Louisiana

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Experimental trials with sugar beets have been carried on at a number of different times in Louisiana during the past fifty years. If it were possible to grow sugar beets in the state commercially, it would mean considerable to those interested in sugar production. It would mean that the sugar factories, most of which are now in operation only about two and a half to three months during the year, could be utilized over much longer periods. The production of sugar beets then would not only be profitable to those who could grow another crop but would be of material benefit in cutting down the large overhead costs of the mills. As further attempts will undoubtedly be made to grow sugar beets, it seems advisable at this time to make a record of some of the results obtained at earlier periods and to state the reasons why these earlier attempts failed or were unsatisfactory.

The idea of growing sugar beets in order that the sugar factories might be kept in operation for a greater part of the year apparently originated with Dr. W. C. Stubbs, first director of the Louisiana Agricultural Experiment Station in about 1886. From that date until about 1910, experimental plots of sugar beets were planted from time to time in the Experiment Station fields. It was during this period that the sugarcane industry was the most prosperous and there was no special need of a supplementary crop. No attempts were made to grow the beets on a commercial scale.

There was a revival in interest in sugar beet growing about 1920. From that date until 1924, beets were grown on the Experiment Station Farm at Baton Rouge by Dr. C. E. Coates and A. F. Kidder (4). Some fairly satisfactory results were obtained, but these tests were not grown on a commercial scale and little attention was paid to the occurrence of diseases. From notes on file in the Department of Plant Pathology, Louisiana Agricultural Experiment Station, it is known that some of these plots showed as high as a 50 percent infection with one of the important diseases. This large percentage would have been a very serious matter if it had been necessary to ship the beets to a sugar house.

In 1925, as a result of the failure of the sugarcane crop, interest in beet growing became more general. Sugar beet machinery was installed in the sugar factory at the Experiment Station at Baton Rouge. In the fall and winter of 1925-1926, plantings of beets were made at a number of points in the cane belt. Altogether, on twenty-nine different plantations in fifteen parishes, about one hundred acres of beets were grown in blocks of from one to seven acres. In 1926 the yields from the larger plantings which were harvested in May and June (2) were quite disappointing when compared with the previous yields from small plots. Yields from most of the plots were less than five tons per acre. However, there were several reasons for the low production, among them being (a) improper soil preparation and deficient drainage, (b) an excessively heavy rainfall during the early months of 1926 (the rainfall in southwestern Louisiana in January, February, and March was the heaviest in the history of the Weather Bureau, being about twenty-five inches as compared to a normal of around fourteen inches), combined with low temperatures, and (c) the occurrence of two very destructive rot diseases. The losses from these two diseases ranged from 40 to 100 percent, with an average of about 70 percent.
In 1927, about two hundred acres of beets were grown. The early plantings were practically all killed by a freeze in early January, and it was necessary to replant. In order to reduce the loss from rot, the beets were rushed to the mill during the first few days in May before the temperature had become high. There was considerably less loss at the factory as a result. As usual, beets that were left in the field during the latter part of May and the first part of June rotted very severely.

After 1927, the beet work was continued for a few years on a small scale by the Experiment Station but was discontinued by the growers throughout the state. The abandonment of the tests was due to two things: (1) the new cane varieties which had been introduced in the state were making good yields and a supplementary crop was not necessary. (2) The diseases caused such heavy losses that it seemed impossible to grow sugar beets on a commercial scale until satisfactory control measures could be worked out.

The disease problems connected with the growing of sugar beets in a warm, subtropical region should be of interest and should be carefully considered in future attempts to grow beets commercially in Louisiana. This report presents a summary of the observations and the studies which have been made in Louisiana, especially between 1926 and 1928, on the serious diseases of sugar beets.

DISEASES OCCURRING IN LOUISIANA

Several diseases of economic importance or special interest occur in Louisiana. These include two diseases which rot the beet itself, two leaf diseases, and the gall disease of the root.

The two rot diseases are the Rhizoctonia rot, dry rot canker or winter rot, caused by the fungus, *Rhizoctonia* sp., and the Sclerotium or summer rot, caused by *Sclerotium rolfsii*. The two diseases are rather easy to distinguish by their symptoms and by the fact that the Rhizoctonia disease appears in the cool winter and spring, while the Sclerotium rot occurs only in warm weather. There is some overlapping of the two diseases in April and May, but in general the Rhizoctonia disease decreases with the approach of warm weather, while the Sclerotium injury increases. These two diseases were responsible for the crop failures in 1926 and 1927 and are apparently the most important limiting factors in sugar beet production in Louisiana.

Of the two leaf diseases, the common leaf spot caused by the fungus, *Cercospora beticola*, can become very destructive in warm weather. The other, the large leaf spot caused by the fungus, *Phoma betae*, is apparently only of minor importance.

The gall disease caused by the nematode, *Coconema radicicola*, will doubtless become very important if the beet industry is attempted in sandy regions of the state.

I. RHIZOCTONIA ROT

The early symptoms of the Rhizoctonia rot of beets, as the disease develops in Louisiana, are similar to those mentioned by various investigators from other sections of the country. There is first a blackening of the petioles of the outer leaves on half-grown plants. The affected tissues die and the petioles collapse, this often taking place while the leaves are still green. As the fungus spreads, the whole crown gradually becomes affected. When the disease is severe, the tops of all plants on large areas will be killed. With favorable weather conditions, plants.
which are not seriously rotted may put out new leaves and make some growth even after the tops are killed. Typical diseased plants are shown in figure 1.

In another stage of the disease, definite brown lesions quite irregular in shape and size develop on the beet. While these are common near the crown region, many also occur below the soil line. In the older beets (fig. 1-A) large cracks containing heavy, brown mycelial mats are commonly present. These are quite similar to the dry rot canker stage of the disease which occurs in most of the beet sections of the country. The principal injury to the beet caused by Rhizoctonia rot is the rotting of the leaves and crown. The presence of this disease on beets did not cause any trouble at the mill.

![Figure 1.—Rhizoctonia rot on sugar beets. A. Early stages of the rot showing irregular shaped brown areas on the beets. B. Typical cracking of beets characteristic of older stages of the rot.](image)

The Rhizoctonia rot has been very destructive in fields where conditions have been favorable for its development. In the late winter and early spring of 1926, following long periods with excessive rains, losses from this trouble were very severe. In one field, 55 percent of the beets were found affected and the loss was at least 35 percent. In most of the fields, the infection varied from a trace to 25 or 30 percent. The disease was present in practically all of the beet fields in the southwestern part of the state. Most of the loss occurred in the winter and early spring. During the dry weather which occurred later in May and June, the disease symptoms
practically disappeared. In the season of 1927, due to more favorable weather conditions, the disease was much less severe, though fields showing from 5 to 10 percent infection were observed. Losses from this disease can always be expected when the soil becomes saturated and stays so for some time as a result of heavy and frequent rains.

II. SCLEROTIUM ROT

The fungus, *Sclerotium rolfsii*, is largely confined to the warmer tropical and subtropical regions of the world. Where conditions are favorable, it attacks a wide range of plants causing wilts and rots. On sugar beets in this country, the fungus was apparently first reported from California in 1919 (9). In Louisiana, Edgerton (10) reported a "50 percent loss in some patches of sugar beets" in 1922. These were the small test plots being grown by Coates and Kidder on the Experiment Station Farm. The disease also occurs in Oriental countries on sugar beets. Nakato in 1922 (8) found the fungus widespread over Korea, and later in 1925 he (7) reported that sugar beets in Japan were severely affected by root rot caused by *Sclerotium rolfsii*.

In recent years, the disease has assumed considerable economic importance in some of the principal beet sections in southern California (6).

In Louisiana, beets affected with *Sclerotium rolfsii* usually show a yellowing and wilting of the outer leaves followed, when conditions are favorable, by a sudden wilting and collapsing of all the leaves. There is none of the blackening of the leaf bases which is characteristic of the Rhizoctonia disease. When all the leaves collapse, the crown is usually involved in the rather soft, greyish rot. Beets in this condition never recover. Infection begins near the soil line and spreads rapidly over the exposed surface of the beet. Below the soil line the rot develops slowly, and only in advanced stages does it reach the bases of the roots. Under favorable conditions, the brown sclerotia, which resemble mustard seed, form on the surface of the beet at or above the soil line. A decaying beet with sclerotia and mycelium on the surface is shown in figure 2.

In 1926, the Sclerotium rot was observed in varying amounts in all of the seventeen parishes in which beets were grown. The severity of the rot varied from only a trace in a very few fields to as high as 75 percent in one field. The rot became much more severe as the temperature rose in the late spring, and in most of the fields that were not dug until after the temperature became high the beets rotted so severely that they were worthless for milling.

In spite of extreme care in eliminating diseased beets in the field, a certain number will be loaded in the cars with the healthy beets and sent to the mill. If the weather is warm and there is sufficient moisture on the beets, the rot will spread rapidly throughout the car. During the 1926 campaign many cars reached the mill in very bad condition. One car containing eighteen tons of beets was practically destroyed by the rot fungus during the four days that elapsed between loading and arrival at the factory (fig. 3). The beets were almost completely covered with the white mycelium of the fungus and there were very few sound ones in the entire car. While most of the beets were injured only superficially, the rot extending from a quarter to a half inch in depth, they could not be milled because of the effect of the rotted areas on the juice. Mill operators found that a few partially decayed beets lowered the purity of the juice to a point where sugar making was very difficult.

Analyses (2) of beets moderately affected with Sclerotium rot showed a sucrose of 4.99 percent and a purity of 42, while healthy beets showed a sucrose of 14.67
percent and a purity of 83. Brewster and Webre (3) found that "rotted beets slice badly, giving ragged, soft cossettes; the juice becomes dark and the quantity of lime salts rises."

CONTROL EXPERIMENTS

The possibility of controlling the Sclerotium rot disease was considered while the other investigations were being carried on. Tests were conducted with lime and various fertilizers, and attention was paid to the possible resistance of many varieties.

The fungus, Sclerotium rolfsii, responds peculiarly under acid and alkali conditions. It will not begin growth in a medium that is alkaline, but if it obtains a start it can acidify the medium in which it is growing in advance of the mycelium. There was a possibility that lime might be beneficial in controlling the disease in the field if enough could be applied to stop the growth of the mycelium. Lime was used in three different ways: (1) applied to the soil in which beets were to be grown, (2) mixed with the beets in the cars at the time of shipping to the mill, and (3) applied to beets placed in storage.

Figure 2.—Sugar beet showing sclerotia and mycelium of Sclerotium rolfsii. Taken from a car of badly decayed beets.
EFFECT OF LIME APPLIED TO THE SOIL

Tests with lime were conducted in the field at the Experiment Station at Baton Rouge, Louisiana, in 1928 and 1929.* Lime was applied to a loam soil at the rate of two and four tons per acre.

Beets grown in 1928 and 1929 were rotted quite as severely in the plats treated with lime as in those receiving no lime, indicating that lime up to four tons per acre does not make soil of this type basic enough to stop the growth of the fungus.

EFFECT OF LIME APPLIED TO BEETS IN TRANSIT AND STORAGE

Finding that beets rotted quite severely when kept in the cars for two to five days while in transit or waiting at the factory, attempts were made to reduce the amount of decay by applying lime to the beets as they were loaded. As the beets were unloaded from the wagons into the cars, a workman spread lime over them as uniformly as possible at the rate of about twenty to twenty-five pounds per ton of beets. While it was

Figure 3.—Beets covered with white mycelium of Sclerotium rolfsii. Taken inside a car of beets upon arrival at the factory.

* These tests were started by D. N. Barrow and continued by Dr. H. B. Brown.
impossible to have suitable controls and to handle the work in an experimental manner, observations indicated that lime reduced the spread of the rot to some extent. The cars to which lime was applied had smaller percentages of rotten beets than other cars in which no lime was used.

A test was also made to determine the effect of lime in reducing the spread of rot in stored beets. Beets were taken from the field, placed in wooden boxes, and inoculated by means of a diseased beet. In two of the boxes lime was spread over the beets as uniformly as possible at the rate of ten and twenty pounds to the ton, respectively, while the third box was left untreated. The boxes were covered with burlap sacks and a ten-quart pail of water applied to each box. They were then placed under a shed out of the sun and examined after ten days. Lime at the rate of twenty pounds per ton of beets greatly reduced the amount of rot as compared to the controls with no lime.

**EFFECT OF FERTILIZERS**

In connection with general fertilizer tests* conducted by the Department of Agronomy over a period of three years, data were recorded on the effect of fertilizers on the Sclerotium rot of beets. In the 1926 and 1927 tests twenty-six fertilizer combinations were used in triplicate plots. At time of harvest all the beets were examined for Sclerotium rot. In the 1926 tests, the percentage of rot varied from 5 to as high as 50 percent, but there were no consistent, clear-cut differences in the various fertilizer treatments. The tests of 1927 were very similar except that the amount of rot was much less than in the previous season. In the 1929 fertilizer tests the rot percentages varied from 19 to 46 percent, with no distinct differences in the plots receiving the various fertilizer combinations.

**THE COMMON LEAF SPOT DISEASE**

The common leaf spot disease, caused by the fungus, *Cercospora beticola*, is apparently present everywhere that beets are grown. On the leaves are small, light-colored spots with darker borders. Hundreds of these spots may be present on a single leaf, and when they become numerous the leaf turns yellow and gradually dies. When the disease is severe the leaves begin to die by the time they are fully developed and the plants consequently show just a few green leaves at the top. In Louisiana, the disease is usually not important during the cool weather but often spreads very rapidly as spring approaches. Fields were observed in which the plants were practically killed by the disease. If attempts are made to grow beets during the warmer weather, this disease will have to be considered.

**LARGE LEAF SPOT**

The large leaf spot caused by the fungus, *Phoma betae*, was found to a limited extent in Louisiana. This disease is characterized by large spots or dead areas on the leaf.

The large leaf spot disease is of interest because in the past it has been associated with a peculiar rot of the beet. In a recent publication, Kotila and Coons (5) claim that this rot is due to a deficiency of boron in the soil. This possibly explains why this type of rot has not accompanied the disease in Louisiana. It seems evident that the Louisiana soils have sufficient boron present.

* The fertilizer experiments were begun by D. N. Barrow and continued by Dr. H. B. Brown.
NEMATODE ROOT GALLS

Galls on the beets and smaller roots, produced by the nematode, Coconema radicicola, occur very commonly in the sandy soils in warm weather. These galls check the development of the beets. As nematodes attack a great many different plants, it is a very serious matter to have the soils become infested with them. If beets are to be

Figure 4.—Leaf spot of sugar beet.
grown commercially in nematode-infested regions, undoubtedly certain regulations will have to be made regarding the shipping of the beets.

The nematode root gall problem would be very serious in the sandy regions of the state but not so important in the alluvial sections.

Figure 5.—Nematode galls on sugar beet.
SUMMARY

1. Sugar beets grown in Louisiana have been seriously affected with a number of different diseases.

2. Two rot diseases seemed to be the limiting factors when an attempt was made to grow beets commercially in 1926 and 1927.

3. One of the rot diseases, the Rhizoctonia rot, is most severe in the wet, cold weather of late winter and early spring, and practically disappears with the approach of warm weather. This disease sometimes causes losses as high as 50 percent.

4. The other rot disease, the Sclerotium rot, becomes serious when the beets are left in the field during warm weather. It is also favored by excessive moisture. The damage caused by the rot is not confined to the field, as heavy losses may also occur while the beets are being transported to the mill. Partially rotted beets have a very low sucrose content and low purity and are worthless.

5. Methods of controlling the Sclerotium rot have as yet not been successful. The application of lime to the soil at the rate of two to four tons per acre did not decrease the amount of Sclerotium rot, although lime applied to the beets in the cars and in storage did decrease the rot to a certain extent.

6. Fertilizer applications apparently had no effect in reducing the Sclerotium rot.

7. No varietal resistance to Sclerotium rot has as yet been observed.

8. The leaf spot disease is a serious disease during warmer weather and is capable of materially reducing the crop.

9. The larger leaf spot disease occurs in Louisiana but is not serious. It does not produce a rotting of the beets.

10. Beets are very susceptible to nematode root galls. This disease will become a grave problem if beets are grown commercially in the sandy soils.

LITERATURE CITED


