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W. A. CONNER, Director

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Two Important Cotton Diseases And Their Control

F. M. ROLFS,
Botanist and Plant Pathologist

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Cotton is one of the most important crops of this state. Texas root rot and bacterial blight attack the crop and reduce the yield materially. In fact, in some sections of the state these diseases are so prevalent and severe that it is doubtful if the crop can be profitably grown on old cotton land by the methods now employed, but by adopting the control measures described on the following pages good crops can be produced.

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TWO IMPORTANT COTTON DISEASES AND THEIR CONTROL

TEXAS ROOT ROT OF COTTON

Texas root rot is one of the most important plant diseases in this state. The injury resulting from this disease is usually spoken of by the cotton growers as alkali spots but it is also referred to as blight, wilt, root rot and lightning struck spots. While this is a serious cotton trouble it is equally as destructive to the sweet potato, alfalfa, sweet clover, okra, fruit trees, weeds and various other crops. The morning glory is one of the most important weeds affected. The cereals and grain crops are immune to its attacks.

The symptoms of the disease differ but little on most plants. Infected cotton plants at first seldom show any evidence of the disease but later the plants wilt suddenly and the entire foliage droops and dies. In three or four days the leaves shrivel, blacken and in most cases fall off leaving a dead stalk which assumes a reddish brown color. The trouble is due to a complete destruction of the root system. The tap root of all dead plants is invariably dead and shriveled and the bark usually slips off from the wood on the lower end of the root when the plants are pulled up. The smaller rootlets are also dead and readily broken off. Usually several large lateral roots develop on the stem just below the surface of the ground. Apparently these lateral roots are the last of the root system to be consumed. The injured roots are usually more or less covered with dirty yellow or buff colored strands of the fungus. However, these are not constantly present or at least not alway easily observed without the aid of a magnifying glass.

Plants may be killed at any time even before blossoming when they are only a few inches high. The disease spreads from plant to plant so the number of dead plants gradually increases as the season advances, and in old cotton fields many spots of reddish brown dead plants appear. These spots finally unite forming larger, irregular areas of dead plants. It occurs on all types of soil, however, the light lands appear to be more favorable for its development. It spreads most rapidly during wet weather, dry weather tends to check it.

Root rot has been regarded as a plant disease of considerable economic importance in Texas for the past 35 or 40 years. No one appears to know just where it came from. Some seem to think that

it is a native disease of weeds in Texas; others hold that it was introduced from Mexico. We are probably safe in assuming that it was introduced into Oklahoma from Texas. Just how the organism is conveyed from one locality to another is not definitely known but probably by transporting infected material in some way. However, after the organism is once introduced into a field it spreads by direct contact from diseased roots to healthy ones. It may also be spread from diseased weed roots to healthy cotton roots. The early cotton plants usually suffer more than the late. This is no doubt due to the fact that the early plants have a more extensively developed root system and the interlaced roots afford a greater opportunity for the spread of the disease. For the same reason crowding plants in the row affords means for the rapid spread of the disease.

In fields where wide spacing in the row is the practice as in the eastern half of the state the root system of the plants develop equal on all sides, gradually interlacing with the roots of their nearest neighbors. Finally the entire field becomes a net work of interlaced roots. It is evident when infection occurs in such fields that the disease soon spreads in all directions from the point of infection and the infected area naturally assumes a circular form. However, where narrow spacing in the row is the practice this is seldom the case since the crowded condition of the roots enables the disease to pass more readily from plant to plant along the row than across to the plants in the adjoining rows, consequently the infected area is less uniform in outline. In fact so many factors, such as spacing, temperature, moisture, uniformity of soil, age of plants, weeds, etc., enter into the behavior of the disease that it is impossible to guess what form the infected area may finally assume.

Texas root rot is strictly a parasite and grows only on the living tissues of plants. Observations indicate that it dies with the host and does not persist in the soil, as is usually supposed. The organism is perpetuated during the winter months usually on the living dormant roots of the cotton and morning glory. During the last of March and early in April it is found active on the roots of the morning glory and other hosts. Late in April and early in May the cocklebur seed germinate and the roots of the seedlings which come in contact with the infected morning glory roots soon contract the disease. As the season advances and the cotton is planted, the roots of some of the cotton seedlings soon come in contact with the diseased roots of the cocklebur or the morning glory. Once the cotton becomes infected the disease begins to spread, slowly at first, for at this time the root systems of the plants are small and there are very few if any interlaced roots. As the plants grow the roots expand and the interlacing becomes more pronounced. If the weather conditions are favorable, the disease spreads more rapidly and the spots become larger and larger and in many cases finally unite forming larger areas of dead plants. It is

nothing unusual to find as high as 80 to 90 per cent of the plants on old cotton land killed in this way. The amount of rainfall during the months of July and August has a marked influence on the spread of this disease.

The loss due to this disease is not easily estimated. Plants killed early in the season before the bolls have formed result in a complete loss. Those killed after this period produce some lint so the loss per plant is not so great, nevertheless, the disease spreads more rapidly as the plants grow larger, so naturally the loss gradually increases as the season advances. The disease usually reaches its period of greatest activity near the close of the season. Both the quantity and quality of the crop are affected. The lint of diseased plants sticks to the burr and the growers are forced to snap the bolls in harvesting such crops. Production in badly diseased fields is reduced from 40 to 50 per cent.

It is evident that so long as the Texas root rot organism is perpetuated during the winter months on the living dormant roots of cultivated plants and weeds it will reappear during the following summer if a susceptible crop is grown on the land. Even if nonsusceptible crops such as cereals or grain are grown on the land as rotation the disease may be carried over from year to year on the roots of the morning glory and other perennial weed hosts. The first step to control this trouble is to kill out during the fall and winter months not only all the roots of the cotton plant but also the roots of all perennial weeds.

For fields that were only slightly infected during the past season the following line of culture is suggested. As soon as there has been one or two heavy frosts so the stalks will break up readily, harrow down or chop them up with a stalk cutter and plow the land five inches deep at the earliest date possible. Plant the field to oats or any grain or cereal crop next spring (1925). Immediately after the grain crop is harvested, no later than two weeks, plow the land five inches deep. The land should be kept entirely free of weeds by frequent cultivation with the harrow or disc during the summer and fall months being especially careful to kill out all the morning glory roots and cockleburs. If the weeds have all been completely killed out by the spring of the second year (1926) the soil will probably be free of root rot and the field may be planted back to cotton.

Where the fields were badly infected and the perennial weeds are thoroughly established the following culture is suggested. Follow the same procedure as given above for the first year after cotton. In the spring of the second year (1926) plant the field to corn, barley, grain sorghums or any grain or cereal crop. Immediately after harvest, no later than two weeks, plow the land five inches deep. Fallow the land

until the following spring (1927) when it may be safely planted to cotton again. The fence row and turn rows should be kept entirely free of shrubs and weeds to prevent infection. If this is not done all efforts in rotation and fallowing may be defeated.

Alfalfa, sweet clover, and sweet potatoes are very susceptible to root rot and should not be used in rotation with cotton for the control of this disease.

Investigations indicate that any system of rotation with corn, barley or any other grains or grain sorghum crops in which the land is plowed as soon as the crop is harvested and kept free of weeds for a period of two years will rid the field of the Texas root rot.

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BACTERIAL BLIGHT OF COTTON

Bacterial blight is a common disease of cotton. In fact growers have become so assustomed to it that they accept its presence as a "matter of course" and fail to realize that the parasite takes a fairly heavy toll from their field each year. While Texas root rot is usually regarded as a serious menace to the cotton industry and a number of careful observers have eliminated it from their fields, yet they have given the blight organism very little consideration.

The disease attacks the stem, leaf, and bolls of the cotton plant. On the stem it is known as black arm; on the leaf as angular leaf spot; and on the boll, as boll spot and boll rot. The trouble is disseminated by infected seed. The organism passes the winter on the lint of the seed and occasionally in the seed. When the infected seed is planted the organism develops with the unfolding of the seed and the young plants are often killed within a few days after they appear above the ground. The seedling assumes a water soaked appearance, turns black, and finally dries up. In other cases the progress of the disease is less rapid and the stem, after the plant has developed true leaves, become more or less constricted, blackened and bends over, allowing the top to rest on the ground. Such plants are often broken off or covered with soil in plowing. As high as 40 per cent of the young plants that become established may be infected and become more or less distorted and stunted. Usually the most extreme specimens of this sort are unconsciously removed when the field is chopped. Poor and uneven stands can often be traced directly to the work of this organism. As the plants grow, the tissues harden, the influence of the organism weakens, and the plants often apparently outgrow the trouble. However, where lack of moisture and early frost are limiting factors, the retarding influence of the disease is bound to reduce lint production.

Black arm is the name usually applied to the disease when infection occurs on the stems of the older plants. The tissue of the in-

fected area is broken down and turns black. In some cases the young bolls are shed or the injured fruiting stalks are broken off by the wind. This form of the disease is usually most striking on the Egyptian and Sea Island varieties.

Generally the most conspicuous evidence of the disease occurs on the leaves, where it produces spots which are at first dark green, water soaked in appearance, angular in form, and bounded by small veins. The spots are one-eighth to one-fourth of an inch in diameter and scattered over the leaves. As the season progresses the spots increase in number and size and finally run together, often forming elongated diseased areas parallel with larger veins. Later the injured tissues dry out and become dark reddish brown to black. In extreme cases the leaves turn yellow, curl up and fall off. Even in the milder cases when the field is located in exposed situations the leaves are soon torn to shreds by the wind and those badly mutilated fall off. The extent of leaf injury due to the work of the organism in such cases is less serious than the mechanical injury resulting from the action of the wind. The actual loss due to the work of the parasite is not easily estimated but it is self-evident that the normal leaf development is essential for normal boll production. So we feel safe in asserting that this phase of the disease often materially reduces the total cotton yield of the state.

On the boll the disease is less striking than on the leaves but nevertheless quite important as far as direct money loss is concerned. The first indication of infection on the bolls appears as small round dark green water-soaked spots which gradually enlarge; as the tissue dies it loses its green color, shrivels and turns black. The diseased areas soon become more or less sunken and finally takes on a brown or reddish brown color. Often one or two locks or even the entire boll fail to open or if they do open the lint produced is badly discolored and rotten. Early boll infections naturally causes greater loss than the later ones. Nevertheless lint under the spot on the later infection is often stained yellow and frequently such infections are sufficiently abundant to reduce the grade of lint.

The Egyptian varieties are especially susceptible and this is probably one reason why these varieties have not been profitably grown in the southeastern states. This parasite like other bacterial organisms is usually most active on the young tender tissues, so naturally it is aggressive on the young tender plants, as the season advances the tissue hardens, its action becomes less conspicuous, however, the extent of lint injury becomes more apparent as the bolls open.

The disease is carried over winter on the lint and seed from the diseased bolls. Experiments indicate that it does not pass the winter in the soil nor ordinarily on the dead infected material left in the field.

The control of the disease is largely a seed problem. The best method known is to use disease free seed combined with crop rotation. Seed should be saved only from fields where the disease does not occur or if this is not possible it should be selected from fields least affected.

If it is not possible to secure disease free seed the grower will be obliged to resort to growing his own seed. While this is really a seed grower's problem and the steps must be followed in detail yet it is not an impossible undertaking for the average cotton grower. It will require about five or six acres of good land and sufficient first class (treated) seed to plant the tract. In order to avoid loss from Texas root rot and also to avoid all danger of the blight being carried over on the old infected cotton material left in the field from the previous year, the seed crop should follow some crop, other than cotton. Dew or rain drops coming in contact with the diseased tissues of the plant often contain many active cells of the parasite. Tests show that the drops of rain from such plants may be carried seventy or eighty feet by the wind. The plot should be at least 100 feet or more from other cotton field in order to avoid infection from wind-blown dew or rain. Corn planted on this strip of land will afford additional protection.

Treating the seed with some germicide is probably the only means at present of securing seed free of this parasite. However, this is not so simple a process as in case of most other seeds on account of the fuzz. The fuzz holds air and prevents the ordinary disinfectants such as formaldehyde and mercuric chloride from coming in direct contact with the entire surface of the seed. So concentrated sulphuric acid is recommended. This will not only remove the fuzz but will also disinfect the seed. Sulphuric acid is extremely caustic and must be handled with care. Wooden tubs coated on the inside with melted roofing pitch are quite satisfactory since the pitch is very resistant to the action of the acid. Three tubs should be provided, one with closely perforated quarter inch holes to furnish a sieve for draining off the acid and to assist in washing the seed after treatment. Place the seed to be treated in one of the coated tubs and pour enough concentrated acid over them to wet them completely. Stir continually until all the lint has been removed. It will take from 10 to 12 minutes. Then pour the treated seed into the perforated tub, which should be securely placed over the second coated tub and allow the acid to drain off. Then place the perforated tub containing the acid treated seed over a hole dug in the ground and quickly wash the acid from the seed by pouring or running considerable water over them. The seed should be stirred constantly during the washing process or the temperature in the mass of seed may become high enough to injure germination. It will take from 15 to 20 minutes to remove all the acid from

the seed. After the seed has been thoroughly washed spread it out on a clean floor to dry. The acid may be used until it becomes too thick to pass through the sieve. Usually it can be used to treat three lots of seed.

Commercial sulphuric acid costs about one dollar per gallon and one gallon of the chemical will treat a little more than one bushel of seed.

The rows should be placed four feet apart and when the plants are about one foot high, they should be thinned to three feet in the row. In chopping, great care should be exercised to remove all plants which show any signs of infection.

The length of time it will take to eradicate the disease will depend very much upon the individual and surrounding conditions. If the instructions are carried out as given it will take at least one year to grow disease free seed. From then on there should be no further loss from this disease. However, it would not be safe to abandon the seed plot for the organism will be constantly carried into the clean field. It would not be safe to rely on the main field for disease free seed. However, if the entire neighborhood could be induced to use disease free seed the organism could probably be eliminated in one year. From the nature of the disease it is evident that it will take persistent effort on the part of the grower to keep it under control.