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CORN ROOT ROT

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Fig. 1.—Stalks which have gone down before maturity, because their root systems were weakened by corn root rot.

CAUSES OF CORN ROOT ROT

Corn root rot has come to be known over the Corn Belt as a serious disease of corn. This disease, which not only attacks the corn roots but the ears and stalks as well, is caused first by molds or fungi that live in the soil. A second cause is seed corn that contains these molds; and a third is soil that is lacking in certain things, generally lime or phosphorus or both. There are possibly other causes of root rot which are not well understood at the present time. Just which of the three causes is pro-

ducing the most root rot of corn in Missouri is not known. It is the opinion of the writer that diseased soil, and soil not properly fertilized or limed decrease the yield of corn more than the use of diseased seed.

SYMPTOMS OF THE DISEASE

There are certain well known symptoms that result when a corn plant is diseased with corn root rot. The most common one is indicated when the corn plants fall down in late summer usually about roasting ear time or a little later. These down stalks may appear in single hills throughout the field but often a number of hills go down together forming down spots in the field. In such a case caused by root rot the roots have all rotted off to within 3 or 4 inches of the top of the ground and when the plant goes down the stalk usually does not break but one side of the root system gives way and pulls loose leaving the decayed ends of the roots exposed.

Generally these down stalks have a more or less well developed ear, but it is soon destroyed by ordinary decomposition molds, especially if the weather is very wet. Sometimes even the stalks themselves will be largely decayed by husking time. The number of plants that go down in the field before maturity depends, of course, on the number having most of the root system entirely rotted away just below the surface of the ground and also somewhat on the winds and storms. For instance, in some seasons plants with partly rotted root systems might stand up against ordinary wind storms, but would not be able to withstand very severe storms accompanied with rain. In other words, the rotting of the roots is a matter of degree; some plants lose nearly all their roots and fall down while other plants lose only a few roots and are able to stand throughout the season. At any rate, most of the plants with diseased root systems look just like the healthy plants until they fall. If they do not fall, they usually dry up a week or two earlier than the healthy plants, at the end of the season. In most cases, too, the plants with diseased root systems produce much smaller and lower-grade ears than the healthy plants. A simple method sometimes used to find out how much the root system is rotted is to pull the stalk straight up out of the ground. The stalks hardest to pull up generally have the healthiest root systems.

In very severe cases of corn root rot the plants may show disease symptoms much earlier than the silking or roasting ear stage. In fact, the germinating seed may be so badly diseased that the young seedling dies by the time it gets to the top of the ground. Root rot has been observed in corn fields in May when the plants were just a few inches high. The plants appear rather backward and have very little vigor at first, then they wilt and die within a few days. When pulled carefully out of

the ground, the roots appear brown and partially rotted. Plants may be destroyed by this disease at any time during the growing season, but generally its effect is most noticeable during late summer.

These same molds that attack the roots also attack the stalks and ears. Rotting of the stalks usually occurs inside in the region of the brace

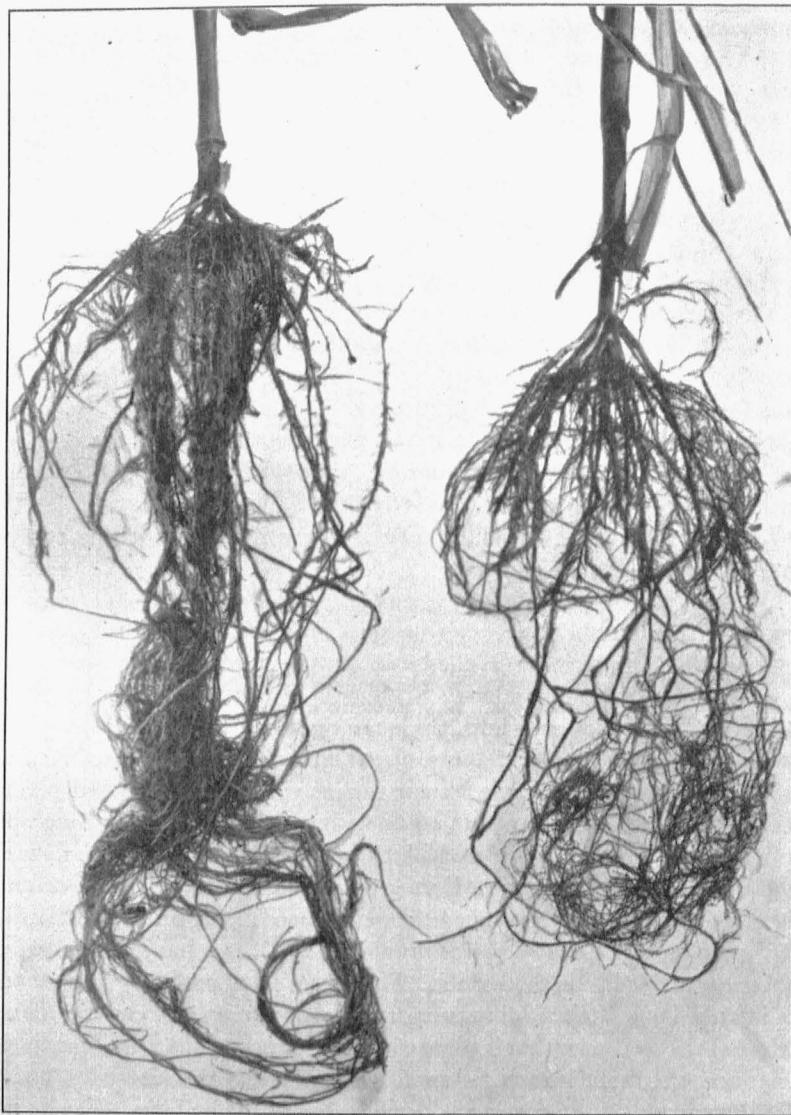


Fig. 2.—Healthy and diseased corn roots. At left is shown a healthy root system. At right is a moderately diseased root system.

roots. When a diseased stalk is cut open near the ground the pith appears dark or brown throughout or in streaks running lengthwise of the stalk. The nodes or joints nearest the ground are discolored and rotted while the upper nodes all the way to the top of the plant may or may not be discolored. In addition, during August and September, a thin, pink, powdery mold may often be found on the outside of the stalk, usually under the three or four lowest leaf sheaths.

The ear rots are very easily identified at husking time. They are quite noticeable because of the moldy condition and light weight of the affected ears. There are three very important molds that attack the ears on standing stalks as well as the ears on the fallen stalks. The most common ear rot is generally known as the dry rot. This mold produces a fine, white, cottony growth on all or part of the ear. The mold grows throughout the cob and kernels, making the ear much lighter in weight and of very little value for feeding. At husking time an ear badly molded with dry rot may be dirty white or dark gray in color. Often the mold grows out into the shuck so that it is hard to separate from the ear.

The second mold, indicated by its pink, powdery condition, occurs less frequently on the ears than dry rot. This mold usually covers only the butt or the tip, but may in some cases affect the whole ear.

Another mold that is also not so common as dry rot makes a dull reddish growth usually on the butt or tip of the ear. Except for the color this mold resembles somewhat the dry rot because the shuck tends to cling tightly to the rotten ear.

These molds get into the ear only from the air. Small seeds or spores of the molds, which can be seen only with a microscope, float through the air and lodge in the husks at the tip or near the butt of the ear. At this time in August or September if conditions are favorable, especially moisture conditions, the mold develops quickly and thus produces a more or less severe case of ear rot. Ears growing on healthy plants are attacked as easily by ear rots as the ears on diseased plants. Of course when diseased plants go down in the field, ordinary decomposition molds like the green and black molds usually attack the ear, if there is one, and destroy it. Ears growing on a diseased plant or on a healthy plant may or may not become diseased. But a remarkable fact is that in most seasons 90 per cent or more of all ears have one or two of these ear molds inside the kernels. These ears seem perfectly normal and it is only by technical laboratory tests that the molds can be found. Most of the seed corn that is planted every year contains these molds, but that does not make it unfit for seed. In fact, really serious losses, due to seed, come only from using seed ears so badly molded that they do not germinate well.

CORN ROOT ROT IN MISSOURI

There is no evidence of the extent of corn root rot damage in Missouri, but we believe it is far less than in Indiana and Illinois, where yearly losses of from 5 to 15 per cent of the total corn crop are reported.

It is true that some fields are damaged very severely. Yields have been reduced one-half or more in some cases, yet in a great majority of fields, observations indicate that corn root rot did no damage at all. Sometimes corn goes down, apparently with root rot, when an entirely different thing may be causing the trouble. Wire worms produce about the same result as root rot; that is, the roots decay and the plant goes down. But a careful examination of the roots of down stalks will show these little hard-skinned worms at work or show holes inside the roots where they have worked and killed the roots. Chinch bugs, too, may cause the stalks to dry up and fall down before the ears are fully developed. The corn root louse and the corn root worm also destroy the corn roots in some cases.

It is hoped that the foregoing descriptions will help farmers of Missouri to tell whether their corn is diseased with corn root rot or whether insect pests are causing the trouble.

RESULTS OF FIELD TESTS

For the past two years the Missouri Experiment Station has compared the yields of "clean" and diseased seed in different sections of the State. The seed used was obtained from farmers in those sections and each ear tested by means of the improved rag-doll germinator for disease.

The least diseased ears, about 10 per cent of those tested, were put in one lot and called "clean" seed; the most diseased ears, again about 10 per cent of all, were put in another lot called diseased seed. This seed was planted on the cooperative experiment fields in that section of the State where it was adapted. The following table gives the resulting yields in bushels per acre:

Year	Maryville		Stark City		Cuba		Warrensburg		Kirksville	
	Clean	Dis.	Clean	Dis.	Clean	Dis.	Clean	Dis.	Clean	Dis.
1922			40.1	41.7	8.9	8.0	38.9	33.5	50.5	49.0
1923	71.7	77.9	33.7	25.27	10.3	6.9	37.7	39.6	-----	-----

No conclusions can be drawn from these figures because the differences are not large except in two or three cases and because the results are not consistent. For example, at Stark City and at Warrensburg the clean seed outyielded the diseased seed one year while the diseased seed outyielded the clean seed the other year. Only by further trials can it be determined whether, in most seasons, clean seed selected from a germinator will outyield diseased seed.

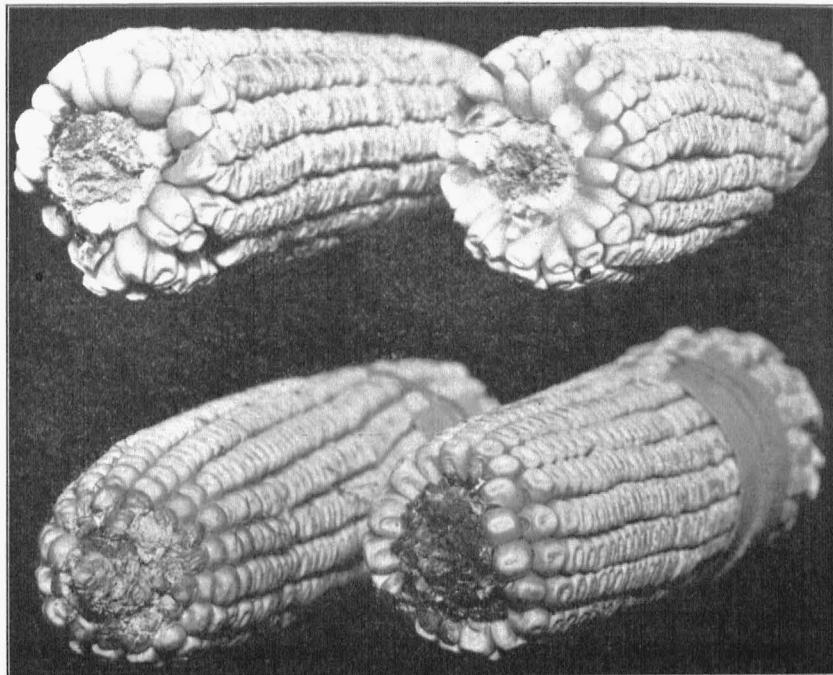


Fig. 3.—Ears with moldy or badly discolored butts and tips should be avoided in selecting seed corn.

THREE METHODS OF CONTROL

Because of the results from our experiments, we do not recommend that farmers test their seed corn for disease. In the first place this test is difficult to do properly on the average farm; and in the second place it does not pay on the average farm. It may be that clean seed corn will outyield diseased seed corn in certain fields. Therefore, we recommend another way to select clean seed corn, which, for the average farmer, is just as effective as the disease germinator.

As in ordinary seed corn selection, it is very important to select the seed in the field about the time the corn is maturing. By doing this

it is possible to select ears from strong, healthy stalks under average conditions in the field. Field selection is especially important in seasons when corn is late in maturing. But if the seed is selected from the crib as is often the case, the points to consider in selecting clean seed are the same. They are as follows:

First.—Select ears that are firm and heavy. Avoid light ears or ears easy to twist.

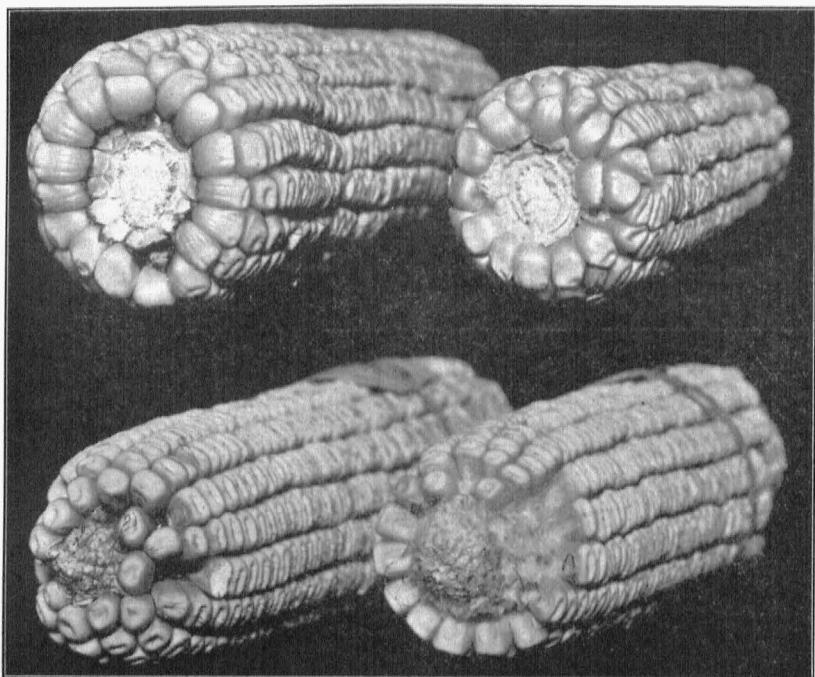


Fig. 4.—For seed select ears with clean, bright butts and tips like those shown here.

Second.—Select ears with no visible signs of molds. Avoid white, gray, pink, red, or other colored molds on the ends or other parts of the ear.

Third.—Select ears with clean white, bright butts where the shank has broken from the cob. Avoid discolored butts.

Fourth.—Select ears with clean, bright cob tips. It is not important that the tips be covered with kernels. Avoid ears with moldy or badly discolored cob tips.

Fifth.—Avoid ears whose kernels break near the tip when pulled out.

However, the above means of seed selection do not always elimi-

nate the need of a germination test. When the general run of seed ears germinate poorly due to the previous season or to poor storage in winter, or to other causes, all ears should be tested for germination and the faulty ones thrown out. It is also likely that in hand selection for clean seed, some of the ears thrown out will be as good for seed as those saved but certainly the selected ears represent on the whole the cleanest lot of seed that can be obtained in a practical way from a field or a crib of corn.

Corn root rot may be largely controlled by using a cropping system which will not have corn on the same field more than two years in five. This is just as important, and in some cases more important, than the planting of nearly disease-free seed. Of course, if corn root rot is so bad that the crop does not pay, it is best to stop growing corn for five or six years, but such cases are rare in Missouri.

A third suggestion to control corn root rot is proper fertilization and liming. The fertilizer generally needed is phosphate. Most Missouri soils contain plenty of potassium, but on soils particularly lacking in this element potash should be used also. In addition to fertilizer, lime is recommended on all sour soils.