

Crown and Root Rot of Alfalfa

new disease of alfalfa caused by water mold found to be component of the crown and root rot complex

Donald C. Erwin

Alfalfa—*Medicago sativa*—stand loss due to crown and root rot in some areas of California may be nearly as great as that caused by bacterial wilt. The common term crown rot includes more than one specific disease, and not all of the causal components of this disease complex are known.

Phytophthora Root Rot

The disease of alfalfa—*Phytophthora* root and crown rot—found in 1952—has been shown, experimentally, to be caused by a water mold—*Phytophthora cryptogea*—favored by wet soil. This fungus has been isolated from diseased plants in Yolo, Solano, San Joaquin, Fresno, Riverside, and Los Angeles counties. Crown, tap roots, or lateral roots may be affected by the fungus. However, the tap root was more often attacked. Periderm—the outer bark, phloem—the inner bark, or xylem—the woody tissues—of the root were damaged by the fungus. Externally, the infected area on the periderm was irregular in shape and brown in color. Internally, necrotic areas in newly infected roots were brown to red. The affected tissue may appear water soaked but remains firm. Later, it turns dull yellow to brown, and in severely infected roots, the yellowed region may extend 2–3 centimeters above and below the lesion. Prior to complete rotting of the roots, the leaves of affected plants often became yellow and flaccid.

Fourteen species of plants other than alfalfa were inoculated with the fungus—*Phytophthora cryptogea*—but none was susceptible. The inoculated species included California No. 5 cowpea, red kidney bean, Thomas Laxton pea, purple vetch, yellow sweet clover, red clover, Ladino clover, broadleaf birdsfoot trefoil, Imperial flax, Acala cotton, sugar beet, Marglobe tomato, aster, and carrot. Roots of cowpea, bean, yellow sweet clover, and red clover showed some lateral root browning, but on none was the disease severe enough to kill the plant.

Tomato and aster have been reported by other workers to be susceptible to the fungus. However, the isolate from alfalfa did not cause root rot of tomato and aster. Also, strains of the fungus—

pathogenic to tomato and aster—were not pathogenic to alfalfa. The *P. cryptogea* isolate from alfalfa is therefore a strain different from those previously identified.

Phytophthora root rot has been frequently found and may be one of the most important factors contributing to stand loss of alfalfa in the San Joaquin and Sacramento Valleys.

The fungus was not easy to isolate, and often typical symptoms of the disease were masked by secondary microorganisms. Thus root diseases of many plant samples cannot always be properly diagnosed.

There is some indication that the disease is more prevalent on soils with an impervious layer which impedes drain-

age or on heavier soils with a high moisture-holding capacity. However, *Phytophthora* root rot has been identified on plants from a few fields, the soil characteristics of which appear to be exceptions to this generalization.

Stagonospora Root Rot

The fungus—*Stagonospora meliloti*—also causes a crown and root rot of alfalfa, which has been found in nearly all parts of California—except the irrigated desert valleys—but has assumed great importance only in some fields. However, it is of potential importance in the crown rot complex.

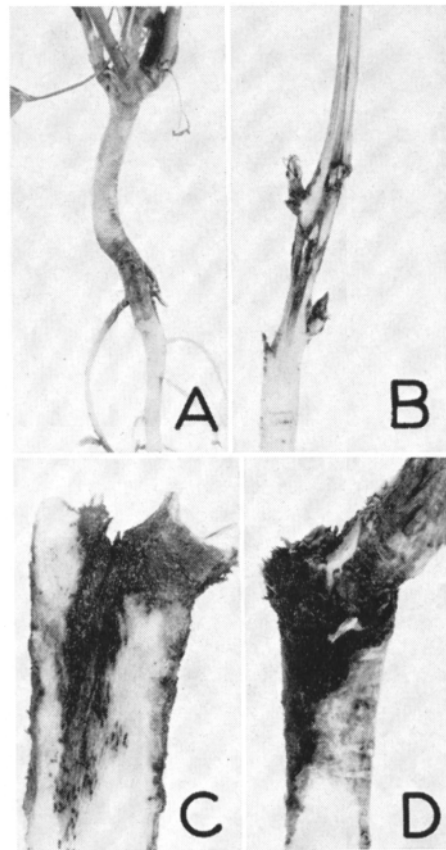
The most distinguishing symptom of the disease is the reddish flecking of the bark and wood of an infected crown branch or root. This symptom serves to distinguish the disease from other root diseases. In the early stages of infection, there is no evidence of decay of infected tissue, but eventually the reddish tissue becomes necrotic and rotten and is followed by death of the infected branch or root.

In areas of the United States where summer rainfall occurs, *S. meliloti* causes a leaf spot disease, but in California this phase of the disease occurs only during the winter. Some stem lesions on which fruiting bodies—pycnidia—can be found are formed during the rainy winter of California. The transportation by water of the spores—from these fruiting bodies—is a means of spreading the fungus in the field. Stem and leaf spots do not occur frequently enough to cause important loss of forage.

In experimental work, *S. meliloti* did not cause death of seedlings when inoculum was placed on the seed. Thus it would not be expected to be a cause of seedling loss in the field. Ordinary methods of inoculation, such as placing inoculum on crowns or roots in the soil or infesting soil prior to planting, resulted in a large percentage of plants escaping the disease.

In tests to determine the varietal reaction of alfalfa, roots were dipped in a spore suspension and incubated for two days in a moist chamber before transplanting to soil. This procedure

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Four crown and root diseases of alfalfa. A, *Phytophthora* root rot. B, Longitudinal section of a stem showing *Rhizoctonia* stem canker and crown bud necrosis. C, Longitudinal section of a root affected by *Stagonospora meliloti*. Flecking appears red. D, One of the types of crown rot termed dark crown necrosis, the cause of which is not fully known.

Westside Dust Plots

test plantings show some promise
as means of reducing dust problem

Lloyd N. Brown and James L. Myler

Areas of bare ground—in fenced test plots of about 500 acres each in Fresno, Kings, and Kern counties—almost disappeared during two years of favorable weather.

The test plots were established in 1951 to introduce plants and develop management practices to alleviate the Westside dust problem.

Trial plantings of grasses and legumes have been made each fall. The plantings made in 1953 started very well. On February 26, 1954, the plantings were growing in good shape but were still small. Soil moisture conditions in Kern and Kings counties were excellent. Fresno County did not get the last rain that fell in the other two counties. But, from the amount of moisture in the soil at that time, it looked as though a good spring growth was assured. However, the plant-

ings made but little growth after February 26. Apparently, the plants had been stunted by earlier dry periods and did not respond to the late February rains. Such phenomena are not uncommon among annuals where the winter rainfall is interrupted by extended periods of no rain. Apparently, this pattern of weather induces the plants to mature, and subsequent rainfall will not start them growing. Fortunately, the condition that results in this plant behavior does not occur very often or on a large scale.

In 1952 and again in 1954, detailed studies were made on an area 100' square on the Kings County plot on the growth of cover. The area was laid out into 10' squares, and a detailed map was made of the cover. The cover was broken down into the four classes of Tall, Medium, Short, and Bare. The area of each

class was figured as percentage of the whole. The following table shows the results of this study:

Cover on an Area 100' Square—Kings County Plot

	1952	1954
Tall	15.3%	20.0%
Medium	41.9	8.3
Short	25.9	70.8
Bare	16.9	.9

The significant thing about this table is that the bare areas had almost disappeared over a period of two years of favorable weather. A survey taken before 1952 would have shown a larger percentage of bare area.

There is indication that the lighter use inside the fenced areas in all three county plots is leading to a slow buildup of plant residue. This slow buildup of plant residue is aiding in giving the plot areas a plant cover and with the return of a series of dry years, should aid in delaying soil movement by wind action.

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showed that the infection process of the fungus in the soil was apparently sensitive to, and adversely affected by, soil microorganisms. When inoculum of the fungus was placed on roots of plants growing in nonsterilized soil, a much lower incidence of disease occurred than where those in sterilized soil were inoculated. These evidences of the unfavorable environment of the soil to *Stagonospora*, coupled with observations of infected crowns and roots of plants from the field, indicate that the fungus first infects a crown stem and progresses downward in the tissues to the tap root. It seems extremely unlikely that the fungus would live over in the soil in the absence of alfalfa.

Dark Crown Necrosis

A type of crown rot which may be called dark crown necrosis is most prevalent of all. The cause is as yet not completely understood. The lesions on the crown may be wedge shaped or may appear longitudinal on crown branches. Eventually, the crown branch or the entire crown is totally affected and the plant is killed.

Numerous isolations of fungi from

diseased tissue were made. The fungi found were: *Fusarium roseum*, *F. solani*, *F. oxysporum*, *Coniothyrium* sp., *Phoma* sp., many sterile mycelial types, occasionally *Rhizoctonia solani* and *Pythium* spp.

One isolate each of *Fusarium roseum* and *Phoma* sp. was capable of causing death of one- to 10-day-old seedlings. These fungi were not, however, capable of reproducing the dark crown necrosis or of inciting a root rot of one-month-old alfalfa plants. Some *Pythium* spp. were able to cause death of seedlings but were not damaging to plants one month old. The sterile mycelial types of fungi and other *Fusaria* associated with the disease were not pathogenic to seedlings or to one- to two-month-old plants.

The fungus—*Rhizoctonia solani*—is composed of many different strains, some pathogenic and others not. In these experiments, some strains were pathogenic to seedlings and produced stem and crown canker symptoms that resembled those of dark crown necrosis. The pathogenic isolates also caused crown bud necrosis and death of the buds at the point of origin.

The leaves of stems affected by *Rhizoctonia* stem canker sometimes turned yellow to reddish purple. A longitudinal section of such a cankered stem showed a black discoloration in the xylem and pith

above and below the canker. This darkened tissue sometimes extends into the crown and resembles the symptoms of dark crown necrosis in the field. Although this fungus was not shown to be the entire cause, the evidence indicates that it is one of the more important contributing factors.

Rhizoctonia root canker occurs mainly in the Imperial and Palo Verde valleys and is an important factor in the destruction of stands in the irrigated desert valleys. In these tests, the strains of the fungus that caused crown stem canker did not cause root canker. The root canker strain, however, readily parasitized stems and is probably a more virulent parasite.

The cause of dark crown necrosis is not fully understood. It is certain that *Rhizoctonia solani* is involved but is not the entire cause.

Symptoms of other diseases, such as *Stagonospora* crown and root rot and *Phytophthora* root rot, may be masked by secondary microorganisms and be erroneously lumped in the dark crown necrosis class. Injury to plants by the implements used in renovation practices or by other implements has been considered as a possible cause of crown rot and is being tested in the field.

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