ROOT-ROTS OF THE SUGAR BEET

Asa C. Maxson
Great Western Sugar Company

From the seedling stage, throughout the growing season, and, in the case of roots held for seed production, throughout the storage period, as well, sugar beets are subject to attack by root-rots.

At least 8 major forms of root-rot of the sugar beet, exclusive of the seedling rots, are recognized. These are:

1. Brown rot; caused by Rhizoctonia solani.
2. Dry canker; caused by a Rhizoctonia, possibly a strain of solani.
3. Red rot or root killer; caused by Rhizoctonia crocorum which seems to be the R. violacea of Europe.
4. Fusarium rot; caused by Fusarium sp.
5. Crown rot; more commonly a storage rot than a field rot; caused by Phoma betae.
6. Pythium rot; caused by Pythium sp.
7. Sclerotium rot; caused by Sclerotium Rolfsii
8. Phytophthora rot; caused by Phytophthora derschleri

To this list may be added a rot which occurs in Texas and adjoining southern states and which is caused by the cotton root-rot fungus Phymatotrichum omnivorum.

DESCRIPTION OF ROTS

BROWN ROT:

The early symptoms of this rot are varied. In some cases dark brown lesions appear on the body of the root at varying distances below the surface of the ground. When one of these lesions occurs deep down on the tap-root a wilting of the leaves indicates the presence of the disease.

DRY CANKER:

The dry canker form of Rhizoctonia rot was described by Richards (1) in 1921 at which time he considered Corticium vagum, the sterile form of which is Rhizoctonia solani, the cause. In discussing the results of his studies Richards says "--- it appears from the results that this particular "strain" of C. vagum is capable of producing the type of canker and dry rot with which it is constantly associated in the field."

Portions of Richards description are given here. "The disease is first detected in the field by abnormal wilting of the leaves in the day time with partial or complete recovery at night. Later the older leaves fail to recover, turn brown and die. "—Localized browning frequently occurs in the blade and petiole—. Neither the petiole decay reported by Dugger nor the Western crown rot described by Edson have been found associated with dry canker in the field. ——The fungus has not been observed to attack the beet above the soil line. ——As the fungus eats its way from the point of entrance the outer tissue, due to killing and subsequent drying out of the cells beneath, sinks in such a manner as to produce the circular lesion with its very definite undulating

contour of alternating raised and sunken concentric rings. -- The distinctive feature of the contour--is obtained usually before the fungus penetrates deeply into the tissue of the beet and before a serious rupture of the outer layer occurs. With the drying out and final cracking of this outer covering the fungus, possibly because of a better oxygen relation, eats rapidly into the beet, producing deep cankers. ---- With numerous points of attack the beet by harvest time is converted into a dry, brittle shell filled with a pithy mass of host and fungous debris.

RED ROT OR ROOT KILLER:

The first indication of disease is a wilting of the leaves of beets over clearly defined areas or of individual beets scattered over the field.

The disease does not penetrate deeply into the tissue of the body of the root. The death of the plant results from the destruction of the tap-root.

Red Rot seems to be a late summer malady no cases coming under our observation before September. It has been observed in northern Colorado and is quite common in the North Platte valley in Nebraska.

FUSARIUM ROT:

Fusarium sp. seems to be constantly associated with several forms of sugar beet-rots. Some of these may be seasonal forms of the same disease, however, for the purpose of this discussion 3 forms will be considered.

Tip-rot: The name tip-rot is applied to that form of Fusarium rot in which the causal organism attacks the tap-root some distance below the surface of the ground.

Wilting of the leaves is the first indication of the disease. Upon removing the beet from the soil it will be found that the rot has destroyed the tap-root. If the beet is pulled one gets the impression that the rot has started at the tip of the root and progressed upward. A careful examination reveals the fact that the rot has developed at a point some distance below the surface of the soil and as a result the root breaks off at this point when pulled. Below this point the root remains in a normal condition.

The second form of Fusarium rot is noted in late summer usually. At this time the affected beets may be completely destroyed. It seems probable that this rot is just the advanced stage of tip-rot. Because its association with tip-rot is seldom suspected if such a connection exists it has been discussed separately. Roots affected by this disease develop the same cavities mentioned in connection with tip-rot.

The third form of Fusarium rot is constantly associated with the disease known as Black-heart.

The first symptom is yellowing of the leaves. This discoloration usually appears between the larger veins. These areas gradually become almost yellow and then turn to a dirty dark brown.

Black heart is a physiological malady induced by a lack of available

phosphate in the soil. Fusarium sp. are constantly associated with the root rot stage of Black-heart.

PYTHIUM ROT:

While the Pythium fungus has long been known as the cause of damping off of sugar beet seedlings its connection with root rots later in the season has not attracted so much attention.

Only one case of Pythium rot after beets have passed the seedling stage has been observed by the writer. This occurred on a ridge planted field near Hershey, Nebraska.

The first indication of the disease was a wilting of the leaves. This was followed by a complete collapse of the plants and a very watery rot of the roots. There seemed to be no cases of recovery.

CROWN ROT:

Wilting and death of the leaves are the first indications of this trouble. An examination of the roots of the beets reveals brownish areas on the body of the root usually not far below the crown. The rot in the field is usually soft and watery at first. In section the rotten areas are a mottled brown traversed by rather narrow, crooked lines of almost black or with scattered small, irregular blackish areas. Phoma betae is constantly associated with this type or rot. This Phoma rot has been observed as a serious field disease several times, however, it more often occurs as a storage rot in beets held for seed production.

Phoma betae is constantly associated with the physiological malady known as Heart-and-dry rot caused by a lack of Boron in the soil. Phoma seems to bear the same relation to Heart-and-dry rot that Fusarium does to Black-heart. "In the early stages of the disease the leaves may wilt during the day and recover at night. Later permanent wilting may occur and the plant is killed. Generally infection occurs near the basal part of the root and invasion progresses gradually upward involving all tissue of the root.---under field conditions the affected parenchyma at the base of the root may soften and disintegrate leaving only the vascular strands. ---Secondary or adentitious lateral roots often develop above the invaded region of the tap-root and an ill shaped, pronglike root is the result."

"Often lesions arise on the sides and sometimes near the upper part of the tap-root. Infrequently infection occurs at the tip or along the sides of lateral roots or rootlets, with subsequent invasion of the tap-root around the base of the infected lateral root or rootlet."

"The lesions vary in size and shape and sometimes the entire root is involved. The predominant external color of the lesions ranges from the mummy brown to light seal brown of Ridgeway, (11) tending toward blackish brown at the center."

SCLEROTIUM ROT:

The writer has had no personal contact with this disease. For the information here given I am indebted to Dr. W. W. Robbins and L. D. Leach, the

following description is from circular 95 of the University of California.

"The most noticeable aboveground symptom of this disease is a sudden wilting of the leaves, frequently preceded, however, by an unthrifty appearance of the plant. When a diseased plant is removed from the soil, the white, silky or cottony strands (the mycelium) of the fungus can be observed on the surface of the root and in the soil nearby. The only reliable sign of this particular type of rot is the presence of small, round, white or tan or brown bodies (the sclerotia) closely resembling mustard seed. These sclerotia, produced in great abundance on the beet root and in the soil surrounding the beet, carry over the fungus from one year to another.

What can be done about it?

The final answer to this important question must come from the agronomist and the plant breeder. The answer must come from studies of seed and soil treatments; for cultural practices and cropping schemes; or from genetic studies and the production of resistant strains of sugar beets.

Work done by the research department of the Great Western Sugar Co. seems to furnish certain guide posts for future endeavor.

It is our opinion that little of practical value can be accomplished by seed and soil treatments outside of those cases where a disease is seed borne or is due to a soil deficiency as in the case of Black-heart and Heart- and Dry rot.

That there is a reasonable chance of producing resistant strains is beyond question. However, what the industry needs is immediate relief while it is waiting for the plant breeder to produce the resistant beet.

The surveys referred to furnish valuable suggestions for the cultural control of Rhizoctonia rot which is the most serious disease in the great plains area.

In the 1935 study the Coefficient of Association was employed to determine the relation of previous crops to Rhizoctonia rot. The continuous growing of sugar beets increased Rhizoctonia as the following shows.

Beets in	1935 only;	Coefficient	0.65
"	" 1934, 1935;	"	0.70
"	" 1933-34-35;	"	1.47
"	" 1932-33-34-35;	"	1.65

The larger the coefficient the larger the percent of fields in the class, injured by Rhizoctonia.

Small grain has the opposite effect from beets upon the amount of Rhizoctonia as the following clearly shows.

Grain	1	year	of	four	preceding	1935	beet	crop	Coef.	1.24
"	2	"	"	"	"	"	"	"	"	1.36
"	3	"	"	"	"	"	"	"	"	0.42
"	4	"	"	"	"	"	"	"	"	No rot.

The data secured in the 1937 survey was of such a nature that the

method of analysis used in 1935 could not be employed.

In addition to other data reported in 1937 the estimated damage was secured. With this as a basis a study was made of the effect of previous crops upon the damage caused by Rhizoctonia. In this part of the 1937 study sugar beets, potatoes, alfalfa, sweet clover, beans, and garden truck are considered host crops. Small grain and corn are considered non-host crops.

The following indicates some interesting relations.

Damage	all	cases	beets	following	host crops regardless of number	12.70%
"	"	"	"	"	non-host crops	6.40%
"	"	"	"	"	2 or more host crops	13.83%
"	"	"	"	"	1 only host crop	10.07%
"	"	"	"	"	1 only non-host crop	7.36%
"	"	"	"	"	2 or more non-host crops	4.40%

EFFECT OF DOWNY MILDEW ON SIZE, SUCROSE PERCENTAGE, AND PURITY OF SUGAR BEETS

By L. D. Leach
Assistant Plant Pathologist, University of California

For many years downy mildew has been recognized as a serious disease of sugar beets in the coastal regions of California during seasons when climatic conditions favored the development of the fungus. Prior to 1935 this disease was considered of minor importance in the interior valleys. During the past three seasons (1935-1937), however, serious infestations have occurred over wide areas in the lower Sacramento Valley.

Growers and sugar company officials frequently report that the yield of beets is strikingly reduced by downy mildew infestations, and some have observed that the sucrose percentage and apparent purity of beets from mildewed fields is lower than from disease-free fields --a condition that would interfere seriously with sugar extraction.

Previous to this year (1937) two attempts have been made to determine the effect of downy mildew on the size and yield of sugar beets. The results reported in table 1 show that both at Salinas in 1930 and at Davis in 1935 the indicated available sugar from infected beets was from 30 to 40 percent less than from healthy beets in the same field. In both cases the average root weight, sucrose percentage, and apparent purity were significantly lower in diseased than in healthy beets.

Table 1.--Effect of Downy Mildew on Yield of Sugar Beets

	Healthy	Diseased	Difference	Odds
A. Salinas, California, 1930				
Average Root weight, pounds	3.13	2.43	0.70	768:1
Sucrose percentage	13.5	11.5	2.0	4999:1
Purity percentage	83.8	77.3	6.5	1666:1
Relative Yield: Ind. available sugar*	100.0	61.0	39.0	
Tonnage	100.0	77.6	22.4	