PRODUCTION LOSSES IN SUGARBEETS CAUSED BY CERCOSPORA LEAF SPOT AND APHANOMYCES BLACK ROOT

By: G. E. Coe [1/]

Cercospora Leaf Spot

Cercospora leaf spot (Cercospora beticola) caused a national annual loss in sugarbeets of 3% for the period 1951-1960, according to estimates given in USDA Handbook 291. In most sugarbeet districts west of the Rocky Mountains, the disease is not a problem. In areas where it is a problem, epidemics are usually sporadic, occurring every three or four years; and in leaf spot years, losses are much higher than 3%.

Losses are governed by the severity of the epidemic and its duration. Unfortunately, the grower has little control over the factors governing the occurrence of epidemics. He can reduce the amount of disease by good farming practices such as crop rotation; but weather conditions favorable for the disease are beyond his control. He can resort to fungicidal treatments when leaf spot becomes apparent; but he must be convinced that the increased production resulting from these treatments will more than cover cost; otherwise, there is no incentive for the additional work.

The first part of this report shows the sugar losses caused by Cercospora leaf spot in resistant and susceptible varieties in an experiment conducted at the Plant Industry Station, Beltsville, Maryland.

Three varieties differing in resistance were used. Plants in one-half of the plots were inoculated with leaf spot, and those in the other half were sprayed with copper oxychloride at weekly intervals. A randomized block, split-plot design was used; each variety subplot was four rows wide and 20 feet long. The rows were 24 inches apart, and the plants were spaced about 10 inches apart in the row. The two center rows of each subplot were harvested, weighed, and analyzed separately.

The warm humid climate at Beltsville favors the pathogen, and a severe leaf spot epidemic can be started early and maintained to autumn. The climatic conditions were especially favorable in 1965, and I was unable to keep the disease out of the sprayed plots. The end result was the measurement of productivity at different levels of disease severity. The average disease readings are presented in Table 1.

[1/] Geneticist, Crops Research Division
Agricultural Research Service
U. S. Department of Agriculture
Beltsville, Maryland

Table 1. Average leaf spot readings of sprayed and unsprayed populations of three sugarbeet varieties in fungicide test for Cercospora leaf spot control, Plant Industry Station, Beltsville, Md., 1965

Variety	Treatment	Average leaf spot reading [1] July 23	July 30	Aug. 6	Aug. 12	Sept. 4
SP 633269-0, Susceptible	Sprayed [2]	1.42 d [3]	2.00 cd	2.83 c	2.92 c	5.00 b
	No spray	4.50 a	4.83 a	5.08 a	5.17 a	6.33 a
US 401, Moderately resistant	Sprayed	1.00 e	1.83 d	1.92 d	2.17 d	3.75 c
	No spray	3.08 b	3.83 b	4.08 b	4.08 b	4.50 b
SP 6322-0, Resistant	Sprayed	0.42 f	1.25 e	1.25 e	1.42 e	2.67 d
	No spray	2.08 c	2.25 c	3.00 c	3.00 c	3.72 c

1/ 0 = No leaf spot; 10 = All leaves dead.
2/ Copper oxychloride, approximately 1/2 pound per acre.
3/ Means in the same column which have the same letter are not significantly different at the 5% level.

The scale for rating disease severity is an arbitrary one used by most sugarbeet pathologists. The grower ordinarily does not realize that his sugarbeets are being damaged by leaf spot until a disease severity reading of 3 is reached. A disease severity rating of 4 is given when the leaves begin to blight. At this stage, the disease damage is readily recognized by the grower. A disease severity rating of 5 is given when many leaves are blighted, and a field appears to be devastated when a rating of 6 or higher is reached.

The harvest data for the experiment are presented in Table 2.

(Table 2 is on the following page)

Table 2. Harvest data of three sugarbeet varieties in fungicide test for Cercospora control. Plant Industry Station, Beltsville, Maryland, 1965

Variety	Treatment	Acre yield: Gross sugar	Roots	Sucrose	Raw juice apparent purity
		Pounds	Tons	Percent	Percent
SP 633269-0 Susceptible	Sprayed[1/]	4033 d[2/]	17.86 c	11.29 c	75.25 c
	No spray	2395 e	12.63 d	9.48 d	72.59 d
US 401 Moderately resistant	Sprayed	6016 b	24.39 a	12.33 b	78.28 b
	No spray	4030 d	18.57 c	10.85 c	75.60 c
SP 6322-0 Resistant	Sprayed	6620 a	25.21 a	13.13 a	80.18 a
	No spray	5444 c	21.67 b	12.56 b	79.36 ab
Difference between treatments:					
SP 633269-0		1638 ab	5.23 a	1.81 a	2.66 a
US 401		1985 a	5.82 a	1.48 a	2.68 a
SP 6322-0		1176 b	3.54 a	.57 b	.82 a

1/ Copper oxychloride at 1/2 pound per acre.
2/ Means in the same column which have the same letter are not significantly different at the 5% level.

The data in Table 2 indicate a significant loss in tons of roots and percent sucrose in all three varieties. In the inoculated plots of variety SP 6322-0, in which the average grower might or might not realize that there had been any leaf spot, there was a loss of at least 1,175 pounds of gross sugar per acre. The loss was undoubtedly greater than this, because how much the sprayed plots of SP 6322-0 would have produced, if they had been completely free from leaf spot, is not known. The loss of gross sugar in the variety US 401 in this experiment was undoubtedly more than 1 ton. When the differences in purity are considered, the loss of sugar that is actually recoverable in the factory is even greater.

It should be emphasized that losses indicated in this experiment were the result of an epidemic that lasted from July 15 to harvest. In the Great Lakes area, leaf spot epidemics are ordinarily of shorter duration, and losses should not be as great. However, the seriousness of losses from leaf spot should not be underestimated.

Aphanomyces Black Root

The national average annual production loss of sugarbeets caused by Aphanomyces black root for the period 1951-1960 was estimated to be 1%. However, since black root does not occur in epidemic proportions in some of the nation's sugarbeet districts, the losses in areas favorable for the disease are considerably more than 1%. Severe black root epidemics in the late 1940's and early 1950's contributed to low beet yields in the Great Lakes region.

Four main factors are related to the amount of loss that occurs: 1) resistance of the variety; 2) seed treatments; 3) weather conditions; and 4) cultural practices. In order to evaluate breeding lines, experiments are conducted at Beltsville to find ways of increasing disease severity in the greenhouse. The seedling tests have revealed that high relative humidity is of greater importance than previously believed. When the relative humidity was maintained near 100%, all seedlings of a moderately resistant variety were killed. When the relative humidity was maintained near 30%, less than 25% of the seedlings were infected. Sugarbeet growers in the Great Lakes region have little control over this important disease factor.

The introduction of black-root-resistant varieties has contributed to reducing loss from both the seedling and the chronic phases of black root. However, these varieties have only moderate resistance, and there are insidious losses due to black root in some areas even though the disease is not conspicuous. Some breeder lines with a high degree of resistance to black root have been produced. Their productiveness is yet to be determined. But highly resistant varieties with good yields should be developed soon.