

# Observations and Correlations on the Detrimental Effects of Savoy and Yellow Vein Viruses on Sugar Beets

R. E. FINKNER AND J. P. YODER<sup>1</sup>

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The incidence of savoy and yellow vein viruses has been noted several times but has not been thoroughly investigated. Coons et al. (2)<sup>2</sup> reviewed the literature concerning savoy and recognized it as a potentially dangerous sugar beet disease. They noted a differential reaction among certain sugar beet varieties and suggested the possibility of breeding for savoy resistance. It appeared that leaf spot resistant varieties also were resistant to savoy.

Yellow vein virus has been described by Maxson (3) and Bennett (1). The incidence of infection usually has been low, but occasionally it becomes sufficiently severe to cause measurable damage to sugar beets.

The observations of savoy and yellow vein reported herein were made in the Central Nebraska beet growing areas in 1964. Additional data were obtained from a cooperative agronomic evaluation test of U. S. Department of Agriculture varieties conducted at Mankato, Minnesota, in 1955. The savoy reaction of the varieties in the latter test were reported by Coons et al. (2).

## Materials and Methods

Two variety tests were conducted at Overton, Kearney and Shelton, Nebraska, in 1964. One test consisted of 64 strains and hybrids, replicated three times in a triple lattice design. The other test was a cooperative U. S. Department of Agriculture agronomic test consisting of eight varieties replicated three times. Plots were single rows 35 feet long. The complete plot was harvested for yield and the beets were divided into two equal samples for sucrose determinations. The number of diseased plants was noted and the percent infected plants was calculated. The percentages of diseased plants were then cor-

<sup>1</sup> Director of Agricultural Research and Research Agriculturist, respectively, American Crystal Sugar Company, Rocky Ford, Colorado.

<sup>2</sup> Numbers in parentheses refer to literature cited.

related with tonnage, percent sugar and sugar per acre. The U. S. Department of Agriculture test and two replications of the 64 entry test were lost at Overton because of poor stands. There was a relatively heavy incidence of savoy, yellow vein and leaf spot in all of the plots.

In 1955, a cooperative U. S. Department of Agriculture test was conducted at Mankato, Minnesota. Eight varieties were replicated in an  $8 \times 8$  Latin Square design. The plots were four-rows wide (22-inch rows) and 35 feet long. The two center rows were harvested for yield and sucrose determinations. All plants in the plots were counted and the number of plants with savoy determined. The percent savoy for each variety was reported by Coons et al. (2). Leaf spot readings and yield also were taken and the results correlated. Both leaf spot and savoy diseases were severe.

## Results

The mean yield data for each area where the American Crystal and the U. S. Department of Agriculture tests were conducted in 1964 are shown in Tables 1 and 2. The yield data and average disease percent for the 1955 cooperative test are given in Table 3.

Table 1.—Yield, percent sugar, stand and disease percentage for the 64 American Crystal varieties tested in 1964 in Central Nebraska.

Location	Lbs sugar per acre	Tons per acre	Percent sucrose	Stand per 35'	Percent savoy	Percent yellow vein
Overton	3521	15.22	11.64	26.0	29.2	7.0
Kearney	6222	22.56	13.79	30.9	7.2	4.0
Shelton	4482	17.87	12.54	38.5	11.6	6.6

Table 2.—Yield, percent sugar, stand and disease percentage of the cooperative USDA tests conducted in 1964 in Central Nebraska.

Location	Lbs sugar per acre	Tons per acre	Percent sucrose	Stand per 35'	Percent savoy	Percent yellow vein	Leaf spot ratings <sup>1</sup>
Kearney	6945	23.43	14.82	37.0	4.84	3.68	
Shelton	5483	19.32	14.19	39.7	10.42	4.16	3.5

<sup>1</sup> 1 = no leaf spot.

5 = plants completely defoliated by leaf spot.

Table 3.—Yield, percent sugar, stand and disease percentage for the cooperative USDA test conducted in 1955 at Mankato, Minnesota.

Location	Lbs sugar per acre	Tons per acre	Percent sucrose	Stand per 35'	Percent savoy	Leaf spot ratings <sup>1</sup>
Mankato	4042	17.61	11.45	30.4	20.0	3.09

<sup>1</sup> 1 = no leaf spot.

5 = plants completely defoliated by leaf spot.

Table 4.—Correlation coefficients of diseased plants and yield for American Crystal's variety tests conducted in 1964 in Central Nebraska.

Characters	Locations			
	Overton	Kearney	Shelton	Composite
Savoy × sucrose	-.318*	-.161	-.107	-.627**
Savoy × tons	-.313*	-.033	-.258*	-.583**
Savoy × sugar per acre	-.284	-.101	-.328**	-.630**
Savoy × yellow vein	-.113	-.007	.108	.102
Yellow vein × sucrose	.198	-.192	.003	-.128
Yellow vein × tons	.096	-.104	.176	-.170*
Yellow vein × sugar per acre	.142	-.198	.195	-.197**
n =	64	64	64	192

\*Significant at the 5% level.

\*\*Significant at the 1% level.

Table 5.—Correlation coefficients of diseased plants and yield for the cooperative USDA tests conducted in 1964 in the Central Nebraska area.

Characters	Locations		
	Overton	Shelton	Composite <sup>1</sup>
Savoy × sucrose	-.728*	-.839**	-.778**
Savoy × tons	.047	-.263	-.181
Savoy × sugar per acre	-.337	-.478	-.439
Savoy × yellow vein	-.268	.004	-.073
Savoy × leaf spot	---	.894**	---
Yellow vein × sucrose	.128	-.336	-.146
Yellow vein × tons	.159	-.375	-.194
Yellow vein × sugar per acre	.242	-.385	-.173
Yellow vein × leaf spot	---	-.188	---
Leaf spot × sucrose	---	-.814*	---
Leaf spot × tons	---	-.335	---
Leaf spot × sugar per acre	---	-.557	---
n =	8	8	16

<sup>1</sup> Calculated by covariance analyses.

\*Significant at the 5% level.

\*\*Significant at the 1% level.

Table 6.—Correlation coefficients of diseased plants and yield for the cooperative USDA test conducted in 1955 at Mankato, Minnesota.

Characters	Correlation coefficients
Savoy × sucrose	-.752*
Savoy × tons	-.574
Savoy × sugar per acre	-.777*
Savoy × leaf spot	.527
Leaf spot × sucrose	-.787*
Leaf spot × tons	-.261
Leaf spot × sugar per acre	-.634
n =	8

\*Significant at the 5% level.

Correlation coefficients were calculated between the attributes studied for each test and are given in Tables 4, 5 and 6. The incidence of each of these diseases was very high and many plants had all three diseases, therefore, it would be impossible to separate out the effects attributed to each disease separately. However, the degree which the characters are associated is shown by the correlation coefficients.

### Discussion

The results shown in the previous tables indicate that the diseases of leaf spot and savoy seriously limit the growth of sugar beets and the accumulation of sucrose. The correlation coefficients between these diseases with weight and sugar are generally high and approach significance even with a low number of degrees of freedom. Both diseases appear to have greater detrimental effects on sucrose accumulation than on root weight.

Savoy and leaf spot were highly positively correlated, indicating plants that were susceptible to one disease also were susceptible to the other. Just what the interrelationships between these two diseases are is not known. Schneider (4) studied the transmission of savoy virus and found that symptoms appear from 19 to 78 days after insects were placed on test plants. The average number of days for the symptoms to show was 40 days. If the same amount of time is required for savoy symptoms to appear in the field, it appears likely that the plants are infected with savoy before they are infected with leaf spot. Whether or not savoy predisposes plants to leaf spot is not known. It also is not known whether or not the same mechanism that conditions resistance to leaf spot may also give resistance to savoy. Regardless of these unknown factors, the results indicate that if savoy were to become a serious factor in crop production, control probably could be obtained by using leaf spot resistant varieties in breeding savoy resistant varieties.

Yellow vein virus was prevalent in the Central Nebraska beet areas in 1964. Although it was not highly correlated with root yield and percent sucrose, nevertheless, in most tests the correlations were negative. These negative correlations indicate that it has an adverse effect on sugar production. The results also indicate that this virus is not strongly associated with either savoy virus or *Cercospora* leaf spot. Apparently this disease has not caused serious loss to the beet crop as a whole, although it appears capable of causing severe reduction in yield.

Considering the two virus diseases, savoy and yellow vein, savoy depressed sugar yield more than did yellow vein.

### Summary

The presence of savoy and yellow vein viruses and *Cercospora* leaf spot was observed in several variety tests. Infected plants were counted and correlated with yield components. The percent savoy infected plants were highly negatively correlated with root yield and sucrose percent. Yellow vein infected plants also were generally negatively correlated with yield and sugar but not as strongly as savoy.

Savoy and leaf spot infections were positively correlated. Reasonable control of savoy virus probably could be expected by using leaf spot resistant varieties.

### Literature Cited

- (1) BENNETT, C. W. 1956. Sugar beet yellow vein diseases. *Plant Disease Repr.* 40: 611-612.
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