

# Sugar Beet Infection by More Than One Strain of Curly-Top Virus

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## Introduction and Methods

These experiments were undertaken as an extension of earlier studies by Giddings (3, 4)<sup>2</sup> and include curly-top virus strains that were not available during the earlier work. Plants grown from curly-top susceptible sugar beet roots 2 to 3 inches in diameter were used for the maintenance of all virus cultures. Such plants are designated as source plants. Approximately 30 adult leafhoppers or 50 nymphs were used in making each of the original transfers to source plants and up to 50 leafhoppers or nymphs, according to numbers available, were used for subsequent transfers. To assure infection by both strains of a combination, the future source plant was first inoculated by the less virulent curly-top virus strain, or by one that it was hoped might be suppressed, and some days later, by the second strain of the combination.

Small, usually two-leaf, susceptible and/or resistant seedling sugar beet plants were used in making tests from either single strains or combinations of the strains. Final readings of symptom severity and/or mortality were usually made about six weeks after inoculation.

The severity of grade of symptoms is based on a scale of 5 points with non-infection indicated by 0.0.

Fourteen virus strain combinations were used, eight of which had not been tested before.

## Results and Discussion

Table 1 gives the results from four virus strain combinations that had not been previously reported. The original, single-strain colonies, listed in Table 1, had been maintained for several years and no date for the original source plant inoculations is given. The first date given in the left-hand column shows when the first of the two-combination virus strains was inoculated into the source plant; the second virus strain inoculation was made on the second date.

The data given in Table 1 deals only with severity of symptoms and mortality of test plants. The percentage of plants infected is a factor that seems unnecessary to include. Strains 7 and 3 rarely infect the highly resistant sugar beet and any such plants infected show very mild symptoms. Susceptible beet plants infected

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

Table I.—Results of Tests from Large, Susceptible Sugar Beet Plants Infected by Curly-top Virus Strain Combinations, Showing Severity of Symptoms and Mortality of Susceptible Test Plants and Severity of Symptoms of Resistant Test Plants.

Dates of First Transfer to Source Plant	Virus Strains Used	Test Dates							
		1954		1955			1956		
		Aug.	Feb.	May	July	Nov.	Mar.	June	
<b>A. Results on Susceptible Test Plants</b>									
		Average Symptom Severity							
		7	1.1	1.3	0.9	0.5	2.1	2.3	1.8
		2	2.0	1.8	2.0	1.4	1.1	1.2	1.6
		3	5.0	3.6	4.1	4.4	3.5	3.3	3.5
1/22	2/2/55	7 + 11		5.0	4.7	5.0	4.8	4.6	4.8
1/22	2/2	2 + 11		4.7	5.0	4.0	4.9	4.9	4.8
1/26	2/2	3 + 11		4.7	4.9	4.4	5.0	5.0	4.7
		11	5.0	4.5	4.7	5.0	5.0	5.0	4.9
		3	5.0	3.6	4.1	4.4	3.5	3.3	3.5
2/2	2/26	3 + 12		3.0	4.3	2.5	3.0	2.9	2.9
		12	3.5	3.1	2.0	3.4	1.9	2.3	1.5
		Percent Mortality After Approximately Six Weeks							
		11	75	33	73	64	18	14	60
		7 + 11		27	50	37	27	20	50
		2 + 11		42	73	56	33	18	40
		3 + 11		25	42	100	20	37	67
<b>B. Results on Resistant Test Plants</b>									
		Average Symptom Severity							
		7	0.0	0.0	0.0	0.0	0.0	0.0	1.0
		2	0.9	0.7	0.8	0.7	1.1	0.7	1.3
		3	0.0	0.0	0.0	0.0	0.0	0.0	1.0
1/22	2/2/55	7 + 11		2.7	3.4	4.8	4.3	3.4	4.6
1/22	2/2	2 + 11		3.8	3.3	3.4	4.7	4.9	4.4
1/26	2/2	3 + 11		2.6	2.7	3.5	4.3	4.6	4.0
		11	3.4	4.5	3.6	3.0	4.9	5.0	3.1
		3	0.0	0.0	0.0	0.0	0.0	0.0	1.0
2/2	2/26	3 + 12		2.0	1.5		0.0	0.0	1.0
		12	1.0	0.0	0.0	1.8	0.0	1.0	1.0

by strain 7 show very mild symptoms while similar plants infected by strain 3 show severe symptoms. Strains 2 and 11 readily infect both susceptible and resistant test plants but strain 2 induces mild symptoms while strain 11 induces very severe symptoms, with a high mortality among susceptible plants and severe symptoms in the resistant beets. Strain 12 induces a different type of symptom than the others mentioned and is relatively mild on both susceptible and resistant beets with a comparatively low rate of infection among the resistant plants.

Considerable variation is evident in the severity of symptoms recorded at different test dates. Such variations apply to the

plants infected with the original single virus strains as well as to those infected by the two-strain combinations. These variations are largely accounted for by differences in the environmental conditions at the times of the tests, age and size of test plants, and differences in the genetic character of the test plants.

It was necessary to change the variety of both susceptible and resistant test plants during the period of the experiment. Larger numbers of test plants would also have tended to smooth out some of the differences indicated in severity between different test dates. Symptom severity variations are well illustrated in Table I and Figure 2 of an earlier publication (2, pp. 886-887 and 890). The percentage mortality is given for only those strain combinations in which a significant number of the susceptible test plants died.

It is interesting to note that infection by a combination of 2 virus strains does not seem to induce greater symptom severity than infection by the single, more-virulent strain of the combination. Similar evidence was obtained from some other experiments, although an earlier report by Giddings (1) suggested that there appeared to be greater severity from the combined infections.

### Summary

Some new combinations of curly-top strains were tested on large, susceptible sugar beet plants. Plants infected by one strain of the virus were readily infected by a second strain. Young test plants inoculated from such sources gave no indication that the earlier infection of the source plant by one curly-top virus strain tended to significantly reduce the virulence or change the character of either virus strain after infection by a second, more virulent strain, or a strain inducing characteristically different symptoms.

The environmental conditions and host relationships that might induce mutations of this virus should have further study.

### Literature Cited

- (1) GIDDINGS, N. J. 1938. Studies of selected strains of curly-top virus. *Phytopathology* (Abst.) 28:670.
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