THE EFFECT OF LATENT MOSAIC (VIRUS X) ON YIELD OF POTATOES IN MAINE

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Latent mosaic, so called because it is carried by Green Mountain and certain other potato varieties without producing conspicuous symptoms, is harbored more generally by most of the old and some of the new potato varieties than any of the other potato viruses. Although an occasional tuber free from latent mosaic (virus X) has been found among some of the old varieties, healthy tubers free from latent mosaic have not been found in tests with thousands of Green Mountain tubers from several potato regions. In the case of many varieties it is practically impossible to diagnose latent mosaic plants in the field. Notwithstanding the general latent mosaic infection in these varieties, they are healthy by commercial standards, but the stocks are diseased according to scientific standards. The general distribution of latent mosaic in potatoes suggests the importance of information about its effect on yield.

Bald and Norris (1) found that in Australia latent mosaic in President and Up-to-Date varieties reduced the yield about 30 per cent and that it is one of the chief causes of the reduction in yield of potatoes in Australia, but, because its effects are evenly spread almost over the entire crop, it passes unnoticed.

Scott (5) reported that in Scotland latent mosaic (virus X) was responsible for yield reductions of 16 to 25 per cent, and that similar yield losses resulted from virus A.

EXPERIMENTAL PROCEDURE

For comparative studies healthy as well as latent-mosaic-infected tubers of Chippewa, Katahdin, and a seedling selection of Green Mountain parentage were used. Two strains of Green Mountain, one har-

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boring weak virus X and the other common virus X, were used to determine the effect on yield of these two virus X strains.

The Green Mountain seedling selection originated from open-pollinated seed and is practically identical with the commercial Green Mountain variety in foliage characters and in susceptibility and reaction to virus diseases. It contracts latent mosaic readily by foliage contact and manifests common latent mosaic by light green foliage. The Chippewa variety also becomes readily infected with latent mosaic by foliage contact and manifests this disease by light green and mottled leaves. Katahdin rarely contracts latent mosaic in the field, so artificial inoculations were made to obtain diseased stock for the yield tests. Katahdin manifests common latent mosaic by light green and slightly rolled leaves. Since no Green Mountain free from the virus is available, two stocks of Green Mountain were used, one harboring a weak strain of virus X, the other the common virus X. The Green Mountain strain harboring weak virus X was obtained from Vermont, and that infected with common virus X was from Maine.

With the exception of the Green Mountain stock that was infected with the weak strain of virus X, the varieties used in the yield tests harbored the common strain of virus X that is present in many commercial potato varieties.

Weak virus X is so called because it infects Jimson weed (*Datura stramonium*) without producing symptoms, whereas common virus X induces distinct mottling, or a typical mosaic. Jimson weed, when harboring weak virus X, is protected against infection with stronger strains of virus X.

The healthy and the virus infected stocks were propagated in isolated plots to provide seed potatoes for the yield tests in 1939 at Aroostook Farm, Presque Isle, Maine.

Diseased and healthy tubers were cut into 1-ounce seed pieces which were planted 14 inches apart in rows 3 feet apart. At least fifty four-hill replicates were used for each of the diseased and healthy lots in a variety. The replicates were planted so that a diseased one alternated with a healthy one in the same row, as well as between rows. To prevent contact infection, a hill of a variety immune from latent mosaic was planted between the mosaic and healthy replicates. To test for virus X, inoculations were made to Jimson weed and pepper (*Capsicum* sp.) from representative leaves of the healthy plants.

At the end of the growing season, during the last week in September, the potatoes were harvested and weighed.

Results

The results recorded in table 1 disclose that latent mosaic in Chippewa reduced the yield 13 to 14 per cent and in Katahdin 12 to 22 pre cent; the latent-mosaic infected Green Mountain seedling selection yielded 9 per cent less than the healthy; and the weak-latent-mosaic Green Mountain outyielded the common-latent-mosaic Green Mountain by 9 to 10 per cent.

Similar yield tests conducted in 1937, 1938, and 1940 at Aroostook Farm gave about the same results as those obtained in 1939.

Latent mosaic in Katahdin, which rarely contracts this disease in the field, depressed the yield somewhat more than in the other varieties tested. The reduction in yield is influenced by the strain of virus X, as the Green Mountain with weak virus X yielded more than Green Mountain harboring common virus X.

Although thousands of tubers representing Green Mountain stocks from different localities in the New England States and Canada have been tested, no plants free from latent mosaic have been found in this variety, so it has been impossible to compare yields between healthy and latent-mosaic-infected plants of this variety. However, the Green Mountain seedling selection used in the latent mosaic yield tests closely resembles the Green Mountain.

Experience has shown (2, 3) that on Aroostook Farm mild mosaic caused by viruses A + X reduces the yield about 25 per cent.

Yield tests with virus A in seedling selection 41956, which is immune from virus X, showed that in this selection virus A reduced the yield 28 per cent, or about the same as viruses A + X in the Green Mountain seedling. Since virus X in Katahdin reduced the yield as much as 22 per cent, it is possible that in some varieties virus X, especially when represented by the more severe strains of this virus, is responsible for as great losses in yield as those from virus A.

Inasmuch as the comparative yield tests show that latent mosaic is responsible for 10 to 20 per cent reduction in yield and that this mosaic is generally harbored by most of the old potato varieties and some of the new varieties, it is evident that latent mosaic when occurring alone is responsible in this country for annual losses in yield of some millions of bushels. Furthermore, because latent mosaic in combination with other viruses affects the potato more adversely than when alone, additional yield losses of millions of bushels result from virus X in such mixed infections.

TABLE 1. *Effect of latent mosaic (virus X) on yield of potato. Aroostook Farm, Presque Isle, Maine, 1939.*

Variety	Yield per Acre		Reduction	Odds
	Healthy	Diseased		
	Bushels	Bushels	Per cent	
Chippewa	476 ± 8.36	414 ± 7.23	13	19,230:1
Do	472 ± 9.29	409 ± 9.00	13	825:1
Do	469 ± 8.52	401 ± 7.09	14	19,230:1
Katahdin	315 ± 4.17	277 ± 4.12	12	19,230:1
Do	324 ± 6.10	270 ± 4.25	16	434,782:1
Do	366 ± 6.18	286 ± 6.26	22	M [3] :1
Green Mountain	445 ± 7.73 [1]	395 ± 7.31 [2]	10	656:1
Do	444 ± 5.62 [1]	403 ± 5.63 [2]	9	1,350:1
Green Mountain Seedling	415 ± 6.32	376 ± 6.24	9	174:1

[1] Harboring weak latent mosaic.
[2] Harboring common latent mosaic.
[3] M=A million or more.

Control

Procedures for controlling latent mosaic involve (1) propagation of healthy seed stocks in isolated tuber-unit seed plots, (2) protective inoculation of very susceptible varieties with the weak virus X strain, and (3) breeding varieties immune from virus X.

Isolated seed plots

To prevent infection the healthy seed potatoes must be grown in isolated fields, because susceptible varieties contract latent mosaic by foliage contact with diseased plants. Since 1930, or for 14 years, the Green Mountain seedling selection, which is very easily infected with virus X, has been maintained free from this virus on isolated seed plots. By growing test samples of this seedling selection in contact with latent mosaic potatoes, it has been found that during one season 30 to 40 per cent of the plants contracted this disease.

Protective inoculation

The Green Mountain harboring weak virus X has been grown for 10 seasons in alternate hills with Green Mountain carrying common virus X without contracting this common strain. Likewise in exposure tests for several years stocks of the Chippewa variety that were artificially inoculated with weak virus X have not contracted stronger strains of this virus. Thus plants harboring a weak strain of virus X are immune from stronger strains of this virus. This experience shows that the more serious yield losses can probably be prevented by inoculating varieties very susceptible to virus X with a weak strain of virus X to protect them against infection with more severe strains of this virus.

Immunity from virus X

Potato varieties differ in resistance to virus X. Some varieties contract infection very easily, others rarely become infected, and some are immune from virus X. Inasmuch as most of the new varieties obtained by using virus X immune parents in crosses are also virus X immune (4), it is possible to produce immune varieties that possess other desirable characters. Such virus X immune varieties will then greatly facilitate the control of latent mosaic.

Summary

Latent mosaic caused by virus X is harbored more generally than any other virus disease by most of the old and some of the new potato varieties. This disease is harbored by some varieties without producing symptoms, whereas in other varieties it appears as a typical mosaic.

Latent mosaic is caused by several strains of virus X, which are distinguished by the severity of the host reaction. In addition to causing more severe foliage symptoms, the stronger virus X strains depress the yield more than the weak strain.

It is shown that latent mosaic reduces the yield by 9 to 22 per cent, that the yield is depressed more in some varieties than in others, and that annual losses amounting to millions of bushels result from this disease.

Control measures are indicated involving propagation of seed potatoes on isolated fields, protective inoculation with a weak strain of the virus and the development of varieties immune from latent mosaic.

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POTATO WART IN AMERICA

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From the time that potato wart *Synchytrium endobioticum* (Schilb. Perc.) was first found in the United States it has been considered a menace to potato production in this country. At that time it was prevalent in the principal potato-growing countries of Europe. It was reported from Hungary, Germany, France, Italy, Scandinavia, and the British Isles. Severe tolls occurred in many potato fields of Europe.

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