IV. VIRUSES ISOLATED FROM POTATO VARIETIES IN CULTIVATION IN CANADA - 1939

by

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The results of my investigation of the viruses found in potato varieties in Canada are presented in a series of tables.

Table 8. Isolations of Solanum Virus 1 obtained from commercial varieties.

Variety	Source	Strain
Bliss Triumph	N.B., N.S., P.E.I.	G, L
British Queen	N.B.	L
Chippewa	Que., N.B.	L, N, S
Dooley	Ont.	L, S
Earlaine	N.B.	L, N
Early Ohio	Alta.	L
Gold Nugget	Alta.	L
Green Mountain	Ont., Que., N.B., N.S., P.E.I.	G, L
Irish Cobbler	Ont., Que., N.B., N.S., P.E.I.	G, L
Katahdin	Que., N.B., N.S., P.E.I.	L, N, S
McIntyre	N.B., P.E.I.	G, L
President	Ont., N.B., N.S.	G, L, S
Sebago	N.B., Que.	G, S
Spaulding Rose	N.B., P.E.I.	G, L
Up-to-Date	Ont., N.B.	G, H, L
Warba	N.B.	G, L
White Rose	N.B.	G, L

Strains H, G, and L of Solanum Virus 1 were usually symptomless, while the D, N, and S strains gave a simple mosaic usually accompanied by a foliar necrosis. Strains H, D, G, L, N, and S were also isolated from a number of potato seedlings grown under field conditions. Potatoes grown from true seed were usually free from viruses, but readily acquired Solanum Virus 1 under field conditions. The seedlings that acquired the necrotic D, N, and S strains usually died in the 2nd or 3rd year. Those which became infected with strains H, G, and L usually showed no symptoms and were immunized against infection by the necrotic strains. A few seedlings were found in which the L strain was expressed as a simple mosaic.

A yellow strain of Solanum Virus 1 was isolated from the President and Earlaine varieties. This strain produced a characteristic yellow mottle on

Lycopersicon esculentum. Another strain which produces characteristic local lesions, ring spotting and a mottle on Solanum nodiflorum was isolated from a new potato seedling. The necrotic S strain was also isolated from a source of Solanum demissum grown under field conditions. An aberrant strain of Solanum Virus 1 resembling the S strain but apparently more potent in its reaction was found in a potato seedling grown in Saskatchewan. This strain produced marked circular brownish local lesions followed by a severe necrotic disease which usually destroyed the plant in the following hosts: Solanum nodiflorum, Capsicum annuum, Datura Stramonium, Lycopersicon esculentum, Hyocyamus niger, Nicotiana Tabacum (White Burley). In Lycium barbarum, numerous brownish local lesions, ranging from 1-2 mm. were formed on the inoculated leaves which resulted in collapse of the same. The virus did not become systemic in this host. This virus also gave rise to severe brownish local lesions on Arran Victory and President, followed by a distortion of the leaf blade and a foliar necrosis accompanied by an interveinal mottle. There was no reaction on Irish Cobbler, Green Mountain and Bliss Triumph.

Table 9. Isolations of Solanum Virus 2 obtained from commercial varieties.

Variety	Source	Strain
Bliss Triumph	N.B., N.S., P.E.I.	W, M, S
British Queen	N.B.	S
Dooley	Ont.	S
Epicure	N.B.	M, S
Gold Nugget	Alta.	S
Green Mountain	N.B., N.S., P.E.I.	W, M, S
Irish Cobbler	N.B., N.S., P.E.I.	W, M, S
Katahdin	N.B.	S
McIntyre	N.B., P.E.I.	S
President	N.B., N.S.	W, M, S
Spaulding Rose	N.B.	W, M, S
Up-to-Date	N.B.	W, M, S
Warba	N.B.	W, M, S
White Rose	N.B.	M, S

Strain W of Solanum Virus 2 is a weak almost symptomless one causing a faint waviness of the leaf blade; M is a medium strain causing a medium rugose mosaic, and S is a strong strain causing severe rugose mosaic and leaf drop streak.

All the varieties listed above, excepting Katahdin and Epicure, also carried without symptoms, a weak strain of Solanum Virus 1. The combination of Solanum Virus 1 and strong strains of Solanum Virus 2 gave rise to a severe rugose mosaic. When Solanum Virus 2 occurred alone in President, Katahdin and Epicure, it produced the characteristic chronic symptoms of this virus. The three strains of Solanum Virus 2 were also found in a number of potato seedlings grown under field conditions.

Table 10. Isolations of Solanum Virus 3 obtained from commercial varieties.

Variety	Source	Strain
Bliss Triumph	N.B., N.S., P.E.I.	W, M, S
Dooley	Ont.	M
Early Ohio	N.B., Alta.	M, S
Epicure	N.B.	M
Golden Wonder	N.B.	M
Green Mountain	N.B., N.S., P.E.I.	W, M, S
McIntyre	N.B.	M, S
President	N.B., N.S.	W, M, S
Spaulding Rose	N.B.	M
Up-to-Date	N.B.	W, M, S
White Rose	N.B.	W, S

Strain W of Solanum Virus 3 is a weak, almost symptomless one causing a faint diffuse interveinal mottle; M is a medium strain causing a mild mosaic; and S is a strong strain causing a crinkle mosaic. Golden Wonder is a symptomless carrier of the S and M strains. All the varieties except Epicure, also carried Solanum Virus 1. Combinations of Solanum Virus 1 and 3 give rise to a range of mosaics, the severity of the disease depending on the strains involved. The strong strain produced very definite mottling and distortion of the leaf blade. Solanum Virus 3 was also found in several new potato seedlings grown under field conditions. The varieties that harboured the weak strain appear to be resistant to the stronger strains. Plants affected by the weak strain are lighter in colour and slightly smaller than normal plants.

Green Mountain plants bearing Solanum Virus 3 were grafted on Irish Cobbler. In 13 days, the Irish Cobbler plants developed a severe top necrosis which was followed by a necrosis of veins and petioles of the middle leaves resulting in the destruction of the upper half of the plant. The tubers showed pin-point brownish lesions scattered throughout the flesh and severe necrotic areas around the eyes, which destroyed most of them. Plants grown from the surviving tubers appeared healthy and showed no trace of the virus.

Table 11. Isolations of Solanum Viruses, 4, 5, and 7, obtained from commercial varieties and other sources.

Variety	Source	Virus
Bliss Triumph	N.B., N.S., P.E.I.	4
Dooley	Ont.	4
Early Ohio	Alta.	4
Gold Nugget	Alta.	4
Green Mountain	N.B., N.S., P.E.I.	4
Irish Cobbler	N.B., N.S., P.E.I.	4
Spaulding Rose	N.B.	4
Up-to-Date	N.B., N.S., P.E.I.	4
White Rose	N.B.	4

Table 11. cont'd

Variety	Source	Virus
Di Vernon	N.B.	5
South American (?)	N.B.	5
New potato seedling	N.B.	5
King Edward	Ont., N.B.	7

Solanum Viruses 4, 5, and 7 were symptomless in the varieties listed above.

Solanum Virus 9 was found in the Green Mountain, Thorbeck, Bliss Triumph, Irish Cobbler and Irish Daisy varieties in which it produced a brilliant aucuba mosaic. The strain found in the Irish Daisy was a necrotic type giving rise to a necrosis in the tubers of the Green Mountain, Bliss Triumph, and Irish Cobbler varieties. This strain has been described by Dykstra, T.P. (Phytopathology 29: 917-933. 1939).

Solanum Virus 11 was identified in the Green Mountain, Irish Cobbler, Bliss Triumph, and White Rose varieties. The virus was almost symptomless in the Irish Cobbler and was expressed as a leafrolling mosaic in the other varieties.

Other Viruses

A disease of virus origin was found in the Katahdin variety, from New Brunswick and Maine, the latter of supposedly healthy stock. Affected plants showed a streaking of the stem extending in some cases along the lower side of the petiole and mid-rib and spreading along the courses of the smaller veins. The necrosis was confined to the epidermis, collenchyma and cortex. Affected leaves first developed a superficial, scattered, brownish, foliar necrosis, then became chlorotic and collapsed, but remained hanging on the stem. The advance of the disease was acropetal and starting with the lower or intermediate leaves, proceeded upwards until only the top leaves remained alive. The virus was transmitted by sap to the following hosts. In Datura Stramonium, Capsicum annuum, Nicotiana Tabacum (Samsun), Lycopersicon esculentum, and Nicotiana glutinosa, it produced a severe foliar necrosis and scattered ring spotting. In Solanum nodiflorum the virus produced light brown, circular, local lesions and a number of characteristic small, regular, ring spots on the lower and middle leaves. There were faint light grey local lesions on Lycium barbarum but no apparent systemic reaction. There was no reaction in Nicotiana rustica. The virus was transmitted by graft to healthy Katahdin plants in which it produced characteristic symptoms.

A disease of virus origin was found in some tubers from the Argentine; some of them appear to be Green Mountain. When affected plants were from 3

to 5 in. high, a top necrosis developed which destroyed from 1½ to 2 in. of the top of the plant. In some cases the entire stalk was killed back to within ½ in. of the seed piece. New shoots arose at the junction of the necrotic area and the unaffected portion of the stem which grew normally until a height of from 10 to 12 inches was attained. These new shoots showed no symptoms of the disease. The affected portion of the stems showed a necrosis of the epidermis and collenchyma which assumed the form of brownish superficial streaks and roundish to oval lesions, ranging from 1 to 5 mm. in diameter. There was also a necrosis of the vascular system and pith, which appeared as scattered brownish streaks and spots when the same was cut longitudinally. The leaves were not mottled or distorted. The tubers showed a faint necrosis of the vascular system at the stem end and a few brownish spots distributed irregularly throughout the flesh. The virus was transmitted by sap inoculation to Datura Stramonium, Solanum nodiflorum, Nicotiana Tabacum (Samsun), Nicotiana Tabacum (White Burley), Nicotiana glutinosa, Nicotiana rustica, Capsicum annuum, Lycium barbarum, Lycopersicon esculentum. A severe necrotic disease developed in all of these excepting Lycium barbarum which showed a distinct mottle. All but the Lycium died in about two weeks. The virus was also transmitted by sap inoculation to President, Arran Victory, Epicure, Up-to-Date, British Queen, Green Mountain, Katahdin, and U.S.D.A. Seedling 41956. All of these varieties excepting U.S.D.A. Seedling 41956 developed irregular brownish local lesions, ranging from 1 to 6 mm. in diameter. The inoculated leaves became chlorotic in about 12 days and dropped off. All the infected plants remained stunted. In the case of the Green Mountain the reaction was more severe than in the other varieties. The local lesions increased rapidly in size and coalesced involving the greater part of the blade, resulting in collapse of the leaf. This virus does not seem to correspond to any found so far in Canada.

A disease of virus origin was found in the Duke of York, Irish Cobbler, Bliss Triumph and Green Mountain varieties, as well as in several new potato seedlings growing in test plots and greenhouses at Fredericton. The stems of affected plants developed brownish, longitudinal lesions which extended in some cases along the petioles and mid-ribs of the leaves. The lesions usually appeared first in the intermediate section of the stem and extended upwards and downwards until the whole stalk was involved. The affected leaves developed a fine, superficial, irregular, brownish, foliar necrosis, then rolled upwards and died slowly. The dead leaves remained hanging on the stem. Longitudinal sections of affected stalks showed scattered irregular necrotic brownish coloured spots in the pith, cortex and xylem, and longitudinal, necrotic streaks in the epidermis and collenchyma, corresponding to the lesions on the stem. The disease spreads fairly rapidly in the greenhouse and reduces the yield about 30 per cent. Attempts to transmit the virus by sap inoculation to Datura Stramonium, Nicotiana Tabacum (Samsun), Capsicum annuum, Solanum nodiflorum, Lycopersicon esculentum and Lycium barbarum were unsuccessful. The disease was transmitted by graft to Irish Cobbler, Green Mountain, Duke of York, and Dunbar Yeoman, in which it gave rise to characteristic symptoms.

A condition resembling purple top was found in a plot of Katahdin, 17 per cent of the plants being so affected. The disease appears widespread in this variety. The first symptoms were a dwarfing and rosetting of the top of the plant, followed by a fading of the foliage on the margins of the younger leaflets. The stem also assumed a purplish tinge. Eventually all the leaflets rolled upwards giving the plant the appearance of being severely affected with rhizoctonia. Axillary shoots were sent out and aerial tubers were formed in some cases. The first tubers were soft, smooth with shallow eyes. The affected plant had many fibrous roots. In a few cases the terminal eye continued to grow with the result that two or more tubers were formed on the same stolon giving a beaded effect. The yield was reduced from 30 to 50 per cent. The condition resembles that described by C.R. Orton and L.M. Hill (Jour. Agr. Research 55: 153-157. 1939).

A disease of virus origin was found in President growing near Saint John. Affected plants showed a diffused, interveinal mottle accompanied by a slight waviness of the leaf blade. Old plants developed a marked rustiness on the lower and middle leaves. A virus was found associated with this disease that is readily sap transmitted to Nicotiana Tabacum (White Burley and Samsun strains) in which it produces a faint vein-clearing followed by vein-banding resembling that produced by Solanum Virus 3. Attempts to transmit the virus by sap to Nicotiana rustica, Nicotiana glutinosa, Datura Stramonium, Capsicum annuum, Solanum nodiflorum, Lycopersicon esculentum were unsuccessful. On Lycium barbarum, faint brownish local lesions with purple margins were produced on the inoculated leaves. When grafted to Arran Victory the virus produced a diffused interveinal mottle accompanied by a marked waviness and faint rusting of the leaf blade. There was no reaction in Epicure, Katahdin, Irish Cobbler, Up-to-Date and Arran Crest, but a mild mosaic was produced in Green Mountain when the virus was introduced by graft in these varieties. President plants affected with this virus were not protected against the strong strains of Solanum Virus 2 and 3. This virus was transmitted by Myzus persicae to Nicotiana Tabacum (White Burley and Samsun).