INTRODUCTION OF A VIRUS TO MCINTOSH APPLE E'ROM AN IMPORTED CLONE OF GRANNY SMITH[1]

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There have been several reports of the introduction, or suspected introduction, of viruses in fruit tree's imported to one country or continent from another. Milbrath (5) has provided a well documented report of the presence in Esperen cherry imported to the United States from France of a virus causing symptoms of Pfeffingerkrankheit in Bing cherry. Brase and Gilmer (3) have recorded the presence of rubbery wood virus in a clone of Malling I apple rootstock originally imported from England. The work of Reeves, Cheney and Milbrath (6), and Wilks (9), has provided evidence for introduction of little cherry virus in imported flowering cherry trees.

This is a report of the demonstration of a potentially serious virus occurring without symptoms in Granny Smith apple trees that were imported to British Columbia from New Zealand.

Experimental Evidence

The indicator hosts that are used in other regions have been included in host range studies of British Columbia apple viruses, in the expectation that some of the virus diseases being demonstrated in British Columbia apple plantings are manifestations of diseases described in other varieties elsewhere,

Granny Smith is the variety in which the symptoms of green crinkle and apple ring spot have been described in greatest detail by New Zealand workers (1,2). Trees of Granny Smith had been imported from New Zealand by a British Columbia grower in 1939. The trees had been purchased from a New Zealand nursery, and planted in a small block at East Kelowna, B. C. In 1958, when scions of Granny Smith were required for the host range studies at Summerland, 3 trees of the original planting remained. Two of these trees displayed mild symptoms of apple mosaic, The third tree, examined carefully in 1958, 1959, and 1960, has displayed no foliage symptoms, and was selected as a scion source, Each season, several scattered fruits were found on this and the neighbouring Granny Smith trees that bore minute areas of russeting. However this low proportion of mildly russeted fruits was not deemed justification for considering the trees to be diseased.

The first test of Granny Smith was designed to determine its reactions to the leaf pucker disease (7, 8). Scions of this variety were topworked in 1958 to 2 limbs each of 3 trees in test plots. These trees were part of a block of 19 bearing McIntosh trees that had been used in leaf pucker transmission tests.

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Ten of the trees were of a striped strain of McIntosh that has now proved to be almost completely tolerant to leaf pucker, The remaining 9 trees are of a blushed strain that displays foliage and fruit symptoms when inoculated with leaf pucker, Two of the trees to which Granny Smith was topworked (Trees 1 and 2), were of the tolerant striped strain, inoculated with leaf pucker in 1955. Tree 3 was of the sensitive blushed strain, but had served as an uninoculated check in the leaf pucker tests. Trees 1 and 2 have displayed mild foliage symptoms of leaf pucker in several seasons since their inoculation in 1955. They began to crop in 1957, bore heavy crops in 1958, and displayed no fruit symptoms in either of the se seasons prior to the topworking of Granny Smith on them, The uninoculated Tree 3 displayed neither foliage nor fruit symptoms prior to the topworking of Granny Smith on it.

In 1959, the year following application of Granny Smith scions to the 3 trees, they bore a light crop. One of the 3 McIntosh fruits on Tree 1 was recorded as having shallow skin depressions. Two of the 33 McIntosh fruits on Tree 3 had similar symptoms. There were no symptoms on the fruits of Tree 2.

In 1960, all 3 trees bore McIntosh fruits with symptoms that had not been seen previously in British Columbia. Patches of coarse scurfy russeting were evident by mid-June. By early September these russeted areas lay within large depressions on the cheeks of the fruit (Fig. IA), The depressions were underlaid by light green watersoaked flesh, extending to the core (Fig, 1B). The numbkrs of affected fruits were as follows: Tree 1 - 103/131; Tree 2 - 56/111; Tree 3 - 14/147. All of these fruits were so severely affected that they would be downgraded or culled. There were additional fruits on all 3 trees that were misshapen but not russeted. No foliage symptoms were observed. All other trees of the sensitive McIntosh strain bore fruits with symptoms characteristic of the leaf pucker syndrome (Fig. 2). The other trees of the tolerant McIntosh strain bore normal fruits, or a small proportion of fruits with mild symptoms of the leaf pucker syndrome.

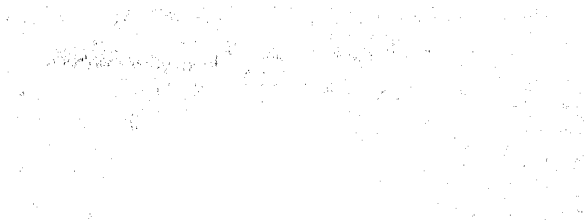
Two of the Granny Smith fruits borne in 1960 on Tree 2, and the one fruit borne on Tree 3, were slightly misshapen, but displayed no russeting symptoms. There were no symptoms on the leaves of Granny Smith branches in 1959 and 1960.

Discussion

There appears to be adequate evidence that a virus was introduced from the Granny Smith scions to the McIntosh trees. The external symptoms induced on McIntosh fruits were quite dissimilar to the much less obvious skin depressions, and the rings of very fine russeting, that occur on the fruits of trees affected by leaf pucker (Fig. 2). There were symptoms in flesh tissues, whereas fruits borne on trees with leaf pucker have never displayed symptoms in the flesh. Moreover the symptoms occurred on 2 trees of a McIntosh strain that has proved almost completely tolerant to the leaf pucker virus, and on a tree that had not been inoculated with leaf pucker.

The assumption seems justified that this virus was present in the Granny Smith tree when it was imported from New Zealand, because the fruit

Figure 1. McIntosh fruits borne on tree topworked to Granny Smith. A) Coarse scurfy russeting on depressed areas of fruit B) Watersoaked flesh extending from russeted depressions to the core.



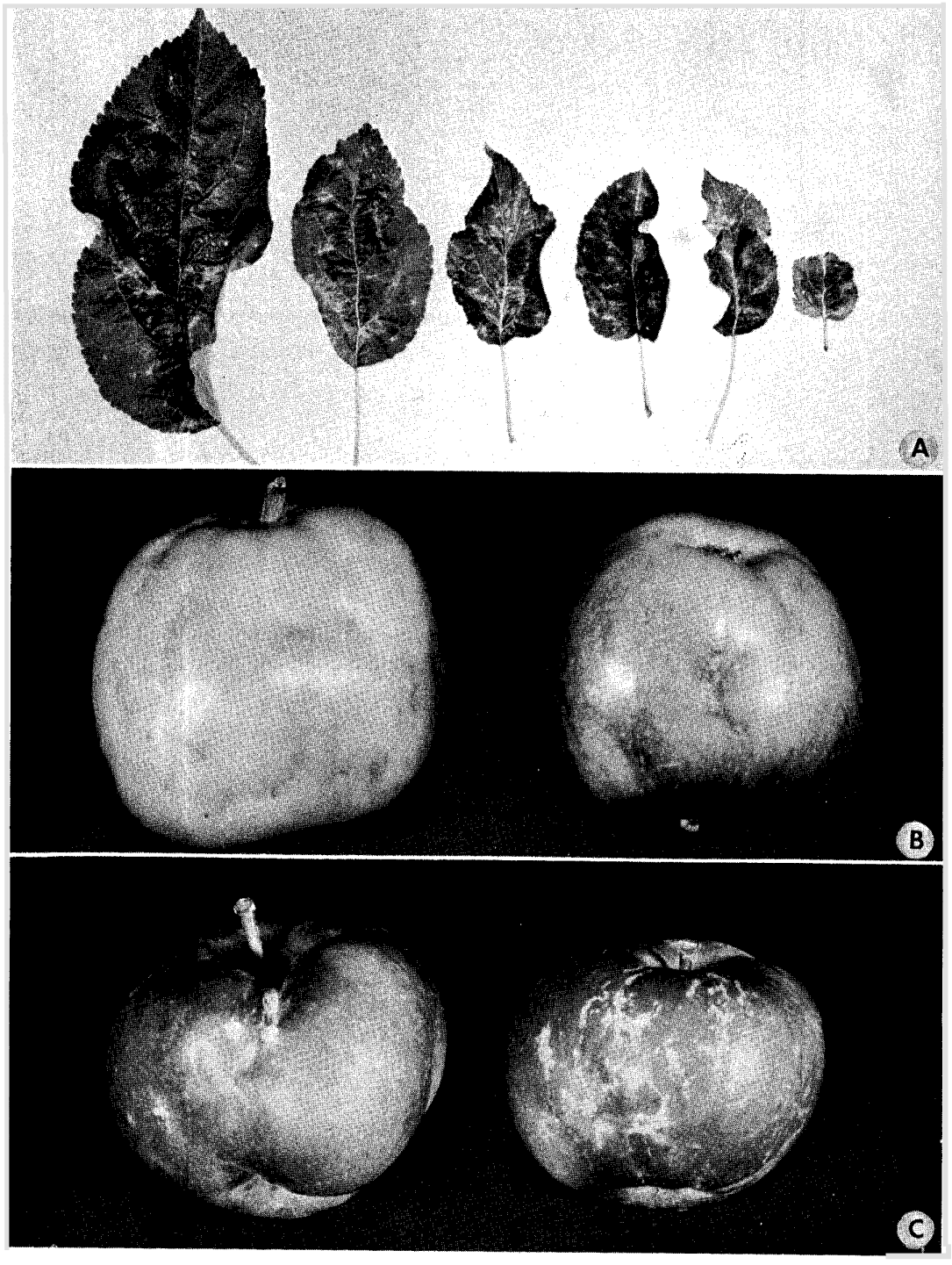


Figure 2. Leaf pucker of McIntosh. *A)* Leaf symptoms *B)* Pitting symptoms *C)* Russet symptoms.

symptoms that were induced have not been observed elsewhere in British Columbia, or reported from other parts of western North America. As McIntosh has not been grown extensively in New Zealand, or included in host range studies of New Zealand virus diseases, it is not possible so far to identify this as one of the viruses responsible for diseases occurring in New Zealand. Fortunately, the virus does not appear to spread naturally in British Columbia. The imported Granny Smith trees have been growing beside a block of McIntosh trees since 1939, without appearance of symptoms in the McIntosh.

There is a probability that the apple mosaic observed in 2 of the Granny Smith trees at East Kelowna was also in the trees when they were imported. British Columbia records of apple mosaic include only 3 other trees in 2 widely separated orchards, whereas this disease is common in New Zealand plantings (4)

This report adds evidence that there is danger, as emphasized by Milbrath (5), of innocently introducing plant viruses in symptomless species and varieties. However, it is not considered justification for exclusionary measures. Rather, it accentuates the need for thorough indexing of propagating materials used by nurseries in producing trees either for domestic use or for export. In recent years New Zealand has been a leader in the development of tree fruit nursery certification measures. Although this virus introduction was possible in 1939, it is highly improbable that it could occur in nursery stock imported from New Zealand in 1960.

The British Columbia grower has been advised to remove his imported Granny Smith trees, and all infected materials in test plots have been destroyed.

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