

The last day of this symposium will be confined to international cooperation in fruit tree virus research. This is I think a very good idea. In order to have the full profit of this research work this cooperation should be widened into a world wide contact of research workers including those in Canada, New Zealand, U.S.A., U.S.S.R. and other countries.

Herewith I declare this second symposium on virus diseases of fruit trees open and wish you all a most successful and pleasant conference to be followed by further discussions in the near future.

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## UNUSUAL FEATURES OF SOME NEW ZEALAND FRUIT TREE VIRUSES

BY

J. D. ATKINSON

Director, Fruit Research, Plant Disease Division of the Department of Sci.  
and Industrial Research, New Zealand

It is only during the past nine years that we have recognised virus diseases in the fruit trees of New Zealand. No great progress has been made but I would like to mention some features of our fruit tree viruses that may be of interest. It would be of considerable assistance if you could bring up in discussion unusual features of similar diseases that you have encountered.

### GREEN CRINKLE OF APPLES

This was not recognised as a separate disease until 1934 when an investigation was made into the much more serious problem of internal cork. During a survey of orchards in the Nelson area, several growers pointed out trees of Dunn's or Granny Smith that consistently produced distorted apples bearing a superficial resemblance to those affected by internal cork. When apples were cut open it was at once obvious that the disorders were not identical as there was no internal pitting in fruit infected with green crinkle. In the following season, when it was found that borax eliminated symptoms of internal cork but not those of green crinkle, the difference was confirmed.

An unusual feature of green crinkle is that the symptoms may remain confined to one branch of a tree for at least ten years. During that period one infected branch consistently produced distorted apples but no symptoms were observed in other parts of the tree. It is not known whether the virus is present though masked in other parts of the tree. This localisation of symptoms has also been noted in stony pit of pears. In one tree observed for four years, severe symptoms appeared regularly on one main branch while the rest of the tree produced apparently normal fruit. Scions taken from this infected branch caused systemic infection in healthy trees to which they were grafted. Lack of material has prevented the testing of other parts of the tree for the presence of the stony pit virus in masked form.

Another feature of green crinkle that is a little unusual for a plant virus is

that symptoms have been found only on fruit. A careful search for other expressions of the virus has given negative results. This appears to be a point of difference between green crinkle and rough skin. Of the other proven fruit tree viruses occurring in New Zealand, apple ring spot and plum pox are the only ones that appear to exhibit fruit symptoms only. Two suspected peach viruses, peach crinkle and stark blemish also fall into this category.

Green crinkle causes two quite distinct symptoms on fruit. Usually, infected apples are stunted with characteristic creases and folds distorting the surface, but occasionally they develop wart like swellings covered with rough russet. In the latter case there is little if any stunting. The two symptoms seen on different apples appear quite distinct, but they may both develop on a single fruit, or a tree may produce fruit with folds one year and lumps the next.

We have found no evidence of natural spread of green crinkle in the field, although natural root grafting is known to occur with the Northern Spy stock commonly used throughout the country. Thus it appears that no insect vector is present in our orchards. The variety Granny Smith which is most commonly affected came into favour quickly during the 1930's, many trees of older varieties being reworked during that decade. Much of the infection present in blocks of Granny Smith can be traced to the use of infected scions at a time when the cause of this disease was unknown.

#### RING SPOT OF APPLES

Like green crinkle, ring spot appears to produce only fruit symptoms on apple, but this and the ability to cause two distinct types of symptom are the only features common to the two diseases. The most usual expression of ring spot consists of a number of irregular patches of varying shades of brown with a rough russeted surface, and a scaly margin. In this form ring spot symptoms closely resemble bronze beetle injury and some types of spray russet. Shortly before harvest a narrow band of smooth dark brown tissue forms round the margin of many spots, and this we regard as a reliable diagnostic feature. After picking, this outer brown strip occasionally continues to develop, but most spots remain unchanged throughout the storage life of affected apples.

A less common but more striking symptom of ring spot is a series of concentric rings of dark brown tissue. Occasionally rings are almost complete, but fragmentary rings are more common. A few apples have been found showing sets of concentric rings with no patches of russet, but usually any rings found are mixed with russet symptoms. We first called this disease thumb mark, as the ring symptoms resemble thumb prints, but when surveys showed this to be a rare symptom the name was dropped.

On trees that show marked symptoms, ring spot reappears year after year, but the percentage of fruit affected and the severity of symptoms varies widely from season to season. We have not been able to find any explanation for this variation. On some trees showing a small percentage of affected apples in one year, it is often impossible to find any symptoms in the following season.

It is curious that ring spot should be widely distributed in an apple variety reputed to be an Australian seedling, but not yet reported from Australia or Tasmania. New Zealand has a most varied native flora, but few native roseaceous plants. We have found only one case of a native plant infected with a

virus, this being a disease called yellow leaf in the monocotyledon *Phormium tenax*. Thus the chances that any of our fruit viruses have come from the native flora seem remote. Most of our apple varieties were imported as worked trees or scion wood and the general picture of fruit viruses is very similar to that found in Europe and North America. We are puzzled that ring spot has not yet been reported from other countries. A recent letter from the U.S.A. suggests that a similar disease has been found there.

We know that ring spot has been present in Granny Smith since 1935, but until a few days before I left New Zealand there was no good evidence of its presence in any other variety. We have now found one Sturmer tree on one of our experimental orchards showing an appreciable percentage of apples with symptoms closely resembling the russet form of ring spot. Odd fruits of Cox's Orange, Delicious and Sturmer showing patches of russet edged with a smooth brown strip have been found in other seasons at widely different parts of the country, but these symptoms have not been found again in later years.

Our evidence of ring spot transmission by grafting from Granny Smith to other trees of the same variety is still slight, and we have not yet been able to transmit this disease to any other variety. Ring spot infected grafts were worked into healthy Granny Smith trees in 1949. Scions were placed at the tops of main branches and near the base of laterals. There was no suggestion of incompatibility and symptoms appeared in the first fruit carried by these scions and have reappeared in every subsequent crop on this infected wood. Less than 0.1% of the total crop from the originally healthy trees has shown typical symptoms. However, for the past two years one small lateral near one of the original grafts, has produced typical ring spot symptoms on each of the five or six apples that it produced. The evidence from this single lateral is clear cut when you see it in the field and it suggests that we are dealing with a virus that is transmitted much more slowly than most other fruit viruses. We have not yet found any evidence of natural spread in the field.

This brief outline covers the more unusual features of green crinkle and ring spot. In conclusion I would like to raise two other disconnected points as they may be of general interest.

First, the form of incompatibility caused by plum mosaic in a few plum and apricot varieties. As this will be dealt with more fully during the Congress proper I will give only a base outline now. Budding trials have shown that the Japanese type plums, Burbank, Sultan and Wilson's Early cannot be budded onto cherry plum stocks infected with one strain of plum mosaic, and that infected cherry plum buds would not grow on healthy trees of these three varieties. With the plum variety, Duff's Early Jewel and the apricots Moorpark and Roxburgh Red there was marked incompatibility but a small percentage of buds grew on infected stocks.

We have since found one tree of Burbank and one of Wilson's Early showing natural infection. With fourteen other varieties of Japanese plum there was no evidence of plum mosaic causing incompatibility.

Second, we have observed recently a case of apple mosaic spreading naturally to healthy apple seedlings in the nursery row. There have been reports from England of natural spread although so far as I know no vector has yet been identified. With us apple mosaic is so widespread and mild symptoms so hard to detect that we have not attempted any counts in established orchards. The

existence of natural spread may well prove an embarrassment in experimental work, and will certainly increase the difficulties of control.

#### DISCUSSION

RØNDE KRISTENSEN: showed some deformed apples of the Danish variety Gøldborg and asked whether these deformations are similar to those of green crinkle. They have been transmitted by grafting in Denmark.

*Answer:* The symptoms are quite similar to those of green crinkle on other varieties and so they may be caused by this virus.

POSNETTE: Does there exist, after the opinion of Dr ATKINSON, a possibility of seed transmission of the apple mosaic virus? It sometimes occurs that apple seedlings develop mosaic symptoms and seed transmission seems more likely than spread of the disease in the nursery.

*Answer:* There is not previously known any case of seed transmission of the apple mosaic. But in New Zealand the Jonathan variety contains for 100% a mild form of apple mosaic. Furthermore the English 'variegation' in the seedlings is quite similar to apple mosaic. So seed transmission might be a possibility.

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## FLAT LIMB (FUREDE GRENE) OF APPLE TREES

BY

H. RØNDE KRISTENSEN

Statens Plantepatologiske Forsøg, Lyngby, Danmark

#### DISTRIBUTION IN VARIOUS COUNTRIES

Flat limb was mentioned in an Australian report (JAS. LANG) as early as 1905 but was then considered a purely genetical phenomenon. In 1907 the disease was reported from Connecticut (G. P. CLINTON) in U.S.A. and then supposed to be frost damage. Later on - in 1911-12 - another hypothesis was brought forward by Australian workers (D. MC. ALPIN), namely that flat limb was due to incompatibility between the rootstock and the scions of certain apple varieties. In 1938 workers in British Columbia (J. W. EASTHAM) believed that flat limb most probably is a virus disease, as no fungus or bacterium had been found in connection with the disease. From Italy flat limb is reported in 1941 (A. BIRAGHI) as a graft transmissible disease, which has been known in Italy for many years. A Californian report from 1942 (H. E. THOMAS) describes the disease as a virosis, which is graft transmissible to *Pyracantha* sp. From Nova Scotia in 1943 (J. F. HOCKEY) flat limb was described as very annoying in the apple variety Gravenstein. In one fruit farm the disease could have existed for at least 40 years. Investigations carried out in Nova Scotia show, that flat limb is transmitted with scions from infected trees, and the results indicate that symptom expressions are strongest on trees growing on rather weak rootstocks (E.M. IX). In the Nova Scotia report it is concluded, that if flat limb