FURTHER VIRUS DISEASES OF PEAR
(Pyrus communis L.) IN NEW ZEALAND

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ABSTRACT

Indexing of pear trees (Pyrus communis L.) in New Zealand over a 10-year period showed widespread infection of ring pattern mosaic, vein yellows and red mottle, and sooty ring spot viruses. The quince stunt complex and a severe type of pear blister canker virus were also found. A programme of virus elimination by heat therapy has produced trees of several pear varieties free from infection.

INTRODUCTION

First record of a virus disease in pears (Pyrus communis L.) in New Zealand was by Atkinson (1948), who described the natural occurrence and graft transmissibility of stony pit virus. After the discovery of several latent or semi-latent viruses in pears in England during the mid 1950s, an indexing programme was begun in 1960 to ascertain if latent viruses were present in orchard pear trees used as budwood sources for commercial nursery pear propagation. Use of the indicator variety 'Beurre Hardy' and in more recent years the quince (Cydonia oblonga Mill.) clone C7/1 showed that the virus diseases described in England were present in New Zealand and that incidence of some was high. The occurrence of apple rubbery wood virus in pears in New Zealand was described by Chamberlain et al. (1971) and pear blister canker by Atkinson (1971). In the present paper three virus diseases and a virus complex causing foliar symptoms on pear and quince indicators are described. In addition, further experiments with pear blister canker virus are reported.

DESCRIPTION OF VIRUSES

(1) Ring pattern mosaic

Christoff (1935) described leaf mosaic symptoms on pear in Germany, and this is thought to be the first recording of ring pattern mosaic virus. Ring pattern symptoms on pear were later described in the Netherlands by van Katwijk (1954). Posnette (1957) found 'Beurre Hardy' and 'Doyenne d'Eté' to be the best indicator varieties

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of the disease in England. Cropley et al. (1962) suggested pear ring pattern mosaic and apple chlorotic leaf spot might be caused by the same virus, but Campbell (1967) showed that not all isolates of apple chlorotic leaf spot cause ring pattern mosaic in pears. Pfaelzter (1962) transmitted a virus to herbaceous hosts from pear leaves with ring pattern mosaic, and Cropley (1963a) concluded that this virus was probably apple chlorotic leaf spot. Dunez and Marenaud (1969) suggested that apple chlorotic leaf spot virus occurs in a number of strains which may be selected differentially by various host species.
In New Zealand, Chamberlain (1961) recorded mosaic pattern on leaves of the variety 'Louise Bonne de Jersey'. Later transmission experiments using 'Beurre Hardy' as indicator showed ring pattern mosaic to be widespread in a number of varieties. Symptoms appear on the leaves of 'Beurre Hardy' in early summer as a pale green chlorotic mottle, sometimes forming ring spots (Fig. 1). As the leaves become darker green and more mature during the summer, the lighter green chlorotic areas become more pronounced. Growth of affected plants in the nursery is not notably reduced. Although ring spot symptoms have been found in the variety 'Louise Bonne de Jersey' in the field, most pear varieties commonly grown in New Zealand appear to be symptomless carriers of the disease. Under Auckland conditions the quince rootstock clone C7/1, which has been used as an indicator for ring pattern mosaic in England, does not express symptoms as well as 'Beurre Hardy'.

Transmission experiments have confirmed that bud transmission from pears showing ring pattern mosaic can cause chlorotic leaf spot symptoms in the apple indicator R12740-7A. Sap inoculation from this apple indicator to the herbaceous hosts *Chenopodium quinoa* (Willd.) and *C. amaranticolor* (Coste & Reyn.) caused local necrotic lesions followed by a systemic mottle.
Fig. 4—Quince C7/1 showing epinasty of lower leaves caused by sooty ring spot virus.
[Photo: A. Underhill]
Indexing has shown ring pattern mosaic to be present in trees of the pear varieties 'Beurre Bosc', 'Beurre Capiaumont', 'Conference', 'Doyenne du Comice', 'Kieffer', 'Louise Bonne de Jersey', 'Packham's Triumph', 'Peter Barry', 'Williams' Bon Chrétien', 'Winter Cole', and 'Winter Nelis'. The virus has been eliminated from pear varieties with relative ease by heat therapy and tip grafting methods.

(2) Vein yellows and red mottle

The vein yellows and red mottle syndrome of pear was first recorded by Posnette (1957) in England. In New Zealand, Chamberlain (1961) described pale yellow bands along the veins of leaves of young nursery pear trees. Subsequent indexing has shown vein yellows and red mottle to be a common virus disease of pears in New Zealand.

Vein yellows symptoms develop on leaves of infected trees in spring and become most conspicuous by mid summer. General weathering of the leaves in late summer and autumn makes the symptoms less conspicuous. Early symptoms appear as small, pale yellow spots or blotches, usually associated with the finer veins and sometimes banding them (Fig. 2). The symptoms are more pronounced on young (nursery) trees than on older (orchard) trees. Severity of symptoms can vary from year to year. It is not known if the red mottling and flecking symptom which is usually associated with vein yellows is caused by certain strains of the virus or whether it is a distinct virus. Symptoms of red mottle are most pronounced in late summer and autumn and appear as scattered dark red spots or flecks usually associated with the finer veins (Fig. 3). Nursery pear trees affected with vein yellows and red mottle have a yellowish unthrifty appearance.

Symptom expression varies according to variety. Under Auckland conditions the varieties 'Beurre Alexandre Lucas', 'Beurre Hardy', 'Clapp's Favourite', 'Patten', and 'Winter Cole' show the most conspicuous symptoms. Using 'Beurre Hardy' as an indicator, trees of

Vein yellows and red mottle is readily transmitted by budding and grafting from pear to pear, but has not been transmitted mechanically to herbaceous hosts. The virus has been eliminated from important varieties by heat therapy followed by tip grafting, but has proved to be the most difficult pear virus to remove by this method.

(3) Sooty ring spot

Sooty ring spot virus on quince seedling was described first in England by Posnette (1957). As a result the C7/1 clone derived from seedlings of Quince E (Portugal Quince) has become the standard indicator for sooty ring spot virus (Posnette and Cropley 1958). Recently, it has been reported that sooty ring spot is synonymous with apple spy decline virus (Anon. 1969).

The disease was first found in New Zealand in 1968 when it was transmitted from locally grown pear varieties to the C7/1 indicator. Symptoms first appear in early summer as an epinasty of the lower quince leaves (Fig. 4). Later, characteristic small black rings develop on upper leaves (Fig. 5). Affected leaves usually become yellow and fall prematurely.

In England, *Pyronia veitchii* (Trabut) Guillaumin has been shown to be sensitive to sooty ring spot and quince stunt viruses (Campbell 1967), and transmission experiments here with this species have shown similar results.

Using C7/1 as indicator, sooty ring spot has been found in trees of the varieties ‘Beurre Alexandre Lucas’, ‘Beurre Bosc’, ‘Clapp’s Favourite’, ‘Conference’, ‘Josephine de Malines’, ‘Louise Bonne de Jersey’, ‘Packham’s Triumph’, and ‘Winter Cole’. The virus has been eliminated from several pear varieties by heat therapy and tip grafting.

(4) Quince stunt

Quince stunt, first recorded in England (Posnette 1957), is believed to be a virus complex caused by the interaction of ring pattern mosaic, sooty ring spot, and bark necrosis (apple rubbery wood) viruses (Posnette and Cropley 1963). Leaves of the quince clone C7/1 affected by this complex are small, puckered, and distorted, with conspicuous yellow chlorotic spots. Shoot growth is severely stunted (Fig. 6). In the C7/1 tests reported above, quince stunt was found only in the pear varieties ‘Beurre Bosc’ and ‘Winter Cole’. The complex has been eliminated from a ‘Winter Cole’ selection by heat therapy and tip grafting.

(5) Blister canker

Blister canker was first recorded in England (Cropley 1960) causing blisters and bark splitting on the stems of ‘Williams’ Bon Chrétien’ pear trees. In 1962, similar bark blistering and cracking was
found in a block of young ‘Williams’ Bon Chrétien’ trees at Oratia, near Auckland, New Zealand (Atkinson 1971). However, transmission trials using this inoculum source have been unsatisfactory. Symptoms did not reproduce and no transmission was obtained to ‘Williams’ Bon Chrétien’ or to ‘Doyenne du Comice’, although the latter has been found to be susceptible to blister canker in England (Cropley 1963b).

In 1967, severe bark blister symptoms were found on several trees of the pear variety ‘Winter Nelis’ in a Gisborne orchard. In a nursery trial this condition was found to be bud-transmissible, severe blister symptoms appearing in the bark of 2-year-old wood in the second season after inoculation. Both reproduction of symptoms on wood grown from the original trees and transmission of symptoms to healthy ‘Winter Nelis’ occurred. Symptoms first appeared as small blisters. These enlarged and split, the outer layer of affected bark rolling up on itself and becoming light brown in contrast to the darker brown of the surrounding healthy bark. The exposed wood turned grey, split and
Fig. 7—Blister canker virus affecting bark on second-year wood of 'Winter Nelis'. Healthy bark on left.

[Photo: A. Underhill]
cracked, and formed large cankers which gradually girdled the stems (Fig. 7). As a result dieback and death of affected stems occurred. Although transmission tests have not been made to 'Williams' Bon Chrétien' or 'Doyenne du Comice', the symptoms on the affected 'Winter Nelis' appeared similar to those illustrated for blister canker in England.

As incidence of blister canker virus appears to be low in New Zealand, it is not a serious disease problem of pears. Elimination by heat therapy has not been attempted.

INCIDENCE

An indication of the extent of infection of ring pattern mosaic and vein yellows and red mottle viruses in New Zealand was obtained from the results of indexing pear budwood trees. These trees, which had been selected as being of good bearing qualities and apparently free of stony pit virus, were located mainly in the Hastings district, the remainder being located in Auckland, Nelson, and Alexandra districts. Tests of 203 trees were made (Table 1) using 'Beurre Hardy' as indicator, and in some varieties a high percentage of infection was found. With sooty ring spot and quince stunt, indexing has been limited to single trees of selected varieties. As sooty ring spot was found to be present in 8 of the 10 varieties tested, the incidence of this virus in pear trees in New Zealand is probably as high as that of ring pattern mosaic

<table>
<thead>
<tr>
<th>Variety</th>
<th>Orchards No.</th>
<th>Trees No.</th>
<th>Ring Pattern Mosaic</th>
<th>% Infected</th>
<th>Vein Yellows and Red Mottle</th>
<th>% Infected</th>
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<tbody>
<tr>
<td>(1) Beurre Bosc</td>
<td>3</td>
<td>17</td>
<td>17</td>
<td>100</td>
<td>15</td>
<td>94</td>
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<td>(2) Beurre Capiaumont</td>
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<td>2</td>
<td>2</td>
<td>100</td>
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<td>100</td>
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<tr>
<td>(3) Conference</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>100</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>(4) Doyenne du Comice</td>
<td>2</td>
<td>12</td>
<td>5</td>
<td>42</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>(5) Kieffer</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>100</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>(6) Louise Bonne de Jersey</td>
<td>2</td>
<td>17</td>
<td>16</td>
<td>94</td>
<td>16</td>
<td>94</td>
</tr>
<tr>
<td>(7) Packham's Triumph</td>
<td>2</td>
<td>20</td>
<td>18</td>
<td>90</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td>(8) Peter Barry</td>
<td>3</td>
<td>23</td>
<td>17</td>
<td>74</td>
<td>11</td>
<td>48</td>
</tr>
<tr>
<td>(9) Williams' Bon Chrétien</td>
<td>4</td>
<td>42</td>
<td>12</td>
<td>29</td>
<td>19</td>
<td>45</td>
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<tr>
<td>(10) Winter Cole</td>
<td>4</td>
<td>30</td>
<td>29</td>
<td>97</td>
<td>22</td>
<td>73</td>
</tr>
<tr>
<td>(11) Winter Nelis</td>
<td>3</td>
<td>28</td>
<td>14</td>
<td>50</td>
<td>19</td>
<td>68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>203</strong></td>
<td><strong>142</strong></td>
<td><strong>70</strong></td>
<td><strong>138</strong></td>
<td><strong>68</strong></td>
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</table>
and vein yellows and red mottle. Incidence of the quince stunt complex appears to be lower. Bark blister does not appear to be common, but some varieties may be latent carriers of the disease.

SPREAD OF INFECTION

Most of the popular pear varieties in New Zealand are of European origin and have been in this country for many years. Pear viruses were not known during the nineteenth century and it is likely that most varieties were infected with virus diseases when they were imported.

Spread of infection in New Zealand is thought to have been almost entirely through use of infected scion-wood during nursery propagation, or by the grafting of infected pollinator wood into orchard trees. Transmission by pruning instruments is considered unlikely. As pears in New Zealand are normally propagated on pear seedling stocks, transmission by rootstocks is unlikely. Although seed transmission of vein yellows and red mottle has been recorded in England (Posnette 1963), no seed-transmitted pear virus has been found in 10 years of nursery work at Plant Diseases Division. Pollen transmission of pear viruses is not thought to occur.

EFFECT ON GROWTH AND YIELD

Little information is available in New Zealand on the effects of pear viruses on growth and yield. When the variety 'Winter Cole' (known to be infected with stony pit, vein yellows and red mottle, and the quince stunt complex) was budded on to pear seedling rootstocks, the resulting growth was weak and lax, most plants being unable to support themselves. Four of the 10 scions were broken off by wind because of weak unions. Plants of the same 'Winter Cole' clone from which viruses had been eliminated by heat therapy were upright and vigorous and their unions strong. None of the 10 healthy scions were broken off by wind.

In England, much of the incompatibility between pear varieties and quince rootstocks is caused by virus infection (Cropley 1967). More widespread use of quince rootstocks for pears will be possible as virus-free varieties become available.

The effect of viruses on orchard pear trees is not yet known, but yields of the more susceptible varieties are likely to suffer through infection. Trees of varieties particularly susceptible to vein yellows and red mottle have been observed to be slow growing and have a sickly, yellowish appearance. The other leaf symptom viruses do not normally show visible symptoms on orchard trees in New Zealand.

CONTROL MEASURES

When results of indexing showed that virus diseases were widespread in New Zealand pears, a programme of virus elimination by heat
therapy and tip grafting was initiated. By this method pear foliar-
symptom virus diseases and apple rubbery wood virus were eliminated
from the varieties ‘Peter Barry,’ ‘Williams’ Bon Chrétien’, ‘Winter Cole’,
and ‘Winter Nelis’. Scion-wood of these varieties is being distributed
to nurseries for the propagation of virus-free trees for orchard planting.

There is some evidence that a severe strain of stony pit may have
been eliminated from a ‘Winter Cole’ selection by these methods, as
the stem-pitting symptom usually associated with trees infected with
stony pit was not present in trees grown after heat therapy. However,
results of stony pit elimination cannot be confirmed until the treated
trees bear fruit.

Because there has been no record of insect transmission of the
viruses described, it is unlikely that virus-free trees planted in orchards
will become infected by such vectors. However, care will have to be
taken that the new plantings are located so that natural root grafting
does not occur. Also, the practice of grafting some branches with
pollinator varieties will have to be avoided unless a known virus-free
source of the pollinator is available.

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