PLANT PATHOLOGY

VIRUS DISEASES OF RED CURRANT

By J. M. THRESH

Abstract

Black currant reversion, cucumber mosaic, white mosaic, strawberry latent ringspot, and raspberry ringspot viruses have each been found once in red currants in Britain. On present limited evidence they seem to be rare and of little economic importance. European currant mosaic and arabis mosaic viruses are relatively common in the National Fruit Trials, and vein-banding virus is so widespread that it will be difficult to select uninfected clones of certain varieties. Vectors are known for all except currant mosaic, but there is little evidence on rate and pattern of spread between bushes.

The red currant crop in Britain has declined in importance in recent years to an area of approximately 700 acres, compared with 15,000 acres of black currants and 5,000 acres of gooseberries. The situation is quite different in Holland, France, Germany, Yugoslavia, Scandinavia and North America, where the red currant crop is important and the substantial areas sometimes exceed those of black currants and gooseberries.

The main commercial varieties have been grown for many years. They have originated in various countries including U.S.A., France, England and Holland, from crosses involving *Ribes rubrum* L., *R. rubrum* var. *pubescens* Swartz., *R. sativum* Syme (*R. vulgare* Jancz.), *R. petraeum* Wulf. and recently *R. warscewiczii* Jancz. and *R. multiflorum* Kit. There has been ample opportunity for viruses to accumulate, and diseases known or thought to be caused by viruses have been described in Czechoslovakia (2, 3), Germany (11, 21, 22, 24), and Holland (9, 14). The present paper summarizes the situation in Britain.

DISEASES CAUSED BY APHID-TRANSMITTED VIRUSES

Vein-banding

This disease is attributed to gooseberry vein-banding virus.

Symptoms

Infection causes broad, yellow or pale-green bands along the main veins of the first-formed leaves (Fig. 1). Later leaves tend to be symptomless or develop a narrow banding and clearing of the main and subsidiary veins (Fig. 2). Symptoms vary considerably between years and are said to be pronounced in cool, cloudy seasons (15).

Varieties

The 126 varieties in the National Fruit Trials at Faversham, Kent, have been observed for several seasons. A few varieties have always been symptomless, while many others produce slight symptoms and these only at certain times in some seasons. Other varieties consistently produce conspicuous symptoms. Clones of some of the main commercial varieties are not uniformly infected.

Distribution

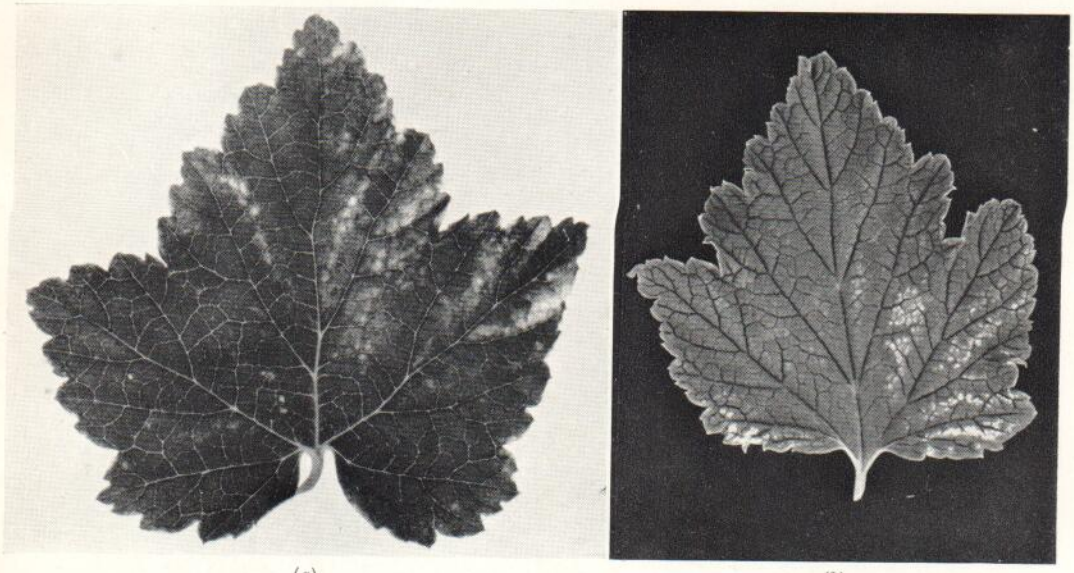
Infection occurs throughout Great Britain and virtually all nurseries and plantations contain infected bushes of one or more varieties. Experience in Holland suggests that spread is slow (15).

Vectors

Vein-banding is caused by a virus that is identical or similar to gooseberry vein-banding virus, which is transmitted by *Aphis grossulariae* Kaltb., *A. schneideri* Börn., *Nasonovia ribis-nigri* (Mosley) and *Hyperomyzus pallidus* H.R.L. (18, 19). These aphids and *H. lactucae* L., *Cryptomyzus ribis* L., *C. galeopsidis* (Kltb.) and *A. triglochinis* have transmitted red currant vein-banding in Holland (15, 17).

Fig. 1
Vein-banding.

Fig. 2
Vein-clearing.



(*a*) (*b*)

Fig. 3
Interveinal white mosaic (*a*) var. Laxton's No. 1. (*b*) var. Earliest of Fourlands.

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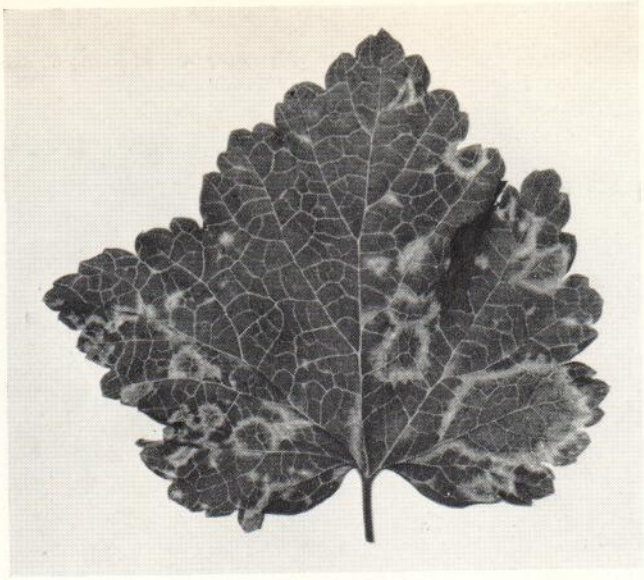
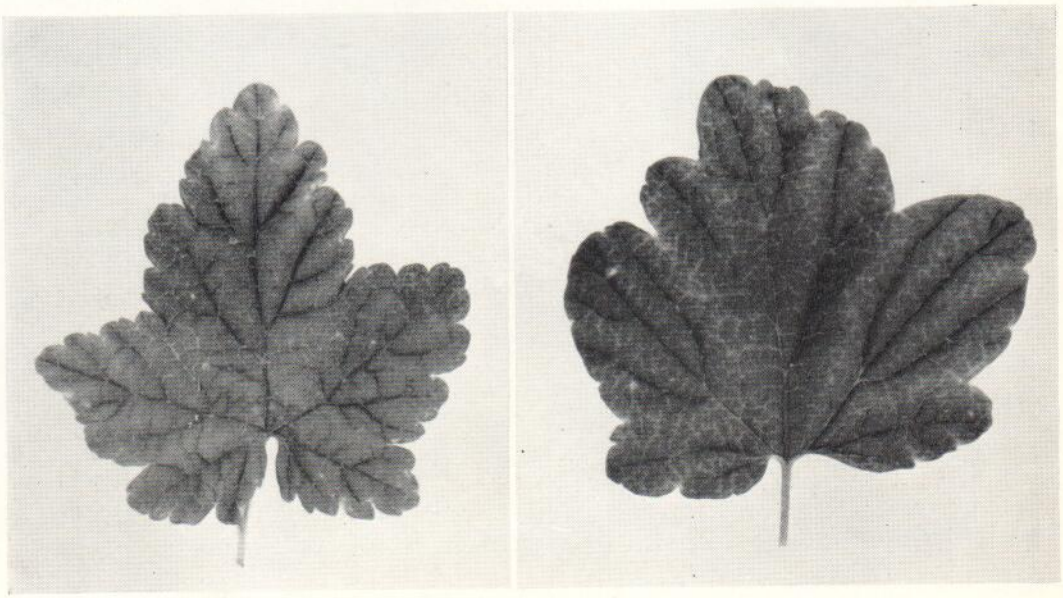


FIG. 4
Ringspot caused by raspberry ringspot virus.



(*a*) (*b*)

FIG. 5
Leaves var. Fay's Prolific (*a*) normal shape, (*b*) malformation caused by raspberry ringspot virus.

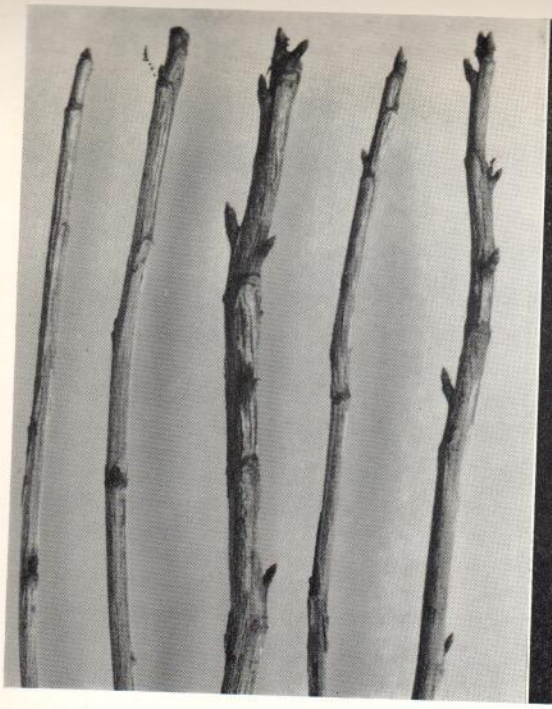


FIG. 6
Abnormal shoots var. Fay's Prolific. Some shoots have no apical bud and others have axillary buds missing or appearing between nodes.

FIG. 7
Leaf of *Ribes rubrum* var. *pubescens* infected with reversion virus.

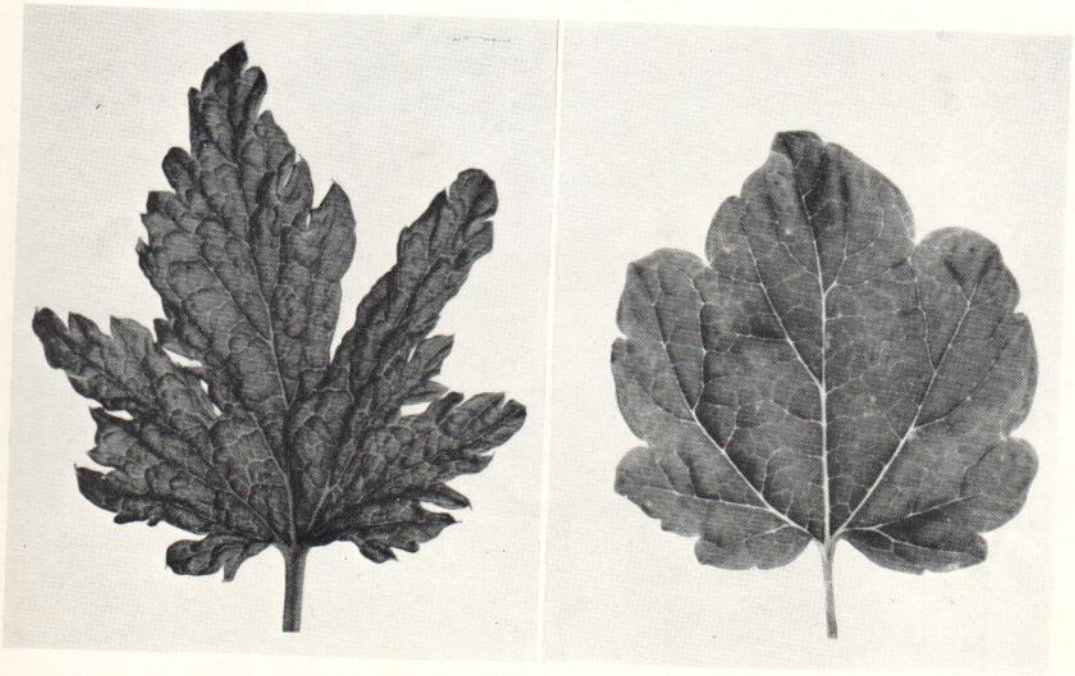


FIG. 8
Leaves from abnormal growth var. Fay's Prolific.

FIG. 9
Uninfected leaf with yellow margin, var. Laxton's No. 1.

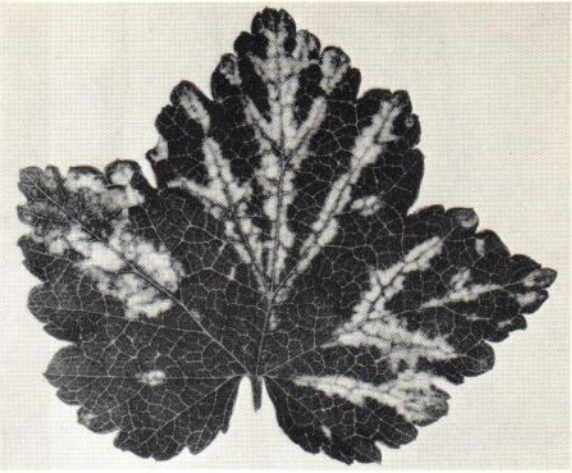


FIG. 10
Currant mosaic in May, var. Laxton's No. 1.

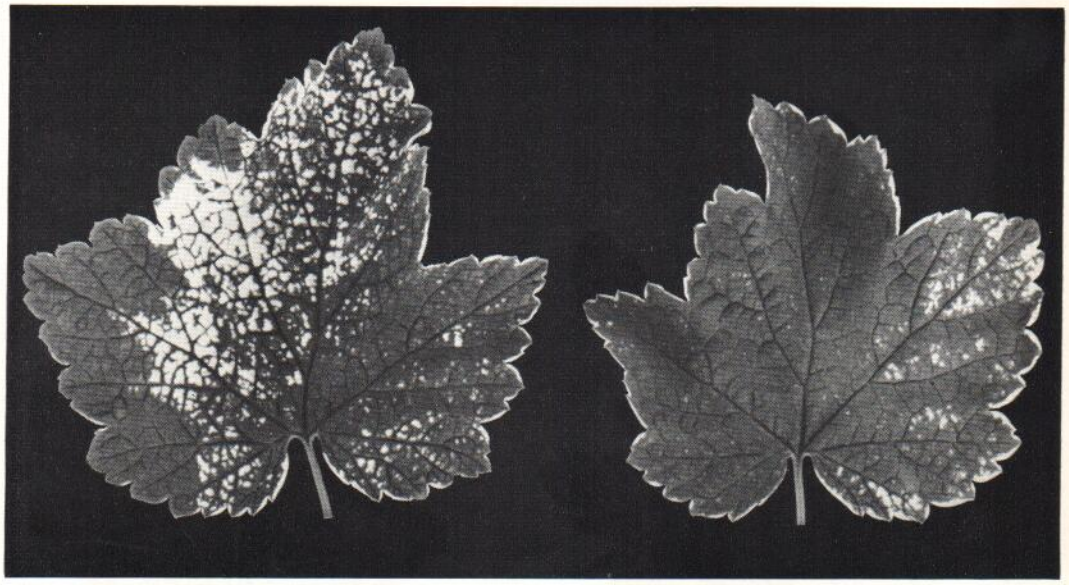


FIG. 11
Currant mosaic in June, var. Laxton's No. 1.

Control

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Indexing

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Green mottle

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Symptoms

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Varieties

The main varieti

Distribution

Natural infection
Occasional infected bu

Vectors

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Control

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Indexing

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Interveinal white mosaic

This disease may b

Symptoms

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They may tend to form a
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lost or obscured and
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Varieties and distrib

Infection has been
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No. 1.

Control

Control is largely dependent on the introduction of virus-free clones. However, the health of existing material may be maintained or even improved by rigorously selecting only symptomless material for propagation and by the effective control of aphids. Tar-oil winter washes, which destroy overwintering eggs and prevent infestations developing are preferable to spring applications of systemics. Additional sprays are necessary during the summer to control *Aphis* spp. on nursery stocks.

Indexing

The causal virus has not been transmitted by sap inoculation and the present method of indexing is by patch or chip grafts to gooseberry seedlings ex Leveller (18, 19), to red currant seedlings ex Jonkheer van Tets (15) and to black currant var. Amos Black.

Green mottle

This disease is caused by cucumber mosaic virus.

Symptoms

The usual symptoms are similar to those of cucumber mosaic virus in black currant (23). A dark green/light green mottle is seen best in leaves as they become fully expanded in April, May, and June. Symptoms are often restricted to certain branches of affected bushes and are difficult or impossible to see after mid-summer.

Varieties

The main varieties are susceptible, but there is no information on the effects on growth or yield.

Distribution

Natural infection has been found only in a single bush, var. La Constante, at East Malling. Occasional infected bushes of other varieties have been reported in Holland.

Vectors

The virus is transmitted by numerous species of aphids, including several that feed on currants and gooseberries. Currants are highly resistant to infection and there seems to be little spread within plantations.

Control

Infection seems to be so rare that specific control measures are unnecessary. However, care should be taken in the selection of material for propagation and in controlling aphids. There is also a case for controlling weeds in and around nurseries as several are hosts of cucumber mosaic virus and its vectors.

Indexing

Indexing can be done by graft transmission to black currant var. Amos Black, or by sap transmission to herbaceous hosts using extracts of leaves or dormant buds.

Interveinal white mosaic

This disease may be caused by lucerne mosaic virus.

Symptoms

Symptoms are seen best in the early leaves, some of which develop an interveinal white mosaic. The pale, irregularly shaped and indefinite areas are often concentrated about the leaf margin (Fig. 3). They may tend to form a white edge to the leaf, but this should not be confused with a non-transmissible condition found in some uninfected varieties (Fig. 9). By mid-summer the earliest leaves have been lost or obscured and the symptoms are virtually unrecognizable. Infected bushes are severely stunted, but there is no detailed information on effects on growth or crop.

Varieties and distribution

Infection has been found in a single bush, var. Laxton's No. 1, at East Malling and in occasional bushes of other varieties in Holland (14). The main commercial varieties of black and red currant

were infected in experimental transmissions, and gooseberries have been infected by lucerne mosaic virus in Germany (20). Symptoms in graft-inoculated black currants were so slight that any natural infection is likely to be overlooked.

Vectors

Lucerne mosaic virus has been isolated from the single bush of Laxton's No. 1 at East Malling with interveinal white mosaic disease, but never from symptomless bushes or from those with other symptoms. This suggests that the disease is caused by lucerne mosaic, which is transmitted by several aphid species, including some that are chance or temporary visitors to currant plantations.

Indexing

Indexing is done by graft transmission to red currant var. Earliest of Fourlands, or by sap transmission to herbaceous hosts using leaf extracts.

Diseases caused by nepo viruses

The NEPO group of viruses consists of all those with polyhedral particles that are transmitted by nematodes. Characteristically these viruses have a wide host range in weed and cultivated plants, including currants and gooseberries.

Ringspot

This disease is caused by raspberry ringspot virus (6), which is synonymous with red currant spoonleaf virus (12, 13, 16) and probably synonymous with currant ringspot virus (10).

Symptoms

Conspicuous ringspot symptoms develop in the earliest leaves produced following virus invasion of the shoots (Fig. 4). Later leaves are symptomless or abnormal in shape, with a tendency towards the pronounced ' spoon leaf ' condition as seen in the sensitive variety Fay's Prolific (Fig. 5).

Varieties

All the main varieties are susceptible, but differ in tolerance. Wilson's Long Bunch and Versailles develop slight ringspot symptoms and then recover, whereas Chenonceau develops conspicuous ringspot symptoms followed by typical ' spoon leaf '.

Some difficulty may be experienced in diagnosing the chronic symptoms of infection as some varieties, especially Fay's Prolific, have a non-transmissible tendency to produce abnormal shoots (Fig. 6) and atypical leaves (Fig. 8).

Distribution

The disease has been found affecting two sets of bushes imported from Holland (10), but has not been reported subsequently in Britain ; infection may, however, have been overlooked in tolerant varieties that do not produce the typical spoon leaf condition.

Vectors

Strains of virus from red currants and *Ribes sanguineum* Pursch. were of the Scottish type (5, 12, 16) transmitted by *Longidorus elongatus* de Man.

Control

Specific control measures are unnecessary, although red currants should not be used to replant sites where raspberry ringspot virus and its vectors were present in previous crops. Care should be taken also in the propagation and importation of material from overseas.

Soil fumigation has been used successfully in the ' De Bangert ' area of north Holland to prevent reinfection of red currants planted in contaminated land (16).

Indexing

Indexing is done by graft transmission to red currant var. Chenonceau, or by sap transmission to herbaceous hosts using extracts of leaves or dormant buds.

Latent infection

Latent infection discovered incidental grafts to black curra no definite symptom discoloured leaves w with the virus from h

Distribution

Tests on materia varieties sampled. bushes of the import with these two viruses

Vector

Arabis mosaic a soil-inhabiting nemat at the National Fruit varieties were importe

Control

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Indexing

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Reversion

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Mosaic

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Symptoms

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These symptoms a aucuba mosaic, whereas There are objections to u var. *variegatum* (4). Th currant mosaic, pending

Latent infection

Latent infection of red currants with arabis mosaic and strawberry latent ringspot viruses was discovered incidentally whilst testing for other viruses by sap inoculation to herbaceous hosts and by grafts to black currant. Infection with arabis mosaic virus is virtually latent in red currant since no definite symptoms were observed on inoculated bushes of the main commercial varieties ; slightly discoloured leaves were, however, produced when young seedlings were infected by sap inoculation with the virus from herbaceous hosts.

Distribution

Tests on material from the National Fruit Trials revealed arabis mosaic virus in 10 of the 100 varieties sampled. Moreover, strawberry latent ringspot virus was isolated from symptomless bushes of the imported variety Kernlose. There is no information on the incidence of infection with these two viruses elsewhere, or of their effects on growth and yield.

Vector

Arabis mosaic and strawberry latent ringspot viruses in other crops are transmitted by the soil-inhabiting nematode *Xiphinema diversicaudatum* Micoletzky. *Xiphinema* spp. were not found at the National Fruit Trials, suggesting that infection had occurred elsewhere, perhaps before the varieties were imported in to England.

Control

Red currants should not be used to replant sites where the viruses and their vector were present in previous crops. It will be necessary to select and release virus-free stocks if infection of commercial material is as widespread as in the National Fruit Trials.

Indexing

Indexing is done by graft transmission to black currant var. Amos Black, or by sap inoculation to herbaceous hosts using extracts of leaves or dormant buds.

Disease caused by virus with eriophyid mite vector

Reversion

The term reversion has been used somewhat indiscriminately in the past for any condition of red currants causing changes in leaf shape. There have been few attempts to infect suitable black currant indicators, yet such tests are essential for diagnosis and to distinguish the effects of reversion virus from those of its mite vector (*Phytoptus ribis* Nal.) (1), from raspberry ringspot virus and from the non-transmissible conditions that affect Fay's Prolific, Rondom, Wilson's Long Bunch and other varieties (24). In tests on suspect material from various sources in England, authentic reversion was caused only by inoculum from a clone of *R. rubrum* var. *pubescens* growing at East Malling in a collection of species. The clone was infected throughout and there was no healthy material for comparison. The leaves closely resembled those produced by black currants with reversion (Fig. 7). Flowers appeared and opened normally but failed to set fruit, again behaving exactly like infected black currants.

Disease caused by virus with no known vector

Mosaic

(Caused by European currant mosaic virus).

Symptoms

Early leaves develop a conspicuous and extensive bright yellow mottle along the veins (Fig. 10). Symptoms later become restricted to pale yellow spots which may be tinged pink (Fig. 11). By midsummer the new growth is virtually symptomless, although infection accentuates the tendency for certain varieties to develop leaves with a yellow margin.

These symptoms are similar to those described in Czechoslovakia (2, 3) and Holland (14) as aucuba mosaic, whereas the currant mosaic of Hildebrand (7, 8) in the U.S.A. seems to be distinct. There are objections to using the term aucuba mosaic for a disease unconnected with *Aucuba japonica* var. *variegatum* (4). These difficulties are avoided if reference is made to either European or American currant mosaic, pending further information on the diseases and the viruses responsible.

Distribution

Mosaic has been found in 9 of the 126 varieties grown at the National Fruit Trials. There is no information on the incidence of infection elsewhere or on the effects on growth and crop.

Vector

No vector has been found and there is no evidence of natural spread.

Indexing

Sap inoculations of herbaceous hosts have been unsuccessful, but red currants var. Laxton's No. 1 produce conspicuous symptoms the year after graft inoculation.

Discussion

Economic significance

Any assessment of the economic significance of virus diseases in the red currant crop will be premature until further evidence is available on the distribution and virulence of the different viruses and on the sensitivity of the main commercial varieties to infection. Such evidence may be difficult to accumulate as the red currant crop in Britain is so unimportant that there is no official certification scheme to ensure that planting material is true to variety and free from injurious pests and diseases. Bushes receive no routine inspections and little attention from research and advisory officers. Consequently there have been few previous reports of virus diseases affecting the crop and there is little information on the incidence of the diseases now known to occur.

Reversion has not been found in commercial red currant varieties and strawberry latent ringspot has been recovered only once. Cucumber mosaic and lucerne mosaic viruses also seem to be rare. Both viruses are stylet-borne by many aphid species and infection in red currants may result from occasional probes by aphids that are only chance and temporary visitors to the crop from woody or herbaceous weed or cultivated hosts.

Raspberry ringspot virus has been found only in imported red currant material, but infection may have been overlooked elsewhere because natural outbreaks have been found in other crops including raspberry, blackberry, and cherry. The status of arabis mosaic virus is also obscure. Numerous outbreaks have been found in other crops including black currant, whereas infection of red currants in the National Fruit Trials at Faversham must have occurred elsewhere. Further observations may also reveal currant mosaic to be as common as the observations at the National Fruit Trials suggest. Meanwhile, vein-banding is the only virus known to be widespread and to occur throughout certain stocks. Its effects are unknown but likely to be considerable.

Indexing

Five of the eight viruses affecting red currants in Britain and tomato ringspot virus that infects currants in the U.S.A. can be transmitted readily to herbaceous hosts by sap inoculation. Extracts of consistently high infectivity can be made by macerating leaves or dormant buds with five times the weight of 1-2% nicotine base. On *Chenopodium quinoa* Willd., cucumber mosaic virus causes local lesions within a few days and no systemic symptoms. By comparison, lucerne mosaic and the NEPO viruses soon cause both local and systemic symptoms. Antisera are available to all six viruses, which can be distinguished from each other by gel diffusion tests using crude sap from systemically infected *C. quinoa* or partially purified preparations of cucumber mosaic virus from *Nicotiana clevelandii* Gray. Such tests provide a rapid and reliable method of indexing suspect material without the delays and difficulties involved in graft transmission to woody indicators. Moreover, tests with buds from dormant bushes provide a ready method of checking the health of planting material and of shipments in transit between countries. In routine tests a random sample of buds should be collected, because infection may be slow to become systemic. It is unnecessary, at first, to test each bush or cutting separately, as extracts are infective even when only a small proportion of the buds contain cucumber mosaic or NEPO viruses.

The three other viruses can at present be detected only by grafts to woody plants. The vigorous red currant variety Laxton's No. 1 is a suitable indicator for currant mosaic and the black currant variety Amos Black reacts to infection with reversion virus and is particularly sensitive to cucumber mosaic, gooseberry vein-banding, and the NEPO viruses. Present methods of detecting vein-banding in red currants are tentative, pending clarification of the exact inter-relationships between the viruses affecting currants and gooseberries. Further investigations and the introduction of particularly sensitive clones m
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sensitive clones may improve and simplify the present procedure and perhaps show that Amos Black alone is sufficiently sensitive.

Selection

Using the indexing methods now available it is possible to select clones free from the viruses known to affect red currant. Care should be taken also to ensure that selections are free from the tendency to produce abnormal leaves or shoots. Some progress has already been made in Holland and selections of the varieties Fay's Prolific and Jonkheer van Tets are being multiplied by the NAKB organization for eventual release to nurserymen.

There is little demand for red currants in Britain and the release of virus-tested material is unlikely to warrant the introduction of a new certification scheme. However, there is a case for making available the best possible material to replace the present stocks of mixed or uncertain health. Little difficulty is anticipated in selecting clones of the main varieties that are free from seven viruses, but vein-banding may cause problems as it is widespread and certain varieties seem to be totally infected. Currants have proved intractable to heat-therapy and the possibility of obtaining virus-free red currants from meristem-tips has yet to be explored.

Acknowledgement

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