VIRUS DISEASES OF BLACK CURRANT

By J. M. THRESH

Abstract

Published and unpublished information on the eight virus diseases of black currant in Britain is summarized. Their economic significance is discussed, together with certification and indexing procedures.

Yellows virus is rare and spreads slowly, whilst infectious variegation virus appears to be restricted to little-grown varieties. The nematode-transmitted viruses also seem to be unimportant, as natural infection with raspberry ringspot virus has not been reported and arabis mosaic and strawberry latent ringspot viruses have each been found spreading at only one locality. Cucumber mosaic and gooseberry vein-banding viruses occur at numerous localities, but few bushes are infected and the spread of both viruses by the aphid vectors is slow. Reversion is the only virus disease of known economic importance; it decreases the national crop by at least 20% and the financial loss is augmented by the cost of control measures in nurseries and plantations.

The black currant crop in England and Wales has recently fluctuated about an average of 15,000 acres. The crop is also important in several other European countries and in Russia, New Zealand, and British Columbia. The main varieties have been grown for many years and as they are propagated vegetatively there has been ample opportunity for viruses to accumulate.

The virus disease known as ' reversion ', first reported in 1904, has been investigated extensively. Other virus diseases have received little attention except at East Malling Research Station from 1949 to 1951 and since 1960. The main features of the diseases caused by the eight viruses known to affect black currants in Britain are summarized here.

Black currant reversion virus (12)

Symptoms

1. Infection decreases the hairiness of sepals, so that flower buds appear abnormally smooth and highly coloured as blossoming begins (Fig. 1).

2. Some virus strains cause a non-recurrent line pattern in the leaves of shoots being invaded by virus (Fig. 2a). Affected leaves may be concealed deep within affected bushes and are seen best when growth is rapid in May and June.

3. Affected leaves are flatter than normal and also have a smaller sinus, fewer marginal serrations and fewer main veins (Fig. 2). Only the leaves of undamaged shoots show typical symptoms.

Varieties

All the main varieties are susceptible, although there are minor differences in resistance and tolerance. Difficulty is encountered in diagnosing infection in Raven, Seabrook's Black, Tor Cross, Westwick Choice and Westwick Triumph, and these varieties are unsuitable for use as indicators.

Distribution

Infection occurs throughout Great Britain. Virtually all nurseries and plantations contain some infected bushes, from which spread is rapid if control measures lapse.

Effect on growth and crop

Vegetative growth and flowering are unaffected, but bushes systemically infected with virulent strains fail to set fruit. Avirulent strains merely decrease fruit size and number.

Vector

The black currant gall mite (*Phytoptus ribis* Nal.) transmits virus to many of the bushes colonized during the dispersal period in April, May and June. Healthy bushes have considerable mite-resistance, which is broken down shoot by shoot over a period of two or three years as the virus becomes systemic. Healthy bushes are unimportant as hosts of the mite, which causes little direct damage.

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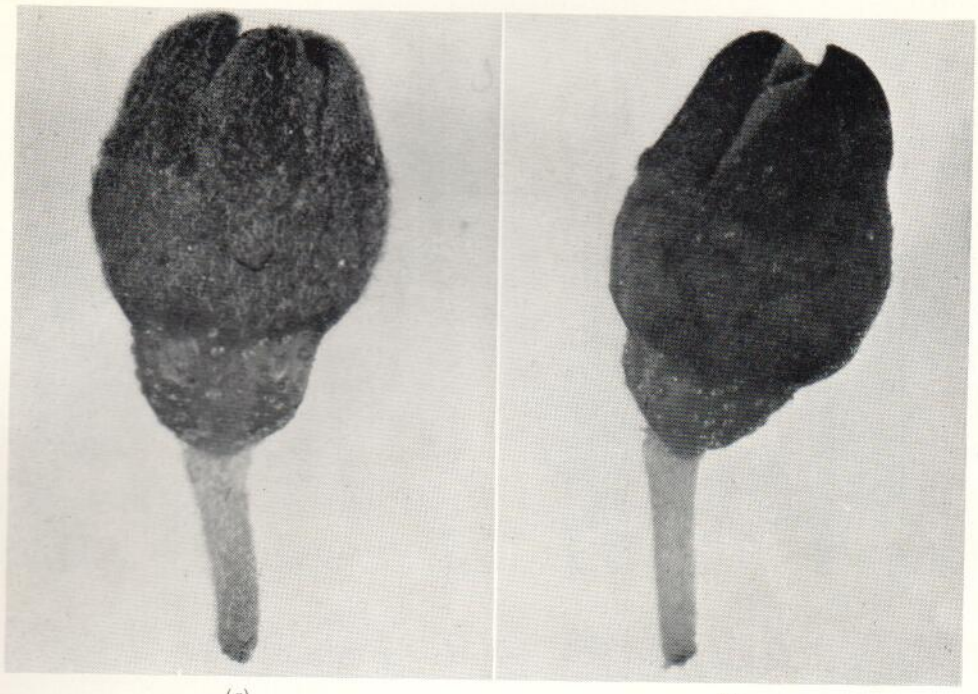
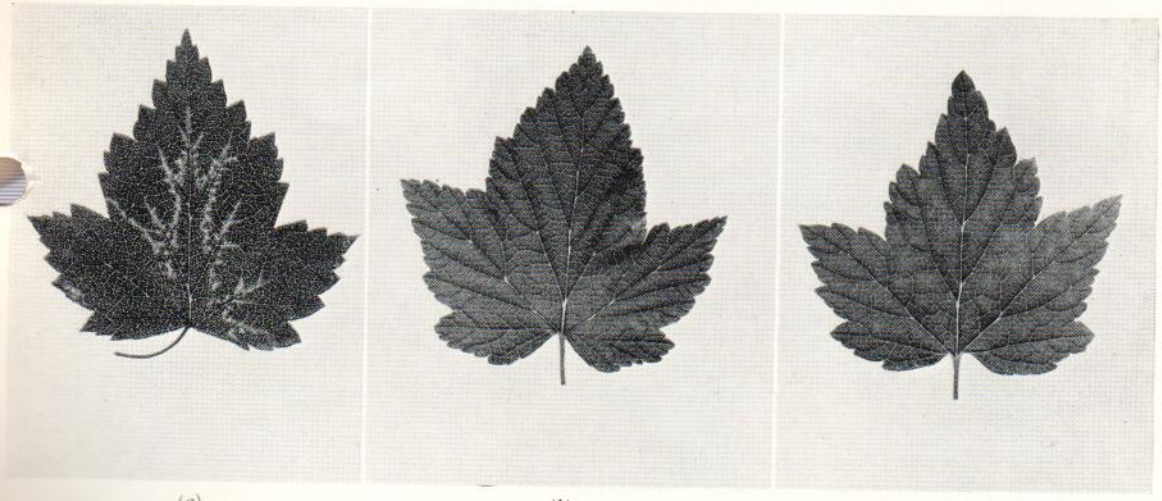
(*a*) preliminary non-rec



(*a*) (*b*)

Fig. 1

Black currant reversion virus : flower buds of (*a*) healthy, and (*b*) infected bushes.



(*a*) (*b*) (*c*)

Fig. 2

Black currant reversion virus:
(*a*) preliminary non-recurrent vein-pattern, (*b*) healthy leaf, (*c*) infected leaf with decreased serrations and main veins.

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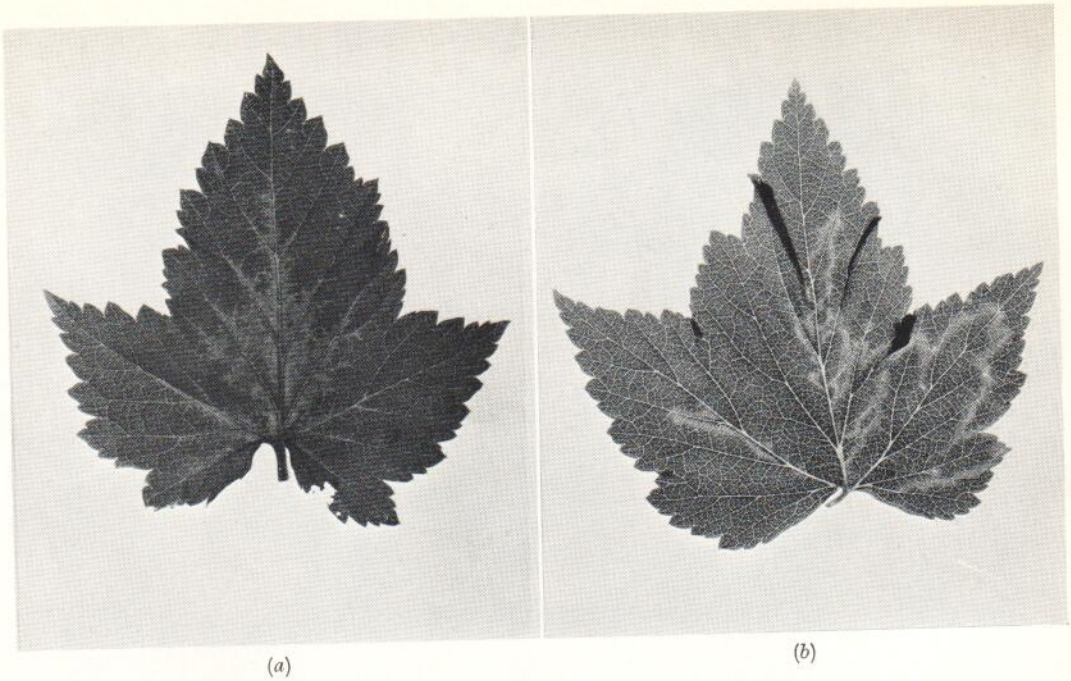
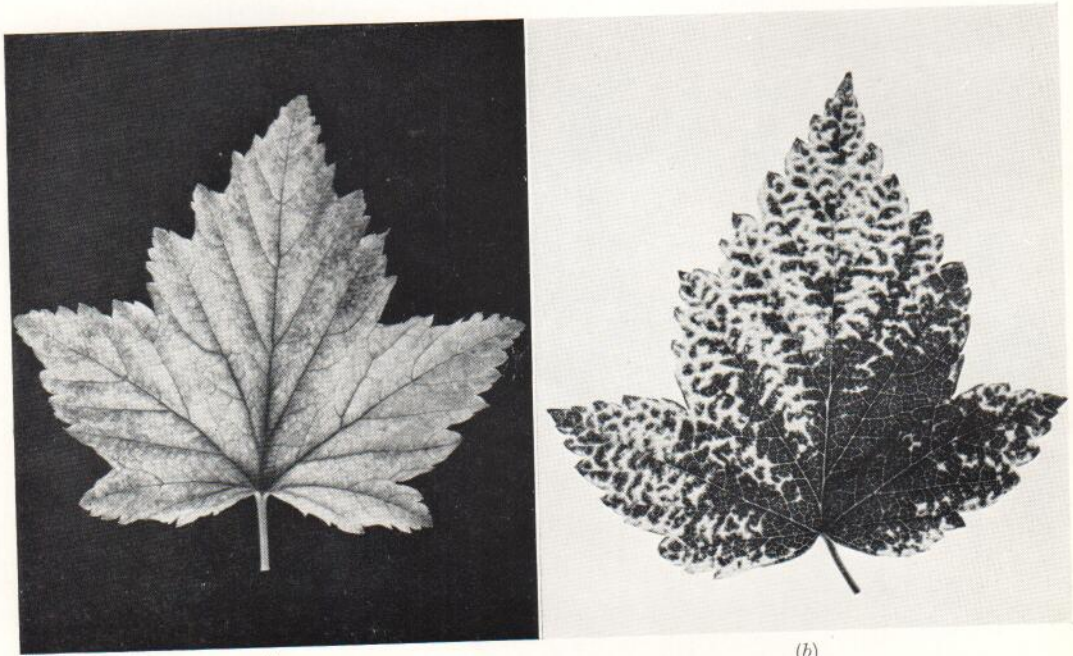


(*a*) (*b*)

FIG. 3

Cucumber mosaic virus symptoms: (*a*) in April, (*b*) in June.

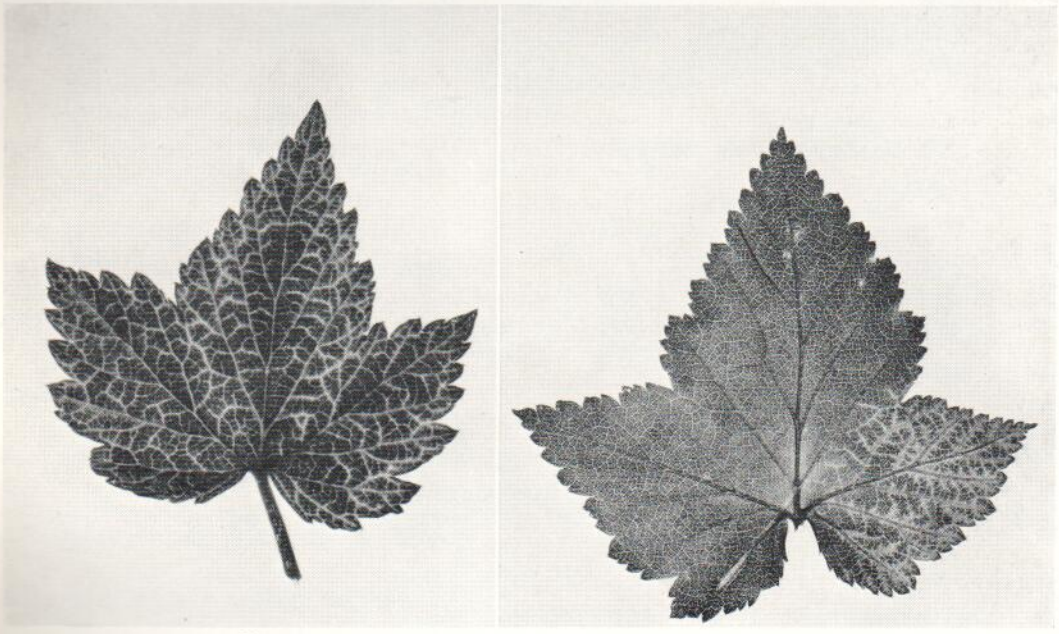


(*a*) (*b*)

FIG. 4

Infectious variegation virus: (*a*) in May, (*b*) in July.

(*a*)



(*b*) (*c*)

FIG. 5

Gooseberry vein-banding virus symptoms:
(*a*) in spring, (*b*) in June, var. Mendip Cross, (*c*) in June, var. Amos Black.

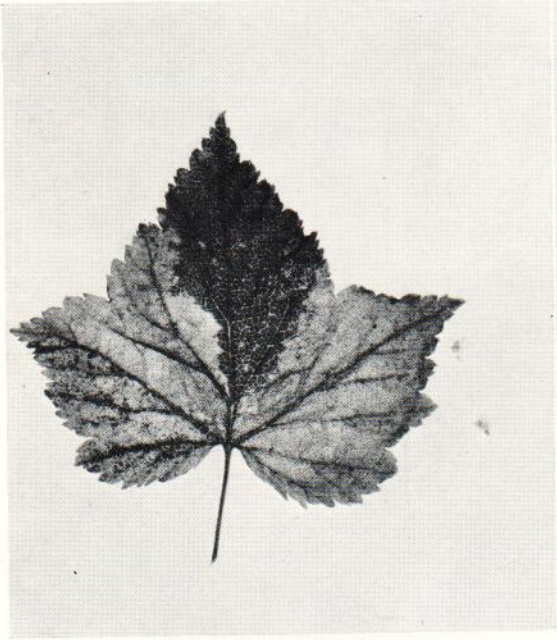


FIG. 6
Black currant yellows virus symptoms.

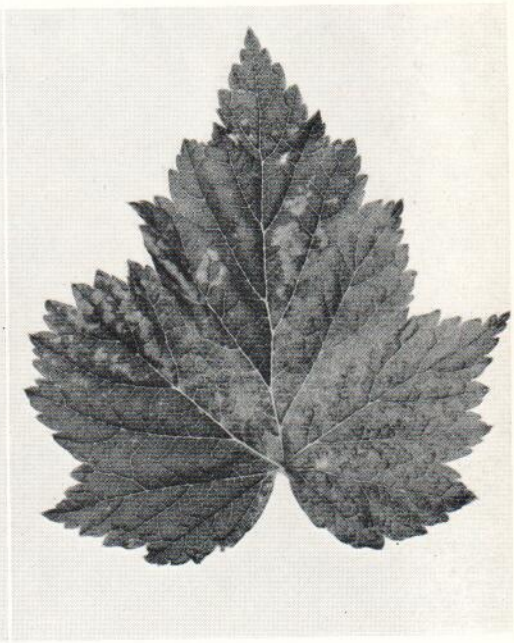


FIG. 7
Arabis mosaic virus symptoms.

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Cucumber mosaic

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Gooseberry vein-bandi

Symptoms

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Control

1. Carefully inspected material, preferably derived from tested sources, should be used for propagation and for establishing new plantations.

2. Sites for nurseries and plantations should be at least 100 yards to windward of sources of contamination, taking into consideration the direction of the prevailing wind during mite dispersal.

3. Routine sprays should be used to control the black currant gall mite.

4. Roguing should be done immediately before blossoming begins and in May, June, and July for leaf symptoms.

Cucumber mosaic virus (13)

Symptoms

The only symptom is a dark green / light green mottle best seen in leaves as they become fully expanded in April, May, and June (Fig. 3a). Symptoms become difficult or impossible to see later and mature leaves show only a faint ' watermark ' (Fig. 3b).

Varieties

All the main commercial varieties are susceptible, although tolerant varieties such as Baldwin produce only slight symptoms. Amos Black and Winch's No. 6 are sensitive and are suitable for use as indicators.

Distribution

Occasional infected bushes of Amos Black, Baldwin, Goliath, Mendip Cross, Seabrook's Black, Wellington XXX, and Westwick Choice have been found in Cardiganshire, Hampshire, Kent, Norfolk, Warwickshire, and Yorkshire. The trial variety Winch's No. 6 is heavily infected in experiments at Faversham and Luddington, presumably as a result of propagation from infected sources.

Effect on growth and crop

The growth and crop of sensitive varieties is decreased by 15-20%.

Vectors

Virus is transmitted by several of the aphid species occurring on black currant, but bushes are highly resistant and there seems to be little spread within plantations. Spread may be primarily from other hosts, by aphid species that are only chance and temporary visitors to plantations.

Control

1. Propagating material should be carefully selected.

2. Aphids should be controlled by routine sprays, preferably winter washes that destroy overwintering eggs and prevent infestations developing.

Black currant infectious variegation virus (3)

Symptoms

A bright chrome or pale yellow mosaic of the early leaves is followed in mid-summer by a broad yellow banding of the main veins, forming a vein-net pattern (Fig. 4). Symptoms differ in severity with season.

Varieties and distribution

All stocks of Climax, Daniel's September, Laleham Beauty, and Laxton's Nigger appear to be totally infected. Consequently, effects on growth and yield are unknown. In certain years some bushes of other varieties develop similar symptoms, that have been seen also in exotic varieties and in seedlings. Infection may be seed-borne or there may be a similar condition that is inherited and not graft-transmissible. The vector is unknown.

Gooseberry vein-banding virus (9, 10, 13)

Symptoms

1. Infection causes a broad yellow banding along the main veins of the leaves subtending flowers (Fig. 5a). The first-formed leaves soon absciss and symptoms are visible only as flowering begins.

2. The later leaves of sensitive varieties develop a clearing and narrow yellow banding of the main

veins. Entire leaves of Mendip Cross are affected and show a vein-net pattern (Fig. 5b). Symptoms in other varieties are often restricted to individual lobes that become slightly distorted and asymmetrical (Fig. 5c). Symptoms may resemble aphid damage. They are persistent but inconspicuous and may be restricted to certain leaves of a few shoots.

Varieties

Transient spring symptoms are followed by a persistent vein-clearing in Amos Black, Boskoop Giant, Goliath, Laxton's Grape, Mendip Cross, Westwick Choice and Westwick Triumph. Usually only transient spring symptoms develop in Baldwin, Cotswold Cross, Seabrook's Black and Wellington XXX.

Distribution

Occasional infected bushes have been found at localities in Hampshire, Kent, Norfolk, Oxfordshire, Somerset, Sussex, and Yorkshire. Infection was not associated with obvious stunting or decreased crop.

Vectors

Several of the aphid species commonly occurring on cultivated *Ribes* transmit this virus, but spread within plantations seems to be slow.

Control

1. Propagating material should be carefully selected.
2. Winter sprays that eradicate the eggs of aphids are preferable to summer sprays applied after hatching.
3. Black currants should be isolated from gooseberries, as these seem to be almost totally infected.

Black currant yellows virus (2, 9)

Symptoms

Slight indistinct chlorotic flecks are produced in April and May, followed in June and July by a more distinct olive-green mosaic affecting large sectors of leaves (Fig. 6). The most conspicuous symptoms follow periods of warm sunny weather, as in 1964.

Varieties

The main commercial varieties are susceptible and affected similarly ; growth and crop being decreased drastically by 70% (2).

Distribution

Infection has been found only in one nursery and in two plantations established with bushes from there. Elsewhere, symptoms may have been overlooked or attributed to nutritional disorders, spray damage, or bad drainage.

Vector

No vector is known, although there is some evidence of slow natural spread at one plantation and in experimental plots at East Malling (2).

Control

Carefully selected material should be used for propagation.

Arabis mosaic virus (13)

Symptoms

Vague, irregularly distributed chlorotic blotches of the first leaves are followed in May by mottle and ringspot symptoms (Fig. 7). Leaves produced by mid-summer are virtually symptomless.

Varieties

Amos Black, Boskoop Giant, Goliath, Wellington XXX, and Westwick Choice produced typical symptoms in experimental transmissions.

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Distribution

Infection has been found only in one nursery and in a plantation established with bushes from there. Infected bushes were slightly stunted and carried much less fruit than their unaffected neighbours.

Vector

Arabis mosaic virus in other crops is transmitted by the soil-inhabiting nematode *Xiphinema diversicaudatum* Micoletzky, which can infest black currant roots and cause galls.

Strawberry latent ringspot virus (7)

This virus is transmitted by *Xiphinema diversicaudatum*. Effects on black currant are unknown, because infection in the crop has been recorded only at one locality in Scotland where the bushes were also infected with reversion virus.

Raspberry ringspot virus (4, 8)

Black currant seedlings became infected with raspberry ringspot virus when graft-inoculated with isolates from red currant or *Ribes sanguineum* Pursch. Naturally infected bushes have not been found.

Certification

The present official schemes for certifying black currants in Britain are intended to ensure that stocks sold for establishing nurseries and plantations are true to type, vigorous and free from reversion and other diseases. Eligible stocks are inspected once, usually in July or August when features used in identifying varieties are visible and any symptoms of yellows virus would be conspicuous in warm, sunny seasons. However, the symptoms of gooseberry vein-banding virus and reversion are then past their best and those of arabis and cucumber mosaic viruses are virtually unrecognizable. A single inspection has obvious limitations in diagnosing infection and the known distribution of several viruses must be regarded as underestimates of the true situation. Indeed, the worst stocks are unlikely to have been entered for certification and are not inspected in detail. The proposed special stock scheme is likely to require additional stringent inspections, including at least one in May when the symptoms of several virus diseases are particularly conspicuous, even though the varieties and yellows disease cannot then be identified with certainty.

Indexing

Cucumber mosaic, arabis mosaic, raspberry ringspot and strawberry latent ringspot viruses can be transmitted readily by sap inoculation to *Chenopodium amaranticolor* Coste & Rayn. or *Chenopodium quinoa* Willd. using macerates of leaves during the spring and summer or of buds during the autumn and winter. Each virus can then be identified by serological tests with sap extracts or with 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.

The other viruses of black currant have not been transmitted mechanically and the symptoms of reversion virus in other susceptible species of *Ribes* are less definite than in black currant. Consequently, identification depends upon thorough inspections throughout the growing season and upon grafts to black currant seedlings and varieties. Seedlings produce conspicuous vein-pattern symptoms, and suitable indicator varieties are Amos Black, Baldwin, Goliath, and Wellington XXX. These are also sensitive to infection with yellows and cucumber mosaic viruses. Baldwin and Wellington XXX are tolerant of gooseberry vein-banding virus, for which gooseberry seedlings are the best indicators.

Material of the main commercial varieties is now being selected and indexed to ensure freedom from the viruses now known to affect black currants. The first bushes have been released to the Nuclear Stock Association and are being propagated at isolated sites free of *Xiphinema* spp. The future discovery of additional viruses by the use of new indicators may necessitate reselection or therapy. Meanwhile heat treatment is being used at Long Ashton in an attempt to invigorate apparently healthy clones (1) and at East Malling to cure varieties totally infected with variegation virus. Further work is required on the identification and distribution of this virus, which has been transmitted only by grafting to open-pollinated seedlings. Baldwin and Wellington XXX are highly tolerant and these and other varieties may be carrying infection.

Economics

Any assessment of the economic significance of virus diseases in the black 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 varieties. Present information suggests that the extremely damaging yellows virus is rare and that infectious variegation virus is a disease only of little-known varieties. The nematode-transmitted viruses also seem to be rare as natural infection with raspberry ringspot virus has not been reported, whilst arabis mosaic and strawberry latent ringspot viruses have each been found spreading at only one locality. Cucumber mosaic and gooseberry vein-banding viruses have been found at numerous localities, but only in occasional bushes, and spread within plantations by the aphid vectors is slow.

Reversion is the only virus disease of known importance in black currants and in nursery practice it is a serious hazard, controlled only by considerable vigilance and expense. Skilled and experienced observers are required to eliminate galled buds and reversion and so maintain the standard of cuttings required for propagation. Moreover, several sprays are necessary for adequate control of the mite vector. If these operations are not done efficiently, levels of reversion may exceed the low tolerance allowed, so that stocks are rejected and become unsaleable. Annually about 4% of the bushes entered for certification are rejected because of reversion, and the worst stocks may have been withdrawn before inspection or not entered at all. Rejection causes an immediate financial loss and volves considerable delay and expense in raising improved stocks. Another risk is that recent infection is not manifest until the bushes have been certified, sold and established in fruiting plantations. This diminishes prestige and goodwill, so affecting the sale of other nursery material.

Routine prophylactic measures against reversion in fruiting plantations include sprays, inspections, and the replacement of infected bushes. These operations involve additional annual expenses that are important in times when many plantations are barely profitable. However, failure to control reversion may result in even greater losses, as numerous bushes have to be replaced and whole plantations become uneconomic or are grubbed prematurely. Heavily infected plantations are often retained, particularly when avirulent strains of virus are common. Such plantations present a special problem as they are a favourable substrate for mites to become numerous and menace other bushes in the vicinity.

Survey data on the extent of reversion in fruiting plantations are available only for East Anglia in 1963 (5, 6), where the percentage of infected bushes increased from 0-2% in the second year after planting, to 50-60% four years later. The loss in crop caused by reversion may be estimated, assuming that the East Anglian plantations are representative of the present national crop, that the yield quoted by Rendell (11) are typical, and that a reverted bush produces one-third the crop of a healthy bush. Bushes systemically infected with virulent strains yield less than this, but many bushes are not in such an advanced stage of infection and some strains of virus have less severe effects. On these assumptions reversion decreases the national crop by a minimum of 20%, and the recent crop of around 20,000 tons per annum would have been increased by at least 4,000 tons if infection had been prevented. To this loss of about £400,000 must be added those in nurseries, the cost of routine control measures and the cost of replacing bushes and whole plantations more rapidly than would be necessary otherwise.

It is impossible to make precise estimates of the financial losses caused by reversion because the marketing of bushes and fruit has been so difficult in recent years that any increase in supply might have resulted in correspondingly lower prices. However, reversion is undoubtedly a major factor consistently depressing national yield, which now fluctuates about the low level of 30 cwt per acre. Efficient control of reversion is practicable on the information now available and present production could be obtained from a much smaller acreage, with a corresponding increase in the efficiency and longevity of plantations.

References

(1) Campbell, J. (1965). The inactivation of black currant reversion virus by heat therapy. *Rep. Long Ashton Res. Sta. for 1964*, 89-92.

(2) Cropley, R., Posnette, A. F., and Thresh, J. M. (1964). The effect of black currant yellows virus and a strain of reversion virus on yield. *Ann. appl. Biol.*, **54**, 177-82.

(3) Ellenberger, Christina E. (1962). Transmission of variegation in black currants. *Rep. Malling Res. Sta. for 1961*, 101.

(4) Klesser, P. J. (1951). A virus disease of red currant (*Ribes rubrum* L.). *Ann. appl. Bi* **38**, 707-13.

(5) LEGOWSKI, T. J., and GOULD, H. J. (1965*a*). The incidence and bionomics of gall mite (*Cecidophyopsis ribis* Nal.) on black currants in East Anglia, 1962-1963. *Proc. 2nd Br. Conf. Insecticides and Fungicides, Brighton, 1963*, 171-8.

(6) ———, and ——— (1965*b*). Relationship between gall mite, reversion and yield on commercial plantations of black currants. *Pl. Path.*, **14**, 31-4.

(7) LISTER, R. M. (1964). Strawberry latent ringspot : a new nematode-borne virus. *Ann. appl. Biol.*, **54**, 167-76.

(8) MEER, F. A. VAN DER (1960). Onderzoekingen betreffende bessevirussen in Nederland. I. Lepelblad van rode bes. *Tijdschr. PlZiekt.*, **66**, 12-23.

(9) POSNETTE, A. F. (1952). New virus diseases of *Ribes*. *Rep. E. Malling Res. Sta. for 1951*, 133-5.

(10) ——— (1964). Transmission studies of gooseberry vein-banding virus. *Rep. E. Malling Res. Sta. for 1963*, 110-12.

(11) RENDELL, J. (1961). Black currant survey : three year report 1957-1959. *Univ. Bristol Selec. Papers in Agric. Econ.*, **7**, (3), 75-203.

(12) THRESH, J. M. (1964). Black currant reversion disease. *Rep. E. Malling Res. Sta. for 1963*, 184-9.

(13) ———, and VINE, SALLIE J. Unpublished.