



NSW DEPARTMENT OF
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Virus diseases in canola and mustard



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INTRODUCTION

Virus diseases in canola (*Brassica napus*) were found in recent seasons in production areas across Australia. Beet western yellow virus (BWYV) was first identified in eastern and Western Australia in the early 1980s. At that time it infected canola and a wide range of other plants in Tasmania. Since 1998 it has become very common outside of Tasmania in canola, mustard (*Brassica juncea*) and pulse crops, often at high infection levels. Two viruses, Cauliflower mosaic virus (CaMV) and Turnip mosaic virus (TuMV), have also been detected in canola in eastern and Western Australia and mustard in NSW. Relatively little information on CaMV and TuMV is available, but in Western Australia they are much less common in canola than BWYV. Viruses other than BWYV, TuMV, and CaMV may also occur as tests have been limited to these three species.

Canola has substantial resistance and/or tolerance to viruses and symptoms are usually indistinct or absent. Estimates of seed yield loss have usually been 'worst case' situations of early infection of nearly all plants, and are complicated by non specific effects of insecticides used to generate different disease levels in trials. However significant seed yield losses are possible. For BWYV, estimated losses of 34% and 46% have been reported in Europe and Western Australia respectively. Yield loss estimates are not available for CaMV and TuMV in canola in Australia.

Mustard has been affected severely by TuMV and possibly other viruses in trials while adjacent canola plots remained healthy. Losses approaching 100% are possible, though severe infection has only occurred in trials and not commercial crops to date.

DISTRIBUTION

Viruses have probably occurred in canola since commercial crops started but were unrecognised due to indistinct symptoms. However, in NSW pulse crops surveyed and tested for a range of viruses between 1994 and 2003, BWYV increased in incidence, suggesting that an increase in BWYV may have occurred in canola also over that period.

A major survey of canola crops in Western Australia in 1998 showed that BWYV was very common. In NSW, symptoms suggestive of BWYV were widespread in canola early in 1999. This prompted laboratory tests which confirmed the presence of BWYV but were unable to confirm associations with viral symptoms. Major surveys employing laboratory tests on field samples were done subsequently in NSW and Victoria. In 2002 BWYV was found from Moree in northern NSW to Cobram in Victoria. The incidence in 47 commercial crops was 2–83% plants infected (average 41%). Crops with high infection rates were evenly spread across the geographic range. Crops sown late had less infection than ones sown early and crops with insecticide applied as early sprays or seed treatment had less infection than untreated crops. There is little information on viruses apart from BWYV in canola in NSW.

In mustard in northern NSW, BWYV is widespread and very common. TuMV and CaMV are common around Tamworth and Gunnedah. These three viruses do not account for all virus-like symptoms in mustard, which suggests that other virus species are involved.

VIRUS SPECIES AND THEIR TRANSMISSION

Beet western yellows virus (BWYV) belongs to the luteovirus family which includes other economically important plant viruses like *Barley yellow dwarf virus*, *Subterranean clover red leaf virus* and *Bean leafroll virus*.

The virus is carried in the body of the aphid and is transmitted during feeding. The aphid having acquired the virus can remain infective through several moults and sometimes for the rest of its life. However, infectiveness decreases over time.

Its host range is very wide: around 150 species of dicotyledons including canola, wild radish, wild turnip, shepherd's purse, field pea, soybean, faba bean, chickpea and subterranean clover. Up until recently BWYV was identified only by tests using BWYV antiserum. Now it is recognised that up to three biologically distinct species of virus were detected in these tests. Isolates of BWYV which infect *Brassicaceae* have recently been called *Turnip yellows virus* and *Brassica yellowing virus* overseas.

Turnip mosaic virus (TuMV) is a member of the potyvirus family which includes *Sugarcane mosaic virus*, *Potato virus Y*, and *Bean yellow mosaic virus*. TuMV is a non persistent virus, being retained by aphids for no more than 4 hours after acquisition and usually much less. It commonly infects brassicaceous hosts, but can also infect other families of plants including legumes.

Cauliflower mosaic virus (CaMV) is a member of the genus *Caulimovirus*. Transmission by aphids is semi-persistent, i.e. up to 4 days. The host range is more limited than for the other viruses, being restricted to *Brassicaceae*.

SYMPTOMS

BWYV does not cause distinctive symptoms in canola. This virus infects phloem (conductive tissue) and therefore has potential to cause stunting, reddening, and stiffening of leaves resembling nutrient disorders or physiological stress. Published work suggests that BWYV-induced symptoms are most likely to be expressed in young plants and under cold conditions. Tests on canola and mustard crops displaying these symptoms have failed to show an association with BWYV, and glasshouse inoculation with BWYV has failed to produce symptoms in infected plants. However, spread of symptoms has been reported when BWYV-infected plants were introduced into plots of young canola in Western Australia.



TuMV in mustard – mosaic symptoms



TuMV in mustard – severe leaf mottling

TuMV in mustard – severe stunting and tip dieback



BWYV has shown a partial association with luteovirus-like field symptoms in mustard in northern NSW, suggesting that it may cause more damage to mustard than to canola.

TuMV has reportedly caused symptoms in canola overseas. Commercial cultivars used in Australia are probably resistant to this virus; it has not been detected at all in canola in areas of northern NSW where it is common in brassicaceous weeds. In mustard, however, it is associated with severe mosaic symptoms. Mustard plots planted alongside canola in northern NSW have shown symptoms of mosaic, stunting, tip necrosis, and premature death while adjacent canola plots were unaffected. *Brassicaceae* weeds including turnip weed and wild radish also show severe mosaic symptoms. The incidence of TuMV in turnip weed (*Rapistrum rugosum*) is often high in northern NSW based on symptoms.

CaMV is reported to cause damaging symptoms in canola overseas. In Australia only an inconsistent association with chlorotic ringspots and mottle has been reported (20% of infected plants). Usually there are no symptoms. Information is not readily available on symptoms of CaMV in mustard in Australia or overseas. CaMV appears to be common in mustard, brassicaceous weeds, and possibly canola in northern NSW, but few samples have been tested and no association with symptoms established yet.

INCIDENCE

BWYV, TuMV, and CaMV probably occur throughout grain production areas in Australia but are more prevalent in some localities than others. Incidence fluctuates from season to season. Seasons with high rainfall over summer and autumn favour the survival of both plant hosts and aphids, leading to extensive early infection

Persistent and non-persistent transmission

Aphids acquire viruses during feeding related activities, and then transmit them to nearby plants. There are two main types of transmission by aphids : persistent and non-persistent transmission.

In persistent transmission, aphids usually carry the virus for life. The virus is restricted to the plant's vascular or phloem (conductive) tissues, rather than the plant surface cells. The aphids must feed for an extended period before acquiring the virus (several minutes to hours). After an incubation period, the virus replicates in the aphids' circulatory system and is passed onto new plants via the injected saliva. The virus is not passed along to offspring. In non-persistent transmission the virus particles can be found in the mouthparts and on the foregut of the aphid. Aphids acquire the virus soon after feeding and are able to transmit the virus immediately to other plants. They usually retain the virus for less than an hour but retention up to 1–3 days has been reported.

of autumn sown crops including canola and pulses. In southern NSW, BWYV-like symptoms were a concern in 1999 and recurred in 2001 and 2002. Each season was preceded by a rainy summer and dry, mild autumn and experienced high numbers of aphids in autumn.

Autumn is the critical infection period, so earliest-sown crops usually have the highest infection incidence. Infections can also occur with spring aphid flights, but these probably have little effect on yield.

SPREAD

BWYV, TuMV, and CaMV are spread by aphids.

Very large populations of aphids can build up rapidly because their reproduction is almost entirely asexual. In Australia aphids survive throughout the year as wingless (apterous) populations on favourable host plants. When populations become large and conditions are right for their dispersal and/or feed becomes limiting, offspring become predominantly winged (alate). These flying aphids fly from plant to plant, producing offspring asexually, feeding, and spreading viruses in the process. Flights usually occur in autumn and spring. Aphid species which colonise and live as wingless populations on crops are often the ones which are most important in spreading viruses. Wingless colonising aphids moving between adjacent plants are sometimes a significant means of spread. However, winged aphids of non-colonising species which feed but do not colonise may also be significant as vectors.

APHID IDENTIFICATION

Four species of aphid colonise canola and mustard in NSW. All are known to be vectors of viruses. Large numbers of colonising aphids indicate a potential for virus problems. For illustrations, see *Insects: the ute guide* published by Grains Research and Development Corporation.

- **Green peach aphid** (*Myzus persicae* Sulzer) transmits BWYV, TuMV, and CaMV. It is considered the most important vector of BWYV. Wingless nymphs and adults are shiny yellow to mid green or pink in colour and are usually found in colonies on the underside of leaves.
- **Turnip aphid** (*Lipaphis erysimi* Kaltentbach) transmits TuMV and CaMV. Wingless adults are yellow or olive green to greyish green. Dark bars on the abdomen are sometimes evident. Their bodies have a light covering of white wax. They are found in dense colonies on

growing tips of canola and other brassicaceous species.

- **Cabbage aphid** (*Brevicoryne brassicae* Linnaeus) transmits BWYV, TuMV, and CaMV. Wingless adults are a dull greyish green or greyish blue colour with a dark head and dark dorsal thoracic and abdominal markings. The dense colonies that form appear bluish grey and are distinctive by the presence of a greyish-white mealy wax that forms on their bodies. The wax is commonly secreted onto the plant surface.
- **Cowpea aphid** (*Aphis craccivora* Koch) transmits BWYV, TuMV, and possibly CaMV. It has not generally been considered a pest of Brassicaceae, but in 2003 there were confirmed reports of large numbers colonising canola in central and southern NSW. It is likely to visit or colonise mustard, but this has not been confirmed. Nymphs are dull grey and wingless adults are shiny black.

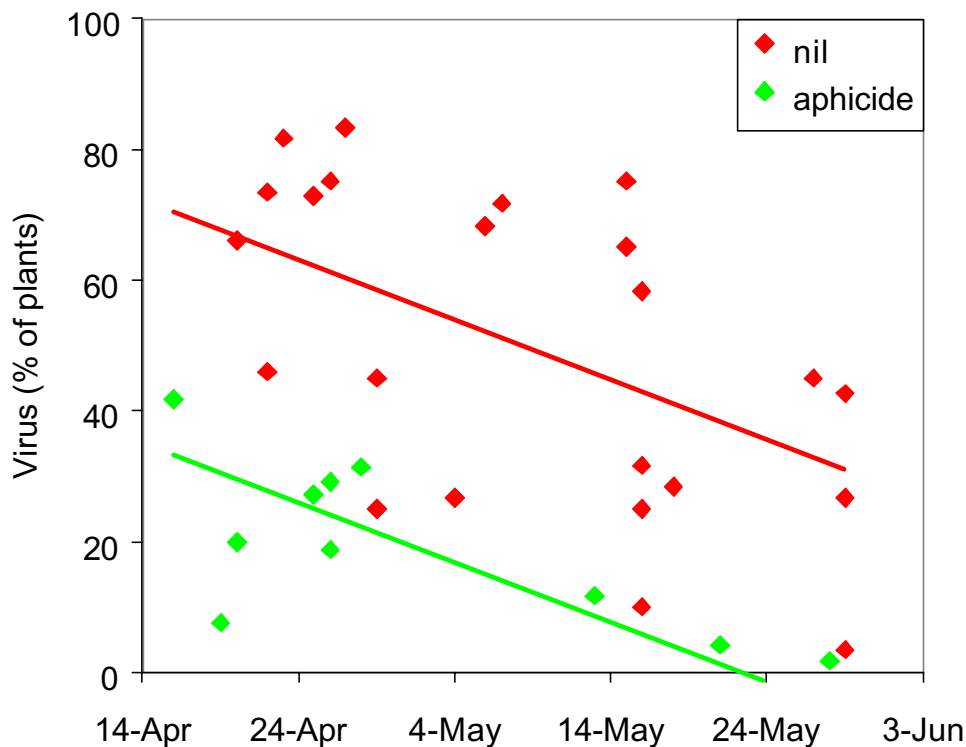
CONTROL MEASURES

The following recommendations are based on current information on viruses and vectors from a range of crops and information from disease surveys, but efficacy has not been experimentally verified in eastern Australia.

1) **For canola and mustard, follow best management practices for canola as outlined in the *Agfact Canola* and updated in *Winter crop variety sowing guide 2004* and *Agnote Canola in northern NSW*.** Most but not all recommendations for canola will apply to mustard. The following are particularly important for minimising viruses:

- **Where practical, retain standing stubble and sow by direct drill.** Standing stubble helps to deter aphids from landing in a number of crop species. Sow by techniques which minimise disturbance to stubble. Do not leave stubble lying directly over the seed as this impedes establishment of plants.
- **Control broadleaf weeds in crops, on crop perimeters, and in fallows.** Brassicaceous weeds such as wild radish and turnip weed can serve as reservoirs and infection centres of viruses. Broadleaf weeds of other families may be reservoirs of BWYV.
- **Sow at recommended times.** A delay of 1–2 weeks can reduce virus infection in some seasons if aphid flights finish before seedling emergence. The first consideration must always be to sow for optimising yield

Figure 1. Effect of sowing date and aphicide on incidence of beet western yellows in canola in 2002



irrespective of disease. However, early maturing canola cultivars and all mustard cultivars produce optimal yields with later sowing time. These cultivars, sown towards the end of their optimal time, may have an advantage in localities and seasons where virus limits yield.

2) For canola, consider using Gaucho® (imidacloprid) treated seed. Gaucho® is registered for control of red-legged earth mite and blue oat mite in canola. It is not registered for control of aphids. Treated canola seed but not mustard seed is available from seed suppliers. The additional cost of using treated canola seed is low, currently \$4–8 per hectare. Resistance to imidacloprid has not been reported in aphids.

3) For canola, monitor and if necessary control aphids.

- **Check plants including undersides of leaves for aphids.** Large numbers of aphids, particularly green peach aphid, indicate that virus infection is likely. It is important to check plants frequently between emergence and leaf production stages.
- **Spray and monitor aphid kill.** If aphids are numerous between emergence and leaf production stages, seek advice and select a registered aphicide. The only aphicide spray currently registered in NSW for canola is pirimicarb, for control of green peach aphid and cabbage aphid. No aphicide is registered for mustard. A permit for endosulfan expired in December 2003 and is under review. Green peach aphid may be resistant to pirimicarb, so crops should be checked after spraying to ensure that aphids have been killed. Spraying after stem elongation is unlikely to reduce losses from viruses.

4) Test for viruses. If virus-like symptoms are observed, arrange for laboratory testing to be done through NSW Department of Primary Industries or another state agriculture department. Tests should include BWYV for canola and both BWYV and TuMV for mustard. At least 5 symptomatic and 5 relatively symptomless plants should be tested. This can establish which virus species occur in the area, show whether viruses account for symptoms, and add confidence to visual diagnosis.

CURRENT RESEARCH

Current research in NSW is aimed at identifying viruses in canola and mustard and assessing yield losses. Relatively little testing has been done for TuMV, CaMV, or any viruses apart from BWYV in field crops in NSW.

Researchers based in Western Australia are developing a decision support system to forecast the risk of aphid outbreaks and BWYV epidemics in canola. The system will assess the need for insecticides to control the aphid vectors of the virus and prevent direct aphid feeding damage. By allowing efficient targeting of insecticides, the impact on natural predators and the environment as well as the development of insecticide-resistant aphids will be reduced.

A quantitative trait for resistance to *Turnip yellows virus* (synonymous with BWYV) has been incorporated into canola in Germany. This trait has not yet been tested in Australia.

FURTHER INFORMATION

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