



## Wheat streak mosaic virus & wheat curl mite

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*Wheat streak mosaic virus* (WSMV) is a seed and mite-borne virus that infects wheat causing severe leaf symptoms and reduced yields. Wheat is its most important host although the virus also infects barley, oats, rye and a range of grass weeds. The symptoms and damage caused are more severe in wheat than in other host plants. In most hosts, the infection is symptomless. WSMV can cause crop failure in wheat when widespread infection occurs at the seedling growth stage.

### Distribution

WSMV has been detected in wheat crops in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia. In Western Australia, it was first detected in 2006 when it caused widespread infection and losses in the central portion of the lower rainfall zone of the wheatbelt. It was scattered over a much wider area from Geraldton to Esperance at levels too low to cause detectable yield losses.

### Symptoms

The symptoms of WSMV in wheat appear as pale green streaking on leaves (Figure 1a), yellowing of the older leaves (especially towards their tips) (Figure 1b) and stunted, tufted plant growth (Figure 1c). Affected plants become stunted relative to healthy plants when they are infected at an early growth stage (pre-tillering) but this stunting symptom is much less obvious with later infection. Heads on early infected, stunted plants are either sterile and contain no seed, or contain small shrivelled grain. Except for volunteer oats, no symptoms have been seen in Western Australia on WSMV-infected alternative hosts (grasses and barley).

### Spread

#### Wheat curl mite

Wheat curl mite (WCM), *Aceria tosichella*, is the only known vector of WSMV. It is capable of transmitting the virus in its nymphal and adult stages. The mite is tiny (<0.3 mm in length), cigar-shaped, cream-coloured and can only be seen with the aid of a microscope. The WCM is also able to conceal itself under leaf sheaths and seed glumes (Figure 2). In warm conditions (25–28 °C), WCM can develop from an egg to egg-laying adult in 8–10 days. Females produce about 20 eggs and consequently each female has the potential to produce over 3 million descendants in 60 days. For this reason, population explosions leading to high WSMV transmission levels can occur in warm weather when temperatures exceed 25 °C. At lower temperatures their ability to reproduce declines rapidly, such that populations are difficult to detect below 15 °C.

WCM have no wings but are spread within and between crops mainly by wind. The mites are quite short-lived and require a 'green bridge' to survive between growing seasons. Their lifespan is 8–10 days at 25–28 °C, but up to 3 months when temperatures approach freezing. Hot, dry summers which prevent plant growth, typical of the Western Australian wheatbelt, are devastating to WCM populations, which can only persist in surviving pockets of green grass hosts. However, in seasons of high summer and early autumn rainfall, the mites develop large populations on grass hosts and then move to infest autumn sown cereals, especially wheat.



Figure 1a) Pale green leaf streaks in young wheat leaves infected with *Wheat streak mosaic virus* (WSMV). b) Bright yellow leaf streaks on older leaves caused by WSMV in late winter/early spring. c) Stunted, tufted, chlorotic wheat plants infected with WSMV as young seedlings

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**Green bridge hosts**

WSMV and WCM both survive between growing seasons in grass weeds or volunteer cereals that grow over summer (Figure 3). Volunteer wheat, barley grass, annual ryegrass, small burr grass, stink grass and witch grass have all been recorded as alternative hosts for WSMV in Western Australia, but some grasses may be non hosts, e.g. windmill grass.

**Seed**

WSMV is seed-borne at low levels (<1 per cent) in wheat seed. Seed transmission has the potential to cause significant yield losses because it results in early WSMV introduction into a crop. Sowing infected wheat seed stocks produces seed-infected seedlings scattered at random within the crop from which un-infective WCM can pick up the virus and spread it to healthy plants (Figure 3). Assuming a wheat crop density of 100 plants/m<sup>2</sup>, a seed transmission level of only 0.1 per cent and survival of all seed-infected seedlings, the numbers of WSMV-infected seedlings in the paddock would be 1000/ha. This constitutes a considerable infection source from which WCM can pick up and spread the virus.

**Yield losses**

Early widespread infection of young wheat plants (approaching 100 per cent infection) is generally associated with greatest yield losses from WSMV and can cause complete crop failure, as such crops produce only small amounts of shrivelled grain. Patchy early infection can also cause substantial yield losses within the affected area of crop. These normally circular patches arise from an initial infection produced by the landing of an infective mite or, alternatively, by an un-infective mite landing on a seed-infected plant. There is minimal yield loss when crops become infected post-tillering. The worst case scenario is when a heavily WSMV-infected green bridge is not adequately controlled before sowing an early crop and warm temperatures favour a high WCM population. Then, volunteer wheat and grasses carrying both WSMV and WCM intermingle with the emerging wheat seedlings. The mites rapidly transfer the virus to the seedlings throughout the crop causing up to 100 per cent early infection (Figure 1c).

**Management options**

Serious outbreaks of WSMV can only occur if the mite vector, WCM, is abundant and a source of WSMV is present. Consequently, management of the disease is highly dependent on controlling WCM populations and sources of WSMV. The control options available against WSMV include the following:

- Control the ‘green bridge’ (volunteer crop cereals e.g. wheat, barley, cereal rye, oats and grass weeds) as they harbour both WSMV and WCM. This

control needs to be done throughout the paddock (including along the fenceline) at least one month before sowing wheat. It needs to be very thorough, involving grazing down to ground level throughout the paddock and early application of herbicide. Neighbouring paddocks should be treated similarly, especially those upwind of the crop. Use of a glyphosphate/paraquat mixture provides the most effective control.

- Sow healthy seed stocks of wheat (deemed healthy after seed testing of a representative seed sample).
- Avoid early sowing in virus risk conditions ie. sowing directly into a recently sprayed out ‘green bridge’ or sowing of infected seed, as warm seasonal conditions in autumn favour high WCM populations.

Unfortunately, there is no effective miticide to spray against the vector and there are as yet no available WSMV-resistant wheat varieties in Australia.

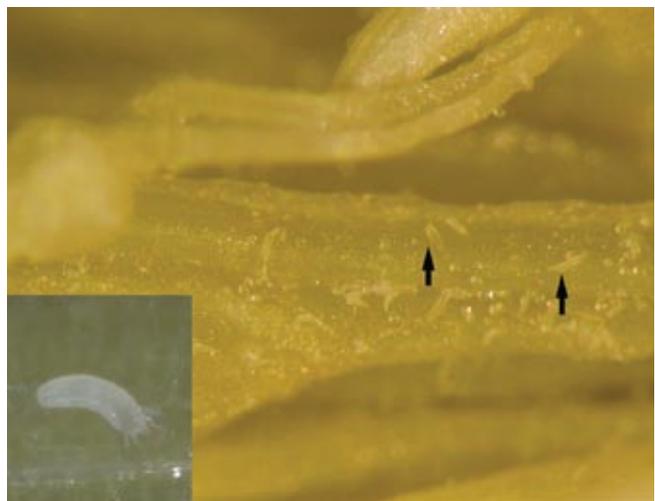


Figure 2 Wheat curl mite (WCM) appearing as tiny and cigar shaped creatures on a leaf sheath (arrows). Inset: Adult WCM <0.3 mm long.

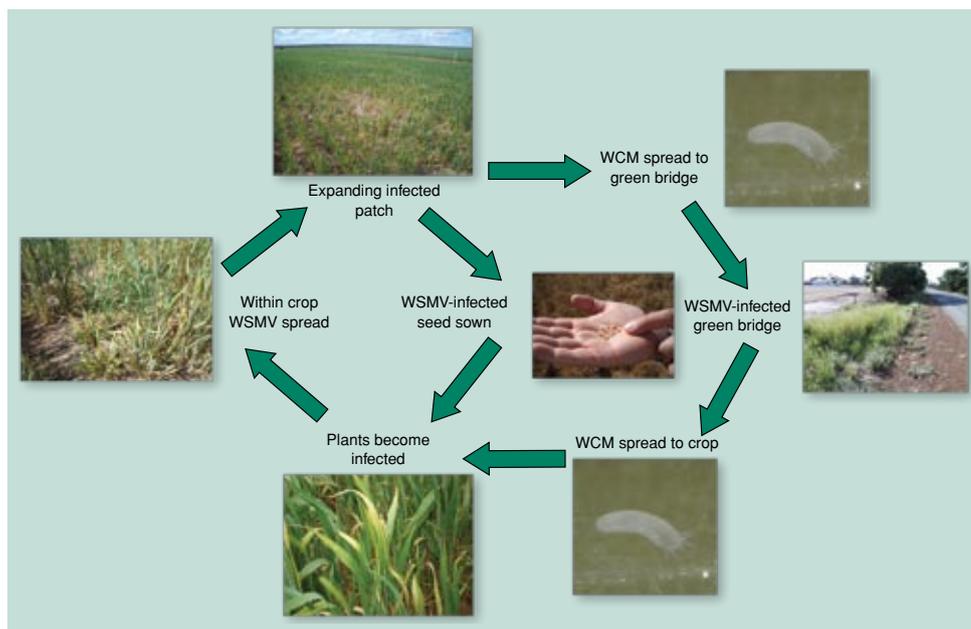


Figure 3 Life cycle of *Wheat streak mosaic virus*