Department of
Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Subterranean clover
red leaf syndrome (SbDV)

Australian Wool Innovation Limited

MEAT & LIVESTOCK AUSTRALIA

THE UNIVERSITY OF WESTERN AUSTRALIA

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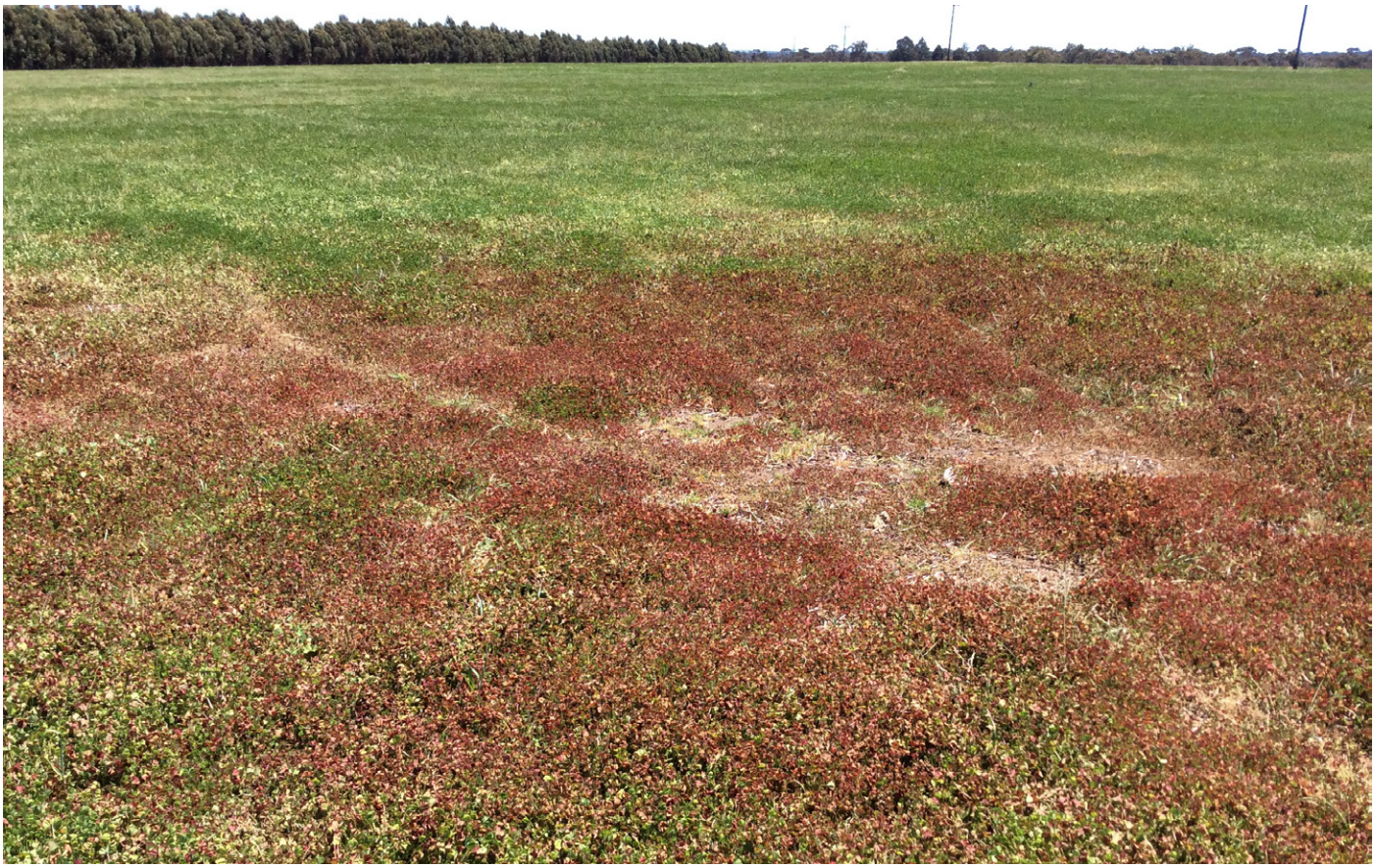
Subterranean clover red leaf syndrome as caused by *Soybean dwarf virus*

Producers are being advised to check their pastures in autumn and winter for aphids that might infect sub subterranean clover plants with a virus that causes the red leaf syndrome. Management options include the use of insecticides and sowing alternative pasture species.



There has been considerable concern amongst livestock producers regarding recent outbreaks of subterranean clover red leaf syndrome. Symptoms include red leaves, stunted plants and even premature plant death. The Department of Primary Industries and Regional Development (DPIRD) investigated the outbreak in 2017, finding that of the subterranean clover plants tested, 80% with obvious red leaves were infected with *Soybean dwarf virus* (SbDV) compared to just 2% without obvious symptoms.

SbDV is spread by aphids persistently (once acquired, the aphid has it for life) and frequently infects subterranean clover. Its incidence in a subterranean clover pasture will vary from season to season depending on the abundance and distribution of alternative plant hosts and aphid vector species. The symptoms can occur as isolated patches in paddocks, to whole paddocks being affected. However, the presence of red leaves in itself does not necessary indicate viruses are present. SbDV is also not seed-borne and therefore is not present in the seed bank or in commercial seed stocks.

Background

Subterranean clover (*Trifolium subterraneum* L.) is the most widely used annual pasture legume in Western Australia (WA) with around eight million hectares sown. As a consequence there has been considerable concern amongst livestock producers regarding recent outbreaks of subterranean clover red leaf syndrome and the loss of pasture, the occurrence of which seems to becoming more frequent and widespread. Symptoms include reddening of leaves, stunted plants and even premature plant death causing significant losses in dry matter and seed production. The degree to which symptoms are expressed is related to overall plant health. Consequently, additional stresses such as drought stress, poor nutrition or root pathogens can weaken the plant further and cause the symptoms to be more severe.

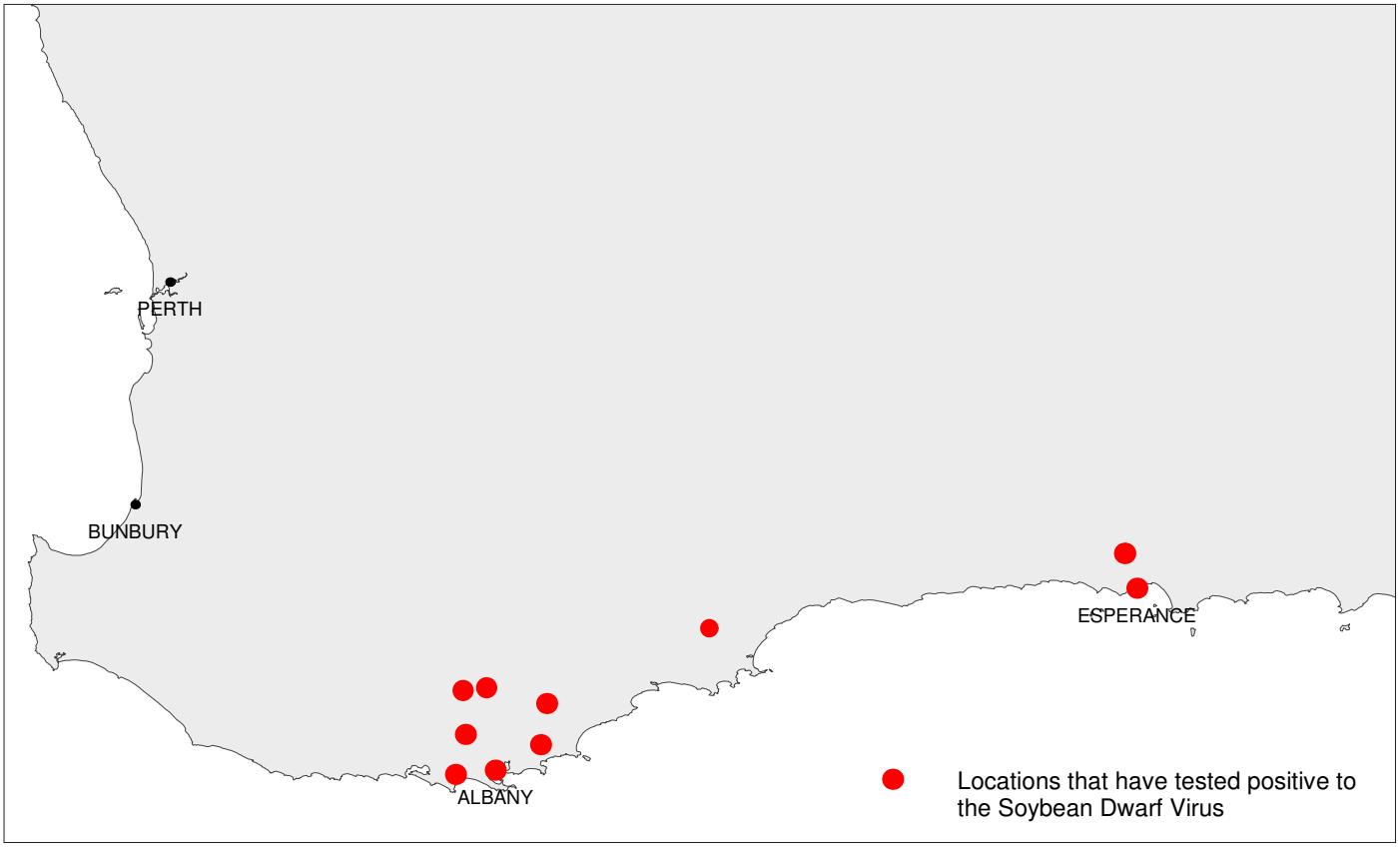


Figure 1. Map of locations that have tested positive to the Soybean dwarf virus (SbDV) and exhibited sub-clover red leaf symptoms in recent years. Note while other locations such as Brookton have reported symptoms the presence of SbDV is yet to be confirmed.

Figure 2. Subterranean clover plant SbDV-infected with red leaves.
Note. Reddening is from the leaf margins inwards.

Figure 3. Close up of leaves in various stages of turning red.

In response to the concerns of livestock producers, DPIRD and the University of Western Australia (UWA) investigated the 2017 outbreak. The DPIRD laboratory found 80% of clover plants with obvious red leaves tested were infected with SbDV compared to just 2% of 'healthy looking' plants.

Soybean dwarf virus (SbDV formerly known as Subterranean clover red leaf virus) was first reported in clover plants in Victoria in 1965. It was subsequently found in Tasmania, New South Wales and South Australia. It has been known to occur in Western Australia since the 1970s.

Reports in southern Australia on subterranean clover red leaf syndrome during 1970-1980s found high virus incidence lead to reduced herbage and growth (60%), significant losses in seed yield (60%), decreased hay production (50%), with early infection causing establishment failure and late season pasture collapse. There is also an increased susceptibility to fungal root pathogens and change in pasture composition as the infected plants are out-competed by plants which are unaffected.

Symptoms in subterranean clover

SbDV infection causes leaf margin reddening of older leaves of subterranean clover plants. Plants infected early in the season exhibit more severe symptoms than those infected later and are often stunted with small leaves and produce few seeds (figures 2 and 3). The type and severity of leaf symptoms differ depending on plant age at infection and environmental conditions. In subterranean clover, SbDV symptoms can be confused with those caused by nutrient deficiencies (especially phosphorous), water-logging, cold or other plant stresses that also cause leaf reddening. In some cases, SbDV infection coincides with secondary infection by fungal root rots which can lead to pruning of the roots, an increase in the severity of symptoms and plant death. Root pruning can result in more plant stress from reduced uptake of water, nutrients, and or poor nodulation.

Biology

Survival in green-bridge hosts

SbDV predominantly infects legume species and does not infect grasses. SbDV is hosted by live plants over summer and spread to subterranean clover pasture plants by aphids, but it is not seed-borne. Substantial summer rain can result in a green bridge of summer weeds that allows both the virus to survive and aphid populations to increase at a time when new autumnal pastures are just developing, which in turn may increases the risk of an outbreak of sub clover red leaf syndrome. Depending on the location, legume crop volunteers (e.g. narrow-leafed lupin, field pea, faba bean), subterranean clover, white clover, red clover, strawberry clover, lucerne and medics are also likely over-summer hosts in WA.

Aphid vectors

SbDV is transmitted persistently, i.e. when an aphid feeds on the sap of an infected plant it acquires the virus permanently, but does not pass it on to offspring. When the infective aphid then probes the sap of a healthy plant, it infects the plant and continues transmitting SbDV for the rest of its life. The virus only infects cells associated with transporting sugars around the plant, and is not present in any other tissues.

SbDV is transmitted by certain aphid species that migrate from green-bridge hosts to colonise subterranean clover. Foxglove aphid (Aulacorthum solani) and pea aphid (Acyrthosiphon pisum) (Figure 3) are the primary vectors. Blue green aphid (Acyrthosiphon kondoi) may act as an inefficient vector.

For more information on aphids visit agric.wa.gov.au/apps/mypestguide-crops

Figure 4. Adult pea aphids, note dark joints on legs and antennae.

Spread into subterranean clover pastures

SbDV and related viruses generally reach epidemic proportions in pastures and crops in south-west WA when late-summer and early-autumn rainfall favours the development of a green bridge. When this occurs, aphids build up under the warm conditions and spread the virus to more vulnerable establishing pastures. In these scenarios, the risk of significant losses in pasture biomass and sudden death of seedlings is higher. Dry springs also favour aphid activity and the development of symptoms. However, aphid numbers are kept down in years with cold wet weather or the presence of aphid parasites. Due to the reliance on pre-season rainfall and the increased presence of its external hosts and aphid vector species, SbDV is more common in medium to high rainfall areas.

Management

Self-surveillance

There are other diseases and factors that can affect subterranean clover. However, if you suspect SbDV is infecting your subterranean clover pasture, collect leaf samples of symptomatic plants and send to DPRID diagnostic laboratory service (agric.wa.gov.au/ddls-plant-pathology-0) for an accurate diagnosis so as to target the most appropriate management strategy.

Although aphids can be difficult to find on pasture plants, using yellow insect traps to monitor their movement is a good early warning tool.

Integrated disease management

An integrated disease management approach using control measures that operate in different ways is needed to control SbDV in subterranean clover pastures:

Use insecticides only when the risk of early infection is high

Application of an anti-feed insecticide (i.e. synthetic pyrethroid) at the highest registered rate for aphid control in subterranean clover at two and six weeks after seedling emergence. This will deter aphids from feeding and therefore spreading SbDV to young vulnerable sub clover seedlings (Refer to the insecticide label for withholding periods or Safemeat for export intervals).

Manipulate pasture composition

Grasses do not host SbDV, so using annual ryegrass or forage oats could be a useful tactic and in the absence of an outbreak would likely improve early feed availability.

Growing alternative pasture species

This is another option to lessen the impact of a loss of subterranean clover pasture as the result of an outbreak. If sowing alternative pasture species, seek further advice to see if they are suited to your soils, rainfall and management system. Serradella is an option as it does not appear to be affected by the syndrome, even when growing alongside symptomatic subterranean clover plants. However, a note of caution, it is unknown whether some of the alternative pasture species are hosts of SbDV.

Barrier

Oats can be sown as a barrier around pasture paddocks to disperse aphids and slow early spread into pasture from outside sources.

Figure 5. An example of sub-clover red leaf syndrome in Esperance in June 2013

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For more information

agric.wa.gov.au/bacteria/ddls-plant-pathology-services

Australian Wool Innovation and Meat and Livestock Australia online survey

A joint initiative between AWI and MLA to continue to host an online Producer Survey into the 2018 season will enable producers to report incidents of the virus and allow for sample testing to continue. You can submit your report via the survey at: survey.mla.com.au/TakeSurvey.aspx?SurveyID=clover