

GREEN BRIDGE FACT SHEET

Green bridge control is essential for pest and disease management

Preventing the early build-up of pests and diseases, preserving soil moisture and nutrients, and reducing the weed seedbank are all good reasons for controlling the green bridge in between cropping seasons.

KEY POINTS

- The green bridge provides a 'between season' host for pests and diseases (particularly rusts) that pose a serious threat to future crops
- Fallow rainfall events and the existing seedbank affect the establishment and size of the green bridge
- Pests and diseases can spread rapidly from the green bridge into crops, allowing for increased damage, more generations during the season and increased requirements for control measures to be implemented
- Early disease infections to crops that have moved from the green bridge can be particularly severe, as many crops have not fully developed resistance at the seedling and early growth stages
- Baiting programs for slugs and snails are less effective when the green bridge is not controlled as volunteers and weeds provide an alternative food source
- Controlling the green bridge reduces risk and has a positive effect on gross margins
- Timing of control must consider pest, disease and vector life cycles
- Controlling the green bridge on your own farm will reduce local pest and disease spread but working with neighbours to synchronise timing of control can benefit the whole district

Action is needed on a community level to remove crop volunteers and summer weeds to effectively manage the risk of pests and diseases that survive the green bridge between crops.

What is the green bridge?

The green bridge is any plant material, crop volunteers and weeds, growing out of season that can act as hosts to pests and diseases, allowing them to move from one season's crop to the next.

A green bridge that overlaps

cropping activities can allow for many pests and diseases to survive in between cropping seasons, leading to much earlier establishment in the crop, more generations of the pest or disease during the growing season and greater damage overall.

PHOTO: EMMA LEONARD





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Crop volunteers and weeds germinating in summer and autumn host diseases and insects, which can quickly spread into newly established winter crops across property boundaries.

Many important crop pests and diseases such as rusts, viruses, slugs and snails, mites and aphids can all use the green bridge to survive. A green bridge for these pests can occur anywhere, including previously cropped paddocks, along headlands and fencelines, and on roadsides adjacent to cultivated areas and fallows.

Volunteers and host weeds remaining in previously cropped paddocks can enable soil-borne pests and diseases to persist, allowing for early infection of the following crop.

Grain pests and diseases that can utilise any local volunteers and host weeds

Many pests and diseases that have an ability to readily disperse can survive on just a few host plants. Without removing all the volunteers and host weeds from all areas on, and adjacent to, the farm there will always be some risk of local pest and disease carry over between seasons.

It is important for neighbours and communities to coordinate their efforts and timing the control of hosts for these types of pests and diseases, especially cereal rusts.

Cereal rusts

Cereal rusts (*Puccinia* species) including stripe rusts, leaf rusts and stem rusts can only survive on suitable living host plants, so the presence of the green bridge allows them to survive locally.

Rusts are the most important foliar cereal diseases in Australia and infection is more widespread and damaging in years where summer/autumn rainfall has resulted in a significant green bridge. Spores are windborne and are easily spread; as little as one infected leaf per 12 hectares surviving through summer and early autumn can produce a rust epidemic in the following cereal crop.

Rusts cause red, orange or yellow powdery pustules on leaves, stems or

heads of plants, and volunteer cereals are the primary reservoir of infection from one cropping season to the next. If high levels of rust are present in a green bridge when crops are sown, even crops selected for their rust resistance are likely to be severely affected. Rust will infect crops during the most susceptible establishment phase, before resistance traits develop in the adult plants.

Stripe rust can be a serious problem on wheat in regions where cool temperatures prevail through the growing season. Barley and some other grasses and cereals are also affected. It survives in the green bridge on volunteer wheat, barley and triticale, as well as on barley grass and other grasses, including brome grass and phalaris.

Stem rust most commonly affects wheat, but barley, oats and rye can also be affected. It is less common than stripe rust but can cause total crop losses where conditions favour the spread of stem rust. The most important hosts are susceptible wheat volunteers, but it can also survive on barley, triticale and some grasses. Epidemics are more frequent in the rust-prone, very high rainfall districts in northern and southern agricultural areas.

Leaf rust is more widespread, but often less severe than stem or stripe rust. The most common hosts are volunteers of susceptible cereal varieties.

PHOTO: BRAD COLLIS



Uncontrolled stripe rust can cause serious crop losses in wheat and barley.

Many cereal varieties that rely on adult plant resistance to combat rust pathogens may be susceptible to infection during the early growth stages of the crop, depending on the variety grown and the rust pathotype present.

The majority of current wheat varieties have little or no seedling resistance or adult plant resistance to newly emerging or exotic rust pathotypes.

Rust spores moving from infected hosts in the green bridge can result in a 100 per cent infection of the crop. Figure 1 illustrates how the presence or absence of a green bridge and adult plant resistance can affect the level of stripe rust infection in wheat.

Viruses

Virus diseases generally have the greatest impact when crops are infected at the seedling stage. Infection is more likely to occur when a green bridge is present before sowing as it allows both the virus to survive and vector populations (such as aphids and wheat curl mite) to increase at a time when new crops are just developing.

Destroying the green bridge (cereal and canola volunteers and weeds) well in advance of sowing minimises the local threat from virus diseases.

Wheat streak mosaic virus (WSMV) and **Wheat mosaic virus (syn. High Plains Virus)** are transmitted by the wheat curl mite (WCM) and can also be spread

by infected seed. It causes severe leaf symptoms and reduced yield.

If there is a severe infection in an emerging crop, WSMV can result in total crop loss. The virus affects wheat, oats, rye and a range of grasses.

The virus and its vector require a green bridge to survive between growing seasons. Hosts for WSMV and WCM include volunteer wheat, barley grass, annual ryegrass, small burr grass, stink grass and witch grass.

Wheat curl mites are less than 0.3mm long and can only be seen with the aid of a microscope.

Warm temperatures tend to increase WCM populations and WSMV spread.

Spraying out volunteers at least four weeks before sowing will reduce the risk of these viruses spreading to emerging seedlings.

Turnip yellows virus (TuYV), formerly identified as Beet western yellows virus (BWYV), and **Bean leaf roll virus (BLRV)** are two viruses that commonly affect oilseed and pulse crops. They rely on the existence of a green bridge for their survival and the survival of their vector aphids between growing seasons. TuYV is endemic in canola crops in south-west Western Australia.

For TuYV it is critical to prevent aphids spreading these diseases to crops for the first eight weeks after emergence. Wild radish is also known to be a host for TuYV.

BLRV causes severe symptoms in pulses. Hosts for this virus and its vectors include broadleaf weeds and pasture legumes such as lucerne, medics and clovers. BLRV causes stunted plants and reduced yields and may kill heavily infected plants depending on the combination of crop and virus.

Barley yellow dwarf virus (BYDV) and **Cereal yellow dwarf virus (CYDV)** infects all cereals, having significant effects on wheat, oats and barley. It is transmitted mainly by the oat and maize aphids, and even low populations of these aphids can cause significant spread of BYDV. Infected plants have less above-ground biomass and a reduced root system, resulting in smaller grain size and lower grain yield. Grass weeds and volunteer cereals can be hosts for BYDV.

FIGURE 1 Illustration of the effects of a green bridge and adult plant resistance (APR) on the development of stripe rust in wheat compared with a drier summer.

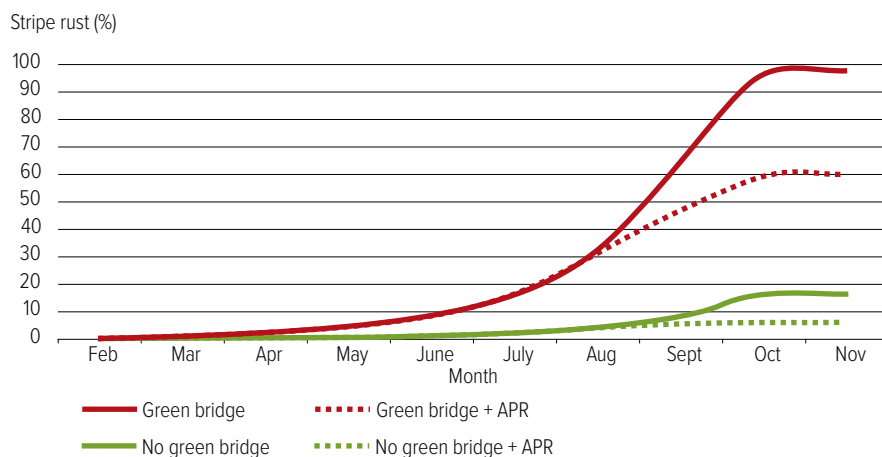


PHOTO: EMMA LEONARD

Even a single host plant can provide refuge to diseases and their vectors.

PHOTO: cesar



Wingless oat aphid

PHOTO: cesar



Winged oat aphid

Turnip aphid



PHOTO: cesar

but their greatest threat is as vectors of plant viruses. Many aphids can survive by taking refuge on plants within the green bridge over summer and autumn, some of which may be hosting viruses.

Destroying the green bridge well in advance of sowing minimises local threat from aphids and aphid-vector diseases.

Diamondback moth (DBM), or cabbage moth, can devastate canola. DBM multiplies over summer on canola volunteers and other weeds including wild radish. In winter crop-growing areas where conditions have remained mild, DBM caterpillars can damage emerging canola.

DBM is usually most destructive later in the season when canola is at the mid to late flowering stage, as high caterpillar numbers can cause yield loss.

Ongoing infestations will impact on the effectiveness of product used for control and increase the risk of resistance.

Snails and slugs. A green bridge provides habitat for slugs and snails to survive over summer and acts as a food source in autumn. Baiting for slugs and snails is less effective when weeds and volunteer plants provide an alternative food source to baits.

Other pests. Other pests may take advantage of summer rain and green bridges to increase in numbers. These can include webworms, cutworm, armyworm,



PHOTO: DPIRD

Eliminate weeds along fencelines, buildings and roadsides in your green bridge control strategy as they can also harbour pests and disease.

Pests

Invertebrate pests present the greatest risk to the crop if they strike early in the season, when crops first emerge. Controlling the green bridge will reduce the risk at emergence. Where a green bridge is present at emergence, pests should be monitored and if present controlled to prevent them spreading viruses or causing damage to the crop.

Insecticides may be required to

counter the direct feeding damage of the insects or to prevent the spread of viruses within the crop, for example, by aphids.

Trials have shown that if a green bridge is controlled at least two weeks before seeding then there is a decreased risk of insect pests damaging emerging crops.

Aphids. Several species of aphid are pests of cereals, pulses and oilseeds,

flea beetle and lucerne flea. Vertebrate pests, such as mice, can also use the green bridge as a food and moisture source, reducing baiting efficiency.

Grain pests and diseases occurring in previously cropped areas

Soil-borne pathogens and pests that are not highly mobile will generally persist in previously cropped paddocks. Removal of the green bridge and rotation with non-host crops are valuable tools for reducing future pest and disease pressure.

Crown rot is a fungal disease (predominantly caused by *Fusarium pseudograminearum* and *F. culmorum*) that typically survives over summer on the debris from previously infected cereal plants.

New infections occur when a growing plant comes into contact with infected debris/stubble, which is favoured by soil moisture and susceptible host plants. Grassy summer weeds and volunteer cereals can all host Crown rot over summer.

Crown rot is likely to be more severe in crops following a green bridge as levels of colonising fungus will already be high at crop emergence.

Good summer rains will help with the breakdown of the previous year's infected cereal stubble, reducing crown rot inoculum carryover, so long as grassy weeds are well-controlled.

Root lesion nematodes (RLN) (*Pratylenchus* species) are widely distributed in the soil of many cropping regions, where they can attack a range of host plants including crop and weed species.

RLN act as parasites on living plant roots; however, they can enter a dormant phase when a food source is not available or when soil moisture is too low.

They do not feed on dead roots or organic matter. If suitable plant hosts and soil moisture are present over summer, their numbers can increase substantially and can reach damaging levels for establishing crops.

Rhizoctonia is a root disease that, while not easily spread, continues to survive in the green bridge of infected areas.

Rhizoctonia attacks cereals, pulses, pastures and weeds. It survives as

PHOTO: BRAD COLLIS



Not all plants in the green bridge will act as a hosts for diseases like the rusts, but they will still reduce moisture and soil nutrients. Mintweed (goosefoot) can also release toxins into the soil, which can reduce the growth of crops, pulses and pasture legumes.

fine fungal threads in organic matter and is likely to be more severe where the fungus has infected the roots of grass weeds before sowing, which enables the fungus to both multiply and tolerate cultivation.

Early green bridge control is a helpful cultural practice in paddock preparation to minimise Rhizoctonia.

Anticipate, monitor and control the green bridge

In winter cropping regions where a summer fallow is common, summer and early autumn rainfall and the size of the existing seedbank will determine how much plant material may be in the green bridge.

The success of weed control during previous crops and fallows, along with harvest practices that reduce seed loss, can reduce the overall size of the seedbank. However, rainfall in the fallow period is the key driver of when and how much of the seedbank can germinate.

Monitoring germinations of weeds and volunteers after rainfall events in the fallow period and implementing control measures while the plants are younger and more susceptible will lead to higher levels of control.

Timing and control options

Aim to complete control options in a timely manner ensuring that no green weed material is present for a minimum of

four weeks before seeding. For disease management purposes, the time taken for herbicides to achieve complete plant death needs to be added onto this four-week period so application timing may need to be up to six weeks before seeding.

Chemical control

Spraying weeds and crop volunteers provides the most effective control of the green bridge. Growers are advised to follow the label directions on herbicides. The objective should be to achieve an outright kill of weeds and volunteers.

While not all weeds act as a green bridge for pests and diseases, any weeds that persist during summer, together with volunteers, will consume valuable soil moisture and nitrogen.

Research in Western Australia and New South Wales has identified that removing weeds shortly after they emerge can preserve 50 to 75 millimetres of soil moisture.

Researchers have also identified yield losses of 0.5 to 1.0 tonne per hectare in cereals where the green bridge remained uncontrolled up to sowing; grower experience parallels this. Nutrients used by the green bridge are no longer available to crops at seeding even if the green bridge is later killed by herbicide. Summer grasses in particular are known to forage for nitrogen, depleting nutrients available to following crops.

FREQUENTLY ASKED QUESTIONS

When is the best time to control the green bridge?

Timing must consider the specific pest or disease life cycle and how they spread, the time taken for the control measure to fully kill alternative host plants, the reduction in soil moisture and nutrients and the potential seedbank. To retain moisture and nutrients, weeds and volunteers should be controlled while they are young and small. This will also help to reduce the future seedbank. Growers should aim to have all weeds and volunteers completely dead, 4 weeks prior to seeding. This would minimise the weeds role as a host and infection source of pests and diseases for the new season crop.

Does the choice of herbicide impact on the timing of green bridge in previously cropped areas?

To remove potential hosts for rusts, viruses and virus vectors the aim is to have the foliage of the volunteer crops and weeds completely dead for a minimum of 4 weeks before seeding. For

many soil-borne diseases the root system must also be dead to reduce pathogen survival and build up in emerging crops. If host plants are not overly stressed, translocated products can kill the root system, but this may take up to two weeks or longer. While contact type herbicides tend to desiccate the foliage quickly, it may also take a few weeks for the root system to die and for the plant to no longer act as a host to many soil-borne pathogens. Always check the product label to see if a plant back period for future crops exists, including factors that may influence the length of the plant back period, such as rainfall or soil pH.

Can I use residual herbicides on fencelines and other non-production areas to extend the length of the green bridge control?

Always check that the intended use pattern is approved on the product label. Use Integrated Weed Management principles and a range of tactics, which may include registered residual herbicides. In non-production areas there are more opportunities to rotate tactics and products to reduce the risk of resistant weeds developing.

Grazing

Heavy grazing can be an effective technique for reducing the summer vegetation load. However, grazing patterns are often irregular and host plants are not always completely killed, so they can continue to harbour viruses and root diseases.

Cultivation

Tillage can be effective in eliminating weeds (also resulting in removal of hosts for pests and diseases) and may kill host plants sooner than some herbicides. Tillage should be carried out four weeks before planting to remove the green bridge, provided volunteers and weeds are completely removed. However, cultivation in areas with light soils that dry quickly during summer months can cause loss of soil moisture and lead to erosion. Cultivation can be effective in reducing the severity of Rhizoctonia.



USEFUL RESOURCES

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