# GREEN BRIDGE
## FACT SHEET

GRDC
Grains Research & Development Corporation

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# The essential crop management tool – green bridge control is integral to pest and disease management

Control of the green bridge gives crops a better chance to reach their potential by reducing the risk of pests and diseases surviving between seasons, while preserving valuable soil moisture and nutrients.

PHOTO: EMMA LEONARD

### KEY POINTS

- The green bridge provides a 'between season' host for insects and diseases (particularly rusts) that pose a serious threat to future crops and can be expensive to control later in the season.
- Outright kill of the weeds and volunteers is the only certain way to avoid them hosting diseases and insects.
- Diseases and insects can quickly spread from the green bridge, jeopardising crops and current control methods including the effectiveness of chemicals and genetic breeding for resistance.
- Effective control of the pest and disease risks requires neighbours to work together to simultaneously eradicate weeds and crop volunteers.
- Weed growth during summer and autumn also depletes soil moisture and nutrients that would otherwise be available to following crops and can have an allelopathic effect.
- Green bridge weeds may also be 'in crop' weeds and their seed set should be prevented.

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

Level 1, Tourism House | 40 Blackall Street, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604 | t. +61 2 6166 4500 | f. +61 2 6166 4599 | e. grdc@grdc.com.au | w. www.grdc.com.au

# WHAT IS THE GREEN BRIDGE?

The term 'green bridge' describes the role of weeds and crop volunteers in helping pests and diseases that cross from one cropping season into the next.

This mass of vegetation grows on paddocks, headlands, roadsides and non-crop land after summer rain – although it can also refer to growth during winter, between summer crops.

A green bridge consists of crop volunteers usually from last year's crop, and sometimes from crops grown one or two years before, plus weeds emerging from seeds set over many years, or from new windborne weed seeds.

## A shared risk

Control of the green bridge is a community issue, not just an individual one, as many pests and diseases can easily spread from adjacent properties and commonly-owned land.

Rust spores, aphids and mites all travel on the wind, and easily cross farm boundaries. Where crops are sown close to a green bridge containing plants infected with fungal or viral diseases, and their vectors, the infection will quickly spread to the newly established crop. The impact of a disease will be more widespread and severe the earlier infection occurs after germination.

Widespread infection places pressure on current chemical controls. High levels of rust on volunteers can make control with fungicides more difficult and also places pressure on genetic resistance in cereal varieties by increasing the likelihood of pathogen mutation.

By providing a host for pests and disease the green bridge can trigger epidemics of insects and diseases later in the year, which cannot be easily or economically controlled. In some instances there are no effective chemical controls for the insects or diseases transmitted from the green bridge, such as wheat streak mosaic virus transmitted by the wheat curl mite.

While individual farmers will benefit from efforts to eradicate the green bridge on their own properties, effective control requires neighbours to work together to remove volunteers and weeds simultaneously.

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.

PHOTO: EMMA LEONARD

## Competition for soil and nutrients

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

Researchers have also identified yield losses of 0.5 to 1.0 tonnes per hectare in cereals where the green bridge remained uncontrolled up to sowing; farmer 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 are known to forage for nitrogen in particular, depleting nutrients available to following crops.

# ASSESSING THE GREEN BRIDGE RISK

Late summer and early autumn rainfall is the key trigger for the establishment of the green bridge in those parts of Australia where winter cropping dominates.

Seasonal conditions provide an indication of the green bridge risk from year to year, with some state government agencies providing awareness campaigns (see back page) in years of high risk. These campaigns identify where there has been enough summer/autumn rain to generate problematic weed and volunteer growth.

The more weed vegetation there is during the summer/autumn period, the longer it is in place and the closer it survives to the start of the new cropping season, the higher the disease and pest risk associated with the green bridge. Information and awareness campaigns generally begin from February onwards.

Cereal crops make up an increasing percentage of the landscape, as traditional grazing regions diversify into cropping, such as Victoria and Tasmania's high-rainfall zones. This increases the potential to generate cereal volunteers between crops, raising the green bridge risk. More crops also mean more area at risk.

## Weed risks

Some regions have experienced a change in traditional rainfall patterns during the past decade, with higher summer rainfall. This has resulted in more widespread establishment of a summer green bridge and increased levels of disease, particularly rusts, in following cereal crops.

New weeds are appearing with changes in traditional summer rain patterns, and their capacity to host disease and viruses are still being evaluated.

Some weeds, such as mintweed (also

know as goosefoot) in WA, are also allelopathic – they put toxins into the soil that prevent plants from growing, further reducing the productive potential of crops.

In many areas there are now far fewer animals within farming systems (the national sheep flock has fallen from 185 million to 75 million) to control the summer weed burden.

Chemical management has become more important, and growers should rotate herbicide groups to prevent resistance developing in weed populations. Chemicals most commonly used for summer weed control with growers are Group B (sulphonylureas), Group I (phenoxys), and Group M (glyphosate) products.

Weeds such as melons also impact on the efficiency of sowing, as vines become tangled in equipment.

### Insect risks

Insect pests provide the greatest risk early in the season, when crops first emerge.

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.

Mintweed (goosefoot) releases toxins into the soil which reduces the growth of crops and legume pastures.

PHOTO: RALPH BURNETT

Where insects are in epidemic numbers, effective control is usually achieved by using the higher registered rates of insecticides and increasing the frequency of applications. However, the greater the insect population is, there is an increased likelihood of mutations developing and this could lead to more fecund or virulent pest species.

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

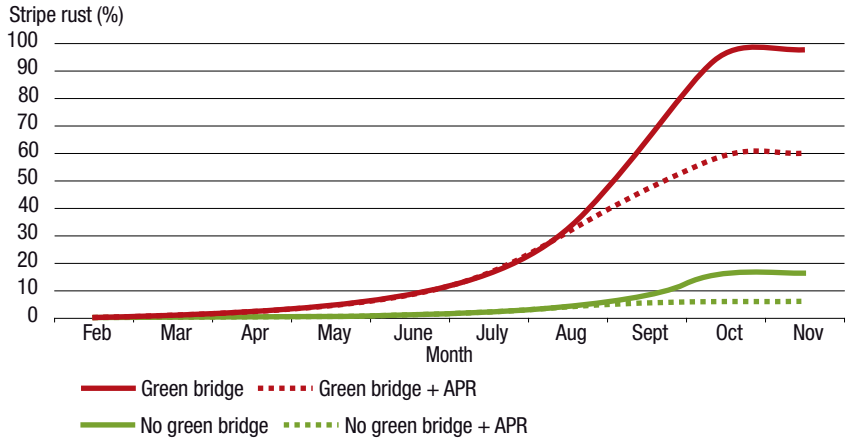
PHOTO: BRAD COLLIS

## COMMON GREEN BRIDGE PESTS AND DISEASES

**Rusts** are the most important foliar cereal diseases in Australia and infection is much more widespread and damaging in years where summer/autumn rainfall has resulted in a significant green bridge. Spores are windbourne and are easily spread; as little as one infected leaf per 12 hectares of regrowth 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

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




## Redlegged earth mites

PHOTO: CESAR CONSULTANTS

volunteer wheat, barley and triticale, as well as on barley grass and other cereal grasses, 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. The most important hosts are susceptible wheat volunteers, but it can also survive on barley, triticale, and some grasses. Where conditions favour the spread of stem rust it can destroy an entire crop. Epidemics are more frequent in the rust-prone, very high rainfall districts in northern and southern agricultural areas.

Leaf rust is more widespread, but less severe than stem or stripe rust, reducing yields around 20 per cent and reducing grain quality. The most common hosts are volunteers of susceptible cereal varieties.

**Wheat Streak Mosaic Virus** (WSMV) is transmitted by the wheat curl mite (WCM) and can also be spread by infected seed. It causes severe leaf symptoms and reduced yield, and 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. Currently there is no effective miticide for WCM in Australia, so removal of the green bridge is an essential strategy to prevent the spread of WSMV.

**Barley Yellow Dwarf Virus** (BYDV) infects all cereals, having significant impacts 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 also a reduced root system, resulting in smaller grain size and lower grain yield. Yield losses of 10 to 20 per cent have been consistently recorded in trials in long growing season areas, with up to 60 per cent losses in some instances.

**Beet Western Yellow 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. BWYV is endemic in canola crops in south-west Western Australia. BLRV causes severe symptoms in pulses. Hosts for these viruses and their vectors include broadleaf weeds and pasture legumes such as lucerne, medics and clovers. These viruses cause stunted plants and reduced yields and may kill heavily infected plants depending on the combination of crop and virus. Infection with BLRV causes severe symptoms in pulses. Hosts for these viruses and their vectors include broadleaf weeds and pasture legumes such as lucerne, medics and clovers. These viruses can result in 30 to 50 per cent yield losses.

**Diamond Back Moth (DBM),** or cabbage moth, can devastate canola. DBM multiplies over summer on canola volunteers and other weed growth including wild raddish. In winter crop growing areas where conditions have remained mild, DBM caterpillars have damaged emerging canola. DBM are 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. One well-timed spray can control the caterpillars but DBM caterpillars are already resistant to some insecticides, and ongoing infestations increase pressure on the effectiveness of remaining products. Insecticides control only the grubs, and not the adults.

**Mites** – Green bridges can breed high populations of mite pests, especially if susceptible crops such as canola are planted into paddocks that have a green bridge. Clover mite and balaustium mites can maintain populations all through the year, as long as there is a green bridge. However, redlegged earth mites and blue oat mites require five consecutive days of temperatures below 20°C to hatch from over-summering eggs, and a green bridge greatly helps to increase their populations.

**Rhizoctonia** is a root disease that, while not easily spread, continues to survive in the green bridge in infected areas. Rhizoctonia attacks cereals, crop legumes, pastures and weeds with a current estimated cost to growers nationally of $5 per hectare (wheat) and potentially costing $14 per hectare. It survives as 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. There is no highly effective chemical solution and weed control to remove host plants is one of the most effective cultural practices.

# GREEN BRIDGE CONTROL

In terms of hosting disease and insects, crop volunteers provide the most serious risk, particularly if they are the same crop, and the same variety as the one about to be planted.

Weeds can be most effectively controlled when they first emerge. Green bridge weeds should not be allowed to set seed. Seed set can add to the cost of weed control in the following crop.

However, in the case of foliar pests and diseases, where one grower eliminates the green bridge early in the season, any subsequent weed growth may be infected by disease or insects from neighbouring properties. An early-sown crop could also be infected from an adjacent property where the neighbouring grower has a later weed control and sowing program.

Weeds and volunteer cereals along fencelines, around sheds and roadsides should all be targeted as potential disease hosts, particularly for rusts.

Neighbours working together to eliminate the green bridge simultaneously will control the pest and disease risks more effectively than growers working independently.

PHOTO: DAFWA

## Timing

If the green bridge has not been eliminated early in the season it is essential to create a break of at least two to three weeks during which there is no green plant matter capable of hosting disease or insect vectors.

To achieve this, the green bridge should be sprayed four to six weeks before sowing, to ensure weeds are completely dead.

For instance, WCM can survive in the core of dead-looking plants and can quickly spread into new crops and infecting them with WSMV. Viruses can be most damaging if weeds are not quite dead when the new crop emerges.

Spraying weeds within two weeks of sowing will not reduce the disease risk, although it will reduce competition from weeds for water, nutrients and light as the crop emerges.

If the first weeds of the summer/autumn season appear shortly before sowing, the previous weed-free period is likely to provide a sufficient break in the disease cycle.

## Chemical control

Spraying weeds currently provides the most effective control of the green bridge. Growers are advised to follow the label directions on herbicides, as prevailing weather conditions, particularly hot weather, can influence the efficacy of herbicides. The objective is to achieve an outright kill of weeds and volunteers. Glyphosate and other translocated herbicides are best as they are usually the most effective – contact herbicides are less reliable.

## Grazing

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

## Cultivation

Tillage can be effective in eliminating weeds for disease control. It should be carried out two to four weeks prior to planting to remove the green bridge effectively.

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.

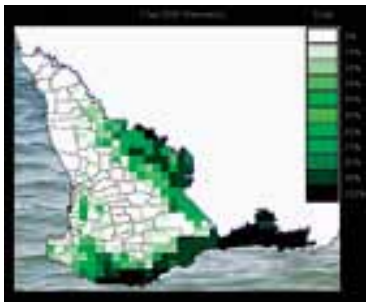
PHOTO: EMMA LEONARD

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

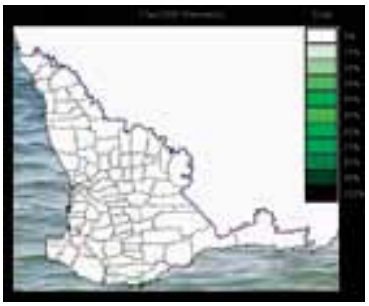
# MODEL HELPS TO ASSESS RISK

In Western Australia, modelling is used to help identify the green bridge risk. Daily temperature, rainfall and evaporation data are used to determine the greenness level or build up and break down of green bridge plant material in the southern cropping belt.

Temperature determines the rate at which greenness increases. Rainfall and evaporation are used to determine the fraction of plant-available water, which is then used to calculate the maximum capacity for greenness. The model outputs have been calibrated using satellite Normalised Difference Vegetation Index (NDVI) imagery and can be viewed at the Department of Agriculture and Food Western Australia website, www.agric.wa.gov.au

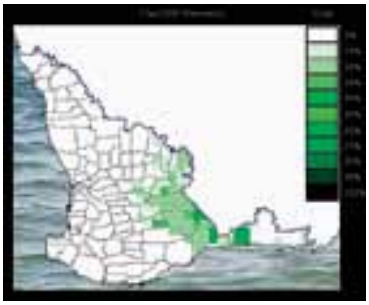


Green bridge, south-west WA April 1, 2000

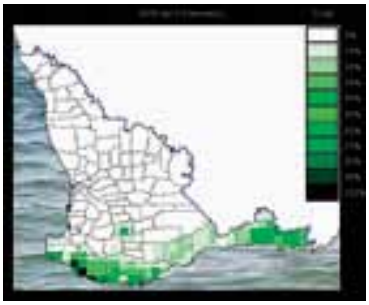


Green bridge, south-west WA April 1, 2005

IMAGES COURTESY OF DAFWA



Green bridge, south-west WA April 1, 2006



Green bridge, south-west WA April 3, 2009

## Useful resources:

**For local information about managing the green bridge risk and seasonal assessments of the risk, contact your local agronomist or:**

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| **South Australia – Hugh Wallwork SARDI** | **08 8303 9382 Email: wallwork.hugh@saugov.sa.gov.au** |
| **Victoria and Tasmania – Grant Hollaway VIC DPI** | **03 5362 2111 Email: grant.hollaway@dpi.vic.gov.au** |
| **Western Australia – Geoff Thomas DAFWA** | **08 9368 3333 Email: gthomas@agric.wa.gov.au** |
| **Western Australia – Svetlana Micic DAFWA** | **08 9892 8444 Email: smicic@agric.wa.gov.au** |
| **New South Wales – Andrew Milgate NSW DPI** | **02 6938 1990 Email: andrew.milgate@dpi.nsw.gov.au** |
| **GRDC website, Rustlinks** | **www.grdc.com.au/rustlinks** |
| **GRDC website, Pestlinks** | **www.grdc.com.au/pestlinks** |
| **GRDC website, Weedlinks** | **www.grdc.com.au/weedlinks** |
| **GRDC website, Diseaselinks** | **www.grdc.com.au/diseaselinks** |
| **Crop disease forecasts provided by each state** | **NSW: www.dpi.nsw.gov.au; Victoria: www.dpi.vic.gov.au; WA: www.agric.wa.gov.au; Queensland: www.dpi.qld.gov.au; Tasmania: www.dpiw.tas.gov.au SA: www.sardi.sa.gov.au** |



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