Understanding and managing brome grass

AGRICULTURE VICTORIA

Brome grass causes $20 million in lost grain yield annually across one million hectares in south-east Australia, with the highest incidence in north-west Victoria. The weed has evolved to thrive and persist in modern cropping systems. Brome grass requires three consecutive years of dedicated control using a variety of methods.

SUMMARY

- Achieving a three-year break is key to managing brome grass.
- Crop competition is a cheap and effective tool.
- Crop-topping can be difficult.
- Harvest weed seed control tactics can help.
- For effective herbicide options in cereals, the imidazolinones ('imi's) are the best but resistance is developing.
- New pre-emergent options are available or coming. Tri-allate is a good mixing partner.

BIOLOGY AND ECOLOGY

The two species of brome grass that cause problems in crops are *Bromus diandrus* – great or green brome and *B. rigidus* – rigid or red brome. They cannot be distinguished at the vegetative stage. *B. rigidus* is more common in low rainfall, calcareous soils in the northern Mallee. *B. diandrus* is the main species in the southern Mallee and Wimmera - and is spreading into higher rainfall areas.

Why brome grass is thriving

Brome grass is well-adapted to a Mediterranean environment. It is widely distributed across southern Australia, particularly north-west Victoria. While most prolific in the Mallee, its incidence is increasing in medium and high rainfall areas.

Brome grass has thrived with the adoption of no-till farming, wide rows and early sowing or dry sowing and intensive cereal-based cropping.

Brome grass is highly competitive, with only 100 plants/square metre reducing wheat yields by as much as 30 to 50 per cent.

Some seed can express dormancy, leading to staggered germination. Populations with very late emergence can thwart early control with knockdown treatments, and to some extent, pre-emergent herbicides. Of note:

- Farming practices in Victoria and South Australia have selected for populations with strong dormancy allowing it to avoid pre-sowing weed control measures. University of Adelaide research found that *B. diandrus* in crops germinates 20 days later than its counterparts along fence lines.
- Brome grass seed requires a period of chilling to overcome dormancy and germinate. The cold requirement is often met in May-June.
- As a large seed, light strongly inhibits germination of brome grass in cropping situations, so seeds on the soil surface will not germinate until they are buried sufficiently.

Brome grass in no-tillage, zero-till and cultivated systems

Brome grass has adapted to no-till and zero-till farming, where most seeds remain on the surface until burial following the sowing pass. This enables seeds to begin the process of germination after sowing.

The darkness requirement for germination delays weed emergence in no-till and zero-till systems, so in-crop control options are very important.

In no-till, seeds remaining on the surface are more vulnerable to decay and to predators than buried seed.

Concentrating weed seeds on the surface can improve the efficacy of pre-emergent herbicides, as they need to be in close proximity to the emerging shoot and roots.

Shallow burial of brome grass seed (a "tickle") to one centimetre can fulfill the dark requirement to stimulate early germination to improve control.

Deeper cultivation before sowing buries seeds and can promote dormancy. This can increase the carryover of seeds in the seedbank.

Production and persistence of seed

Brome grass flowers between September and November. Flowering is driven by cold temperatures and longer days. It occurs earlier in dry seasons, with *B. rigidus* generally

flowering about two weeks before *B. diandrus*. This has implications for crop-topping and harvest weed seed control.

Seeds are large, at approximately 13 milligrams - about four times the size of annual ryegrass. Each plant can produce about 2,000 seeds in the absence of competition. Seeds shed approximately 26 days after flowering.

In a South Australian study, brome grass plants produced almost 20,000 seeds/m^2 in a favourable season and more than 8,000 seeds/m^2 in a dry season.

Brome grass seed can remain viable for up to three years.

More than 20 per cent of brome grass seeds can remain viable and carry over for 12 months. If not well-controlled in the second year, this level is sufficient for populations to recover within one season. A minimum of three consecutive years of control is necessary to eliminate brome grass.

Non-wetting sands

Up to 20 per cent of Mallee soils have non-wetting characteristics. Brome grass thrives on these soils and persists for longer.

Pockets of dry soil in non-wetting sands result in increased staggered germination of brome grass. With less germination, the seed bank persists for longer as it is not being exhausted.

Crop establishment on non-wetting sands is generally poor, creating less competition against brome grass, particularly if the weed germinates in a press-wheel furrow.

HERBICIDE RESISTANCE

It is important that growers maintain herbicide rates for brome grass to reduce the risk of herbicide resistance developing.

The only way to know if a failed herbicide application is due to resistance is by having the weeds tested. Samples from Victoria can be sent to Plant Science Consulting for herbicide resistance testing (www.plantscienceconsulting.com.au).

Herbicide resistance is usually slower to develop in brome grass than annual ryegrass because brome grass is self-pollinated. It first shows up as a patch.

A small number of brome grass populations with resistance to Group A 'fop' herbicides exist in western Victoria and parts of South Australia.

Increasing levels of resistance to Group B sulfonylurea (SU) herbicides have been identified in brome grass. Further, the first case of Group B imidazolinone ('imi') resistance in brome grass was identified in South Australia in 2013. These plants also had cross-resistance to SU herbicides, however, 'imi' resistance is still rare.

A small number of brome grass populations with resistance to glyphosate have been identified in South Australia and Victoria. These have all come from fence lines and had very strong levels of resistance.

Resistance to the Group C herbicide metribuzin was also recently confirmed, with the herbicide regularly used in the lupin phase for broadleaf weed control.

MANAGING BROME GRASS

Brome grass requires two to three consecutive years of effective management to deplete the seedbank. This is due to multiple germinations within a season and long seedbank life.

Consider pasture or break (broadleaf) crops in the first year of control. Break crops, particularly pulses, provide the opportunity for crop-topping, and the use of a Group A selective herbicide like haloxyfop or quizalofop. This can be followed by a Clearfield® wheat crop in the second year, using a registered 'imi' herbicide like imazamox with imazapyr. A competitive crop of barley can be grown in year three, allowing for the use of metribuzin, a Group C herbicide.

This allows appropriate rotation of herbicide Groups. While 'imi' herbicides are very effective against brome grass, it is important to avoid over-use of 'imi' herbicides to limit the risk of herbicide resistance developing.

The season will influence the outcome of management; dry seasons with late autumn breaks are more difficult.

Herbicide options

Knockdown herbicides

Brome grass can be controlled with non-selective knockdown herbicides before sowing or while crop-topping. Optimal timing of crop-topping can be difficult, in order to minimise crop damage while maximising brome grass control. Some growers opt to 'patch out' areas of brome grass in crops with a non-selective herbicide to prevent seed set.

Pre-emergent herbicides

There are limited pre-emergent herbicide options for brome grass, including trifluralin, metribuzin, tri-allate and pyroxasulfone.

The most consistent and effective pre-emergent herbicide option in cereals is a mix of tri-allate and pyroxasulfone. This combination allows for both root and shoot uptake by brome grass. However, its efficacy can be highly variable when moisture is inadequate.

Mixtures of trifluralin with metribuzin provided lower control (50-60%) but are far more cost-effective.

A number of new pre-emergent herbicides with new modes of action will be available for brome grass control or suppression in coming years.

Post-emergent herbicides

Post-emergent herbicides include Group A 'fop' and 'dim' selective herbicides in broadleaf crops like haloxyfop, quizalofop and clethodim.

Post-emergent Group B herbicides include the 'imi' herbicides registered for Clearfield® wheat, barley or canola crops. These are the most effective post-emergent herbicides for brome grass control. (Note, other 'imi' tolerant crop types are best saved for years after 'imi' herbicide use, to overcome herbicide residue issues in soils. However, growers may need to use 'imi' herbicides in 'imi' tolerant pulse varieties when targeting broadleaf weeds.)

Group B "SU" herbicides are registered for suppression of brome grass in wheat and can be less effective than 'imi' herbicides. Further, these herbicides are generally more effective on the 1-3 leaf stage in brome grass.

Non-herbicide options

Crop competition

Crop competition can significantly reduce brome grass seed numbers. The three main factors are crop choice, plant density (as influenced by sowing rate) and row spacing.

Barley is generally the more competitive cereal crop type, followed by oat, triticale, wheat and durum.

Wider rows reduce competition and can lead to considerably higher weed seed numbers. Row spacing has a bigger effect on brome grass proliferation than sowing rate. Paired rows may help. Splitter boots can spread seed over a wider band, to aid crop competition with weeds.

Other factors that affect crop competition are variety choice, time of sowing, sowing depth and vigour, fertiliser placement and pest and disease management.

Some seed companies publish data comparing competitiveness between varieties. Varieties need to suppress weed seed production and yield well, while tolerating the presence of weeds.

Other cultural practices

Other non-chemical practices help further reduce brome grass numbers. These include:

- Using clean seed
- Chemical fallow
- Hay cutting (and spraying re-growth)
- Chaff carts
- Mechanical harvest weed seed destruction
- Narrow windrow burning

Harvest weed seed control

Harvest weed seed control includes some of the above-mentioned tactics. Mechanical harvest weed seed control is becoming more popular, with integrated mill units easily retrofitted to headers.

Weed species that retain most of their seed until harvest are ideal targets for harvest weed seed control. Brome grass is considered intermediate for seed retention.

Seed retention in brome grass is strongly affected by season. In wet years, a higher percentage of seed may be retained, whereas in dry seasons with hot and windy conditions, most seed is shed and ends up on the soil surface.

Timing is also important. Delays in harvest can lead to significantly higher rates of seed shedding.

Burning

Brome grass is tolerant of high temperatures and requires at least 40 seconds at 450°C to kill all seeds. Wild radish and annual ryegrass seed can be completely killed at 400°C.

Narrow windrow burning can be effective in reducing brome grass seed survival, as temperatures can reach between 400-600°C for a longer duration. In contrast, the temperature in burning conventional windrows can reach 400°C. However, the duration is often short, compromising control.

Burning of standing stubble is not particularly effective in killing brome grass. Standing stubble can quickly reach 300°C but this is very short-lived, and most brome grass seeds would remain viable. Very large stubble loads can reach 600°C. Note, this form of burning removes more soil organic carbon and ground cover that protects soil from wind erosion.

Canola stubble burns at a higher temperature than cereal stubble. It is well suited to narrow windrow burning where there is a lower risk of the fire spreading.

ACKNOWLEDGEMENTS

Agriculture Victoria acknowledges the contribution of Dr Sam Kleemann in providing technical information for this factsheet. This factsheet is an output from a series of Agriculture Victoria workshops, with support from the Wimmera Catchment Management Authority and the Wimmera Farming Network.

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