BROME GRASS
FACT SHEET

GRDC Grains Research & Development Corporation

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WESTERN AND SOUTHERN REGIONS

Brome grass, a persistent but manageable weed

Consecutive years of control are key to the depletion of the brome grass seedbank.

KEY POINTS

- Brome grass can be a serious weed and is found across low and high rainfall cropping regions.
- Brome grass is becoming an increasing problem. This is due to higher intensity of cropping in rotations, reduced tillage and the absence of effective herbicides for its control in cereals.
- *Bromus diandrus* and *B. rigidus* are the two most common species; both showing a more protracted and staggered germination pattern allowing them to evade effective pre-sowing control with knockdown herbicides.
- Control is achieved in break crops and by growing wheat varieties tolerant to imidazolione herbicides (Clearfield®).
- Aim for two consecutive years of control to deplete the seedbank of this troublesome weed.

PHOTO: SAM KLEEMANN

A severe infestation of brome grass in wheat where yield losses would be expected to exceed 50 per cent

Brome grass is an annual grass weed widely distributed across the wheat-belt of southern Australia. In crops and pastures this highly competitive weed can markedly reduce productivity with seeds contaminating grain samples and causing injury to livestock. Brome grass competing early in wheat at a density of 100 plants per square metre can reduce yields by as much as 30 to 50 per cent.

This well-adapted weed has proliferated in the past decade. This is due to the absence of effective herbicides for its control in cereals, intensification of cropping systems, especially wheat on wheat, and the introduction of conservation tillage.

About brome grass

The two main brome grass species commonly found infesting crops of southern Australia are *Bromus diandrus* and *B. rigidus,* with accepted common names of great and rigid brome respectively. However, both species are commonly referred to as ripgut brome often resulting in confusion over correct identification.

Both species appear very similar in the early vegetative growth stages with hairy leaves and stem, however, they can clearly be distinguished at the reproductive stage.

On examination of the panicle *B. diandrus* it was found to possess a more loose or nodding panicle in contrast to the erect or rigid panicle of *B. rigidus*.

B. diandrus is widespread across southern Australia, while *B. rigidus* is limited more to coastal regions and is more common on calcareous sandy soils (Figure 1).

Biology and ecology

Brome grass is a major weed in the wheatbelt of southern Australia because:

- it is among the most competitive of all grass weeds, and can cause significant yield losses even at low densities;
- it is well adapted to low rainfall environments with an aggressive root system, which allows it to compete strongly for both nitrogen and phosphorus;
- there are few management options available for effective control in cereals;
- there is an increasing adoption of minimum and no-till farming systems where the majority of seeds on the soil surface germinate only after burial with the sowing pass promoting in-crop emergence;
- staggered and protracted germination, particularly on non-wetting sands, allow it to emerge later in the growing season and evade early control; and
- the seedbank persists with more than 20 per cent carryover of seed from one season to the next, and seeds remain viable for more than three years in the soil.

Seed dormancy and germination

Seeds of both species are dormant at seed shed and usually require a relatively short after-ripening period over summer before emerging from dormancy to germinate.

However, recent research has shown that seed collected from field populations of both species are showing longer dormancy which appears to be under hormonal control within the seed embryo. These populations appeared to be responsive to chilling. This means that in the field dormant seed of brome grass requires both moisture and a period of colder temperatures to germinate. As a result, large germinations of brome grass are not expected until cooler moist conditions in late autumn-early winter.

Moisture is the biggest determinant of brome grass germination, which can be slow and protracted in drier seasons and on non-wetting soils. Germination is usually initiated at the break of the season (April-May) when temperatures are more at an optimum (15°C to 20°C) and when seeds have had an opportunity to absorb following rainfall.

This high dormancy and chilling requirement enables brome grass to avoid knockdown herbicides and germinate in-crop where control options are far more limited.

Seeds that do not germinate can remain viable in the soil for up to three years, particularly on non-wetting sands (Figure 2). This persistence of brome grass seeds means that control must be undertaken over successive years to deplete the weed seedbank.

Seed production

In the absence of competition, a single brome grass plant can produce more than 50 tillers and upwards of 3000 seeds. Seed shed can also occur 26 days after flowering, reducing the effectiveness of seed catching at harvest as a means of reducing seedbank replenishment.

PHOTO: SAM KLEEMANN

Panicle of *Bromus diandrus* (left) and *B. rigidus* (right)

Management

Although brome grass is a major weed of cropping systems in southern Australia, it can be effectively managed. This usually involves development and implementation of a well structured integrated weed management (IWM) plan.

Robust strategies including cultural, biological and chemical control options are required across the tactic groups (See table 1):

1) deplete seedbank;

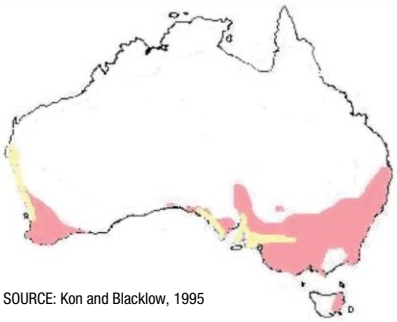
2) kill existing weeds;

3) prevent seed-set;

4) avoid seeds entering seedbank; and

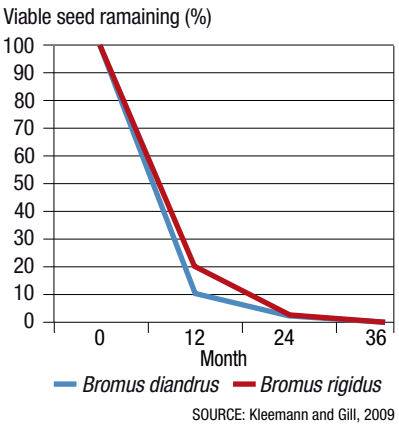
5) prevent introduction from external sources such as sowing contaminated seed.

FIGURE 1 Estimated distribution of *Bromus diandrus* (pink) and *B. rigidus* (yellow) in Australia



SOURCE: Kon and Blacklow, 1995

FIGURE 2 Longevity of *B. diandrus* and *B. rigidus* seeds in the field on the soil surface



SOURCE: Kleemann and Gill, 2009

As seed viability in the soil is usually no longer than three years, weed control strategies should focus on two issues:

- prevention of seed-set; and
- high seedling mortality to exhaust and deplete the seedbank.

Herbicide options

In wheat

Until recently there were very few effective herbicide options for brome grass control in wheat; however, over the past couple of years four herbicides (all Group B) have been registered and released.

- Midas® (MCPA/imazapic/imazapyr) for use in Clearfield® wheat varieties
- Monza® (Sulfosulfuron)
- Atlantis® (Mesosulfuron-methyl)
- Crusader® (Pyroxsulam)

Some limitations are imposed by these herbicides and include: plant back restrictions (especially in low rainfall seasons), herbicide cost ($25-$40/ha) and occasional damage when applied to stressed crops. In addition, Monza®, Atlantis® and Crusader® tend to provide suppression rather than complete kill of brome grass.

A recent limitation of the Clearfield® system was varietal choice, with only two Clearfield® wheat varieties (CLF JNZ and CLF Stiletto) available for safe use of Midas® herbicide. These two varieties possess a single gene for tolerance to imidazolinone herbicides, which restricts the use of more robust rates and herbicide mixtures, and can cause crop damage.

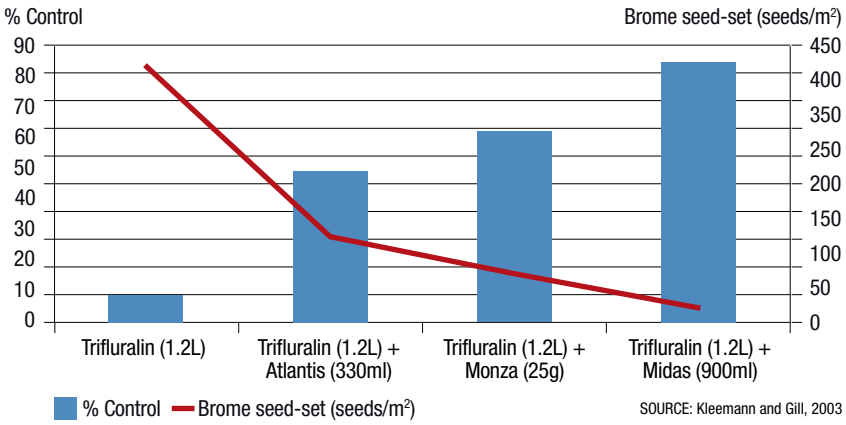
However, new varieties with double gene tolerance to imidazolinone herbicides are expected to be released over the next few years with first releases expected this year. These varieties will offer improved agronomic characteristics and disease resistance.

Research in the South Australian Mallee and upper Eyre Peninsula clearly showed that post-emergent application of Midas® herbicide alone or in conjunction with pre-emergence trifluralin in Clearfield® wheat provided consistently high levels of brome grass control.

Applications of post-emergent Monza® and Atlantis® were effective at providing suppression of brome, however, some seed-set still resulted (Figure 3).

For these herbicides to work it is critical that application is undertaken when the brome plants are at the one to three-leaf stage and when brome grass densities do not exceed more than 150 plants/m^2.

FIGURE 3 The efficacy of different herbicides for brome grass in Clearfield® wheat



SOURCE: Kleemann and Gill, 2003

Table 1 The tactic groups, techniques and effectiveness for brome grass management

Tactic group	Tactic	Likely % control (range)	Comments on use
1	Burning residues	70% (60-80)	Sufficient crop residues are needed
1	Autumn tickle	50% (20-60)	Depends on seasonal break. Seed burial through shallow cultivation enhances seed depletion through germination, especially in *Bromus diandrus* with its shorter dormancy and faster germination
1	Delayed sowing	70% (30-90)	Depends on seasonal break
2	Knockdown (non-selective herbicide)	80% (30-99)	If possible delay spraying until full emergence and youngest plants have two leaves
2	Pre-emergent herbicide	80% (40-90)	Follow label recommendations, especially on incorporation requirements of some herbicides. Use triazines and trifluralin mainly in pulses
2	Post-emergent (selective)	90% (75-99)	Apply when weeds have 2 to 6 leaves and are actively growing
3	Pasture spray-topping	75% (50-90)	Timing is critical. Respray or graze survivors
3	Silage and hay	60% (40-80)	Hay freezing works well. Silage is better than hay. Graze or spray regrowth
3	Grazing	50% (20-80)	Graze infested areas heavily and continuously in winter and spring
4	Residue collection at harvest	40% (10-75)	Works best on early harvested crops before weeds drop their seeds

SOURCE: Bowcher, Gill and Moore, 2005

Release of EGA Eagle Rock(ϕ), a wheat variety from Western Australia bred for tolerance to metribuzin herbicide, potentially provides an alternative to growing Clearfield® wheat and using Group B herbicides for the control of brome.

In barley

Metribuzin (Lexone® or Sencor®), a Group C or triazinone herbicide can also be used in barley for brome grass control. Trials have shown that IBS (incorporated by sowing) tank-mixes of metribuzin with trifluralin (Treflan®) or pendimethalin (Stomp®) provide excellent control of brome and are safer on the crop.

However, performance of metribuzin can be erratic, particularly when applied under dry sowing conditions and to non-wetting sands. This herbicide is highly soluble and requires a moist seed-bed for activation. Users must be aware of the risks associated with the movement of this herbicide with rainfall, particularly into press-wheel furrows where it can cause significant crop damage. In addition, use of this herbicide on soils of low clay and/or organic matter content can result in crop damage.

In break crops

A wider range of herbicide options are available for brome grass control in break crops such as lupins, canola and field peas. The triazines (for example, Simazine) and Group A herbicides (for example, Targa®) are very effective, however Group A herbicides can carry a high risk of developing herbicide resistance.

Spray-topping the pasture phase with paraquat or glyphosate can prevent seed-set, although this is not a reliable control method when targeting more than one species as maturity dates vary and timing of spray application is critical. Early flowering of brome makes it difficult to use spray-topping as it tends to clash with flowering of crop species.

Herbicide resistance

Brome grass populations resistant to Group A 'fop' herbicides (Targa® and Verdict®) have been recorded in Victoria and a population resistant to Group B herbicide Monza® identified in Western Australia. Over-reliance of these vulnerable herbicides has potential to increase resistance development in brome grass.

Cultural options

An integral component of the brome grass IWM plan should be a robust crop rotation ensuring at least two consecutive years of management to deplete the seedbank.

For example, a break crop such as lupins or canola, where triazines and Group A herbicides (Targa®, Verdict®) can be used followed by Clearfield® wheat and use of Midas® herbicide are effective combinations against brome.

Canola can be substituted with pasture in lower rainfall environments where pasture-topping with paraquat or glyphosate can be used to limit seed-set.

Growing herbicide-tolerant crops such as Clearfield wheat and canola or triazine-tolerant canola (TT canola), provide an opportunity for effective brome grass control.

Barley is far more competitive than wheat and suffers lower yield penalties from brome grass.

Maintaining higher seed rates and using narrow row spacing helps increase the crop's competitiveness and ability to suppress brome and its seed production.

A more favourable environment for crop growth is created by banding fertilisers below the crop at sowing where it can access the nutrients before the weed.

Other useful measures to help manage brome grass include:

- delaying sowing to allow for greater weed kill with knockdown herbicides (caution: effectiveness depends heavily on the amount and frequency of rains);
- an autumn tickle with light harrows to encourage greater pre-sowing germination, which can be effectively controlled with follow-up knockdown herbicides (caution: effectiveness depends heavily on the amount and frequency of rains);
- burning of header rows where brome seed has been concentrated (caution: seed shedding by brome before harvest makes it difficult to concentrate seed into header rows);
- green and brown manuring;
- crop patching with glyphosate that is only spraying localised areas of paddock where brome infestations are heaviest;
- an early hay cut; and
- residue and seed collection at harvest.

Useful resources:

- **Sam Kleemann, University of Adelaide** — 08 8303 7908 Email samuel.kleemann@adelaide.edu.au
- **Gurjeet Gill, University of Adelaide** — 08 8303 7744 Email gurjeet.gill@adelaide.edu.au
- **Cynthia Podmore, Industry & Investment NSW** — 02 6938 1999 Email cynthia.podmore@industry.nsw.gov.au

- **Pest Genie** — www.pestgenie.com.au
- **GRDC Weedlinks** — www.grdc.com.au/weedlinks

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