

Combinations of crop rotations and herbicides for effective management of brome grass (Cowell, SA)

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Key messages

- **Reduced crop establishment on non-wetting sands will allow brome grass that survive herbicide application to be highly competitive with crops and set many seeds for future infestations.**
- **Sole reliance on pre-emergent herbicides for brome grass control increased brome plant density 20-fold and panicle density by 35%. Treatments with a 1-year break initially reduced brome grass in 2024, but then experienced a 10-to-20-fold increase in brome panicle density**

in 2025. This indicates a rebound in brome grass pressure.

- **High brome grass plant density wheat grain yield by more than 50%. Superior control of brome grass in systems with effective brome grass control tactics increased wheat yield from 500 to 800 kg/ha.**
- **Systems with 2-year breaks were effective in achieving low in-crop infestation of this weed.**

Why do the research?

Brome grass is currently ranked as the second worst weed in grain crops in Australia, causing annual revenue loss of \$42 million (Ouzman et al. 2025). Brome grass is difficult to effectively control with the pre-emergent herbicides that are currently registered for use in cereal crops but development of herbicide tolerant cereal varieties has opened new options for growers to manage brome grass effectively in the cereal phase of the rotations. Integration of herbicide tolerant cereals with break crops such as pulses and canola offers opportunities to effectively deplete brome seedbank and manage its populations. It is important to demonstrate to growers the effectiveness of carefully considered combinations of cropping sequences and herbicide options for the management of brome grass in different agroecological environments. To achieve this objective, a 3-year field trial was initiated near Cowell on the Eyre Peninsula during the 2024 growing season.

This study aims to identify rotations and herbicide programs that effectively suppress brome grass populations and minimise seedbank replenishment while maintaining crop productivity.

How was it done?

A field trial was established in a randomised complete block design on a commercial farm near Cowell on the Eyre Peninsula. This farm has a yellow sandy loam which is favoured by brome grass. According to the grower, the soil in this paddock has some non-wetting, which also favours brome grass and reduces efficacy of pre-emergent herbicides.

The trial was sown with a no-till cone seeder with 25 cm row spacing and seeding width of 1.5 m (Table 1). There were two seeder runs per plot, and the plots were 16 m long. There was one buffer plot between all experimental plots to minimise the risk of herbicide spray drift and dispersal of weed seeds to neighbouring plots during crop harvest or by wind dispersal. All pre-emergent herbicides were sprayed just prior to crop sowing and incorporated by the no-till seeding tines (IBS). Data was analysed by using GenStat 23rd Edition. Information on herbicide products, active ingredients and label rates can be found in Table 2.

After below-average rainfall in 2024, Cowell again experienced below-average rainfall in 2025. Total rainfall from January to April was only 10 mm. After dry conditions continued into May, it was decided to sow the trial dry on 21 May. The trend of below-average conditions continued throughout 2025 except for July and September, which were above the long-term average. Cowell only received 9 mm rain in August, which was well below the average for the month (26 mm). Annual rainfall and growing season rainfall for Cowell in 2025 was 35% and 23% below the long-term average (218 mm and 188 mm), respectively.

In this trial report, the term 'break' refers to a year where crop × herbicide combinations are expected to effectively prevent brome grass seed production. System components for the first two years are summarised in Table 3.

No-break system (S1): pre-emergent herbicide mixture of Arcade® + Treflan in wheat was used in 2025 to provide some control of brome grass. This system is expected to allow considerable brome grass seed production each year and weed density is likely to remain high.

1-year break systems (S2 and S3): Tomahawk CL (S2) or canola (S3) in 2024 were followed by wheat sprayed with pre-emergent herbicides Arcade® + Treflan in 2025. These management systems are expected to lead to a rebound in brome grass populations due to weed establishment from the residual seedbank.

2-year break systems (S4 and S5): brome grass was controlled in 2024 in Titan AX barley (S4), which was followed in 2025 by Tomahawk CL wheat sprayed with Intervix. In S5, Hyola XC canola provided effective brome grass control in 2024, which was followed by Tomahawk CL wheat sprayed with Intervix in 2025.

3-year break system (S6): Titan AX barley in 2024 was followed by lupins in 2025 (S6) to provide an effective second break from brome grass. Lupin were sprayed with herbicides simazine + Treflan pre-sowing and grass control herbicide quizalofop (Targa) for post-emergent weed control (Table 3). Lupin were selected to diversify crop rotations in this trial because it is already grown on this farm (i.e. good local adaptation).

What happened?

Crop plant density

The combination of dry sowing at this site and the non-wetting nature of the topsoil caused a large reduction in crop establishment, especially in lupins. Across the management systems, wheat plant density ranged from 37 to 56 plants/m², with an average of 47 plants/m². Therefore, established wheat density at the site in 2025 was less than half the target density of 180 plants/m². Below par crop establishment was also observed at this site in 2024 when wheat plant density was 63 plants/m². Wetting agents to promote wetting of this non-wetting soil would be useful in these situations. Crops with large seeds such as lupins are considered more sensitive to non-wetting soils than cereals. This viewpoint was supported by the results in this trial where lupin plant density was only 6 plants/m² as compared to target density of 40 plants/m². Such a low crop establishment in lupins will reduce crop vigour, weed competitiveness and grain yield. However, the combination of herbicides used in lupins is still expected to reduce brome grass infestation for the next season.

Table 1. Trial details for 2025.

Project duration	2024–2026 (3-years)
Trial location	Cowell, SA (EP)
Plot size	16 m x 1.5 m (2 seeder passes)
Replications	4
Soil type	Sandy loam
Sowing date	21 May 2025
Target crop density (plants/m ²)	Wheat 180, barley 150 and lupins 40
Fertiliser	75 kg/ha MAP at sowing; barley and wheat also had 60 kg/ha urea (1 July)
Herbicides	See Table 2
Harvest date	8 December

Table 2. Information about herbicides used for brome grass control in the trial at Cowell, in 2025. Herbicide active ingredients and label rates registered in Australia are also presented.

Product name	Active ingredient	Label rate
Arcade	Prosulfocarb (800 g/kg)	3 L/ha
Treflan	Trifluralin (480 g/L)	1.5-3.0 L/ha when used as incorporated by sowing (IBS) in no-till knife point press wheel system (KP PW)
Avadex Xtra	Triallate (500 g/L)	2.6-3.2 L/ha when used IBS with KP PW
Intervix	33 g/L Imazamox and 15 g/L Imazapyr	375-750 mL/ha for brome grass
Targa	Quizalofop 100 g/L	375 mL/ha
Simazine 900	Simazine 900 g/kg	600 g/ha

Table 3. Crops, varieties and herbicide input programs (per ha) used at Cowell, in 2024 and 2025.

System	2024	2025
S1 (no break)	Calibre wheat PRE: Sakura 118g + Avadex Xtra 2.4 L	Calibre wheat PRE: Arcade 3L + Treflan 2L
S2 (one-year break)	Tomahawk CL Plus wheat PRE: Treflan 1.2 L POST: Intervix 600 mL	Tomahawk CL Plus wheat PRE: Arcade 3L + Treflan 2L
S3 (one-year break)	Hyola Battalion XC Canola PRE: Propyzamide 1 L POST: Crucial + Clethodim POST + Crucial POST	Tomahawk CL wheat PRE: Arcade 3L + Treflan 2L
S4 (two-year break)	Titan AX barley PRE: Treflan 1.2 L POST: Aggressor AX 200 mL	Tomahawk CL Plus wheat PRE: Treflan 2 L POST: Intervix 600 mL
S5 (two-year break)	Hyola Battalion XC Canola PRE: Propyzamide 1 L POST: Crucial + Clethodim POST Late POST: Crucial	Tomahawk CL Plus wheat PRE: Treflan 2L POST: Intervix 600 mL
S6 (3-year break)	Titan AX barley PRE: Treflan 1.2 L POST: Aggressor AX 200 mL	Coyote lupins PRE: Simazine 900 @ 600 g + Treflan 2 L POST: Targa 100 @ 375 mL

Brome grass plant and panicle density

Sole reliance on pre-emergent herbicides in System 1 caused a 20-fold increase in brome grass plant density from 2024 to 2025 (Table 4). Even though Sakura + Avadex is generally considered the best pre-emergent herbicide option available, it often provides only around 60% weed kill and surviving brome grass plants can set seed. In 2024, brome grass was able to set >11,000 seeds/m², which was reflected in high weed density in 2025 (346 plants/m²). Brome grass

produced more than 400 panicles/m² in this management system, which is likely to cause high weed infestation in the next crop in 2026. Systems 2 and 3 (single year break) resulted in a 10 to 20-fold increase in brome grass panicle density (Table 4), which should be reflected in higher brome grass infestations next year. In contrast, systems 4 and 5 (2-year break) showed an ongoing decline in brome grass panicle density, which should lead to even lower weed infestations in 2026.

It was interesting to note that brome grass in system 6 (lupin) was able to produce significantly more panicles (9 panicles/m²) as compared to <2 panicles/m² in systems 4 and 5 (Table 4). As mentioned earlier, lupin establishment in the trial was severely reduced by the non-wetting soil and this would have reduced the ability of lupin to compete with brome grass plants that survived the POST herbicide treatment (quizalofop).

Crop grain yield

Brome grass is known to be a highly competitive weed with wheat where even 10 plants/m² can reduce yield by 5% (Gill and Davidson 2000). Therefore, it was not surprising to see around 50% yield loss in wheat in System 1, which was infested by 300 plants/m² of brome grass (Table 5). As 5 out of 6 management systems were in wheat in 2025, it is valid to directly compare grain yields across these systems. Superior

control of brome grass in systems with 1-, 2- and 3-year break in brome grass resulted in wheat yield increases ranging from 500 to 800 kg/ha (Table 5). There was a general trend for higher wheat yields in 2-year break systems than in single year break systems.

System 6 (3-year break) was sown to lupins in 2025 and experienced poor crop establishment due to dry soil conditions and a non-wetting soil. Even though lupin plant density

in this trial was only 6 plants/m², they recovered well during the vegetative phase and managed to produce grain yield of 328 kg/ha. More importantly, this system allowed effective brome grass control with simazine + trifluralin (PRE) and quizalofop (POST) in 2025. Lupin will be followed by CL wheat in 2026, which is expected to eliminate brome grass from this system.

Table 4. Densities of brome grass plants and panicles across crop rotation sequences and herbicide input programs at Cowell in 2024 and 2025. Crop names in bold indicate the phase in 2025. Means followed by a different letter indicate statistical significance (P=0.05).

System	Rotation sequence	Brome density 2024 (plants/m ²)	Brome density 2025 (plants/m ²)	Brome panicles 2024 (panicles/m ²)	Brome panicles 2025 (panicles/m ²)
S1 (no break)	Wheat – Wheat – Barley (PRE herbicides – weak system)	15 b	346 c	307 b	472 e
S2 (1-year break)	CL wheat – Wheat – Barley	20 bc	33 b	2 a	50 d
S3 (1-year break)	Canola – Wheat – Barley	2 a	5 a	2 a	24 c
S4 (2-year break)	AX barley – CL wheat – Barley	31 c	3 a	6 a	2 a
S5 (2-year break)	Canola – CL wheat – Barley	1 a	0 a	2 a	1 a
S6 (3-year break)	AX barley – Lupins – CL Wheat	35 c	2a	6a	9b
Probability (P)		<0.001	<0.001	<0.001	<0.001

Table 5. Grain yield of crops in response to brome grass management systems at Cowell. Crop names in bold indicate the phase in 2025. Means followed by a different letter indicate statistical significance (P=0.05).

Treatment	Rotation sequence	Grain yield (kg/ha)
S1 (no break)	Wheat – Wheat – Barley (PRE herbicides – weak system)	416 a
S2 (1-year break)	CL wheat – Wheat – Barley	1122 bc
S3 (1-year break)	Canola – Wheat – Barley	956 b
S4 (2-year break)	AX barley – CL wheat – Barley	1249 cd
S5 (2-year break)	Canola – CL wheat – Barley	1387 d
S6 (3-year break)	AX barley – Lupins – CL Wheat	328 a
Probability (P)		<0.001

What does this mean?

The soil type at this site has a significant level of non-wetting, which can reduce crop establishment. This negative effect was evident in 2025, especially in lupins. Reduced crop establishment on such soil types will allow brome grass plants that survive herbicide application to be competitive with crops and set many seeds for future infestations. Growers observing unexpectedly low crop establishment should determine if non-wetting is an issue and use of an in-furrow spray of a wetting agent could be a viable option.

Sole reliance on pre-emergent herbicides for brome grass control in System 1 increased brome plant density 20-fold and panicle density by 35% from 2024 to 2025. Such high brome grass density in this system reduced wheat yield by more than 50% compared to

the systems with better brome grass control. The results of this trial clearly show that currently available pre-emergent herbicides are ineffective at managing high brome grass densities. Systems 2 and 3 (1-year break) also resulted in a 10 to 20-fold increase in brome grass panicle density, which should be reflected in higher brome grass infestations next year. In contrast systems with 2-year breaks from brome grass maintained its populations at a low level. The results from this trial clearly show the need for crop rotation x herbicide combinations likely to provide effective brome grass control over 2–3 consecutive years.

References

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