Crop Rotations Outperforming Herbicide Inputs in Suppressing Brome Grass

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KEY MESSAGES

- Diverse crop rotations were critical for suppressing brome grass, with rotation choice having a greater impact on weed control than herbicide intensity (i.e. low vs high input herbicide programs).
- A continuous wheat rotation provided the poorest control. In a wheat-wheat rotation from 2024 to 2025, brome grass seed production increased by 69%, leading to a 59% reduction in wheat yield.
- The most effective rotation was Clearfield® barley (cv. Maximus) in 2024 followed by XC® canola (cv. Regiment) in 2025. This rotation reduced brome grass density by 82–91% and prevented seed set in 2025.

AIM

To compare different crop rotations, under low or high input herbicide programs, for control of in-crop brome grass infestations in the western grain region.

BACKGROUND

This research investigates the use of break crops in the management of brome grass populations under low and high input herbicide programs, compared to continuous wheat cropping systems, over three years (2024-2026). The study aims to identify rotations and herbicide programs that effectively suppress brome grass populations and minimise seedbank replenishment while maintaining crop productivity. Comparing low and high input herbicide programs in break crop rotations will highlight the potential of reducing chemical use without compromising weed control efficiency. Contrasting these rotations with continuous wheat cropping will quantify the long-term benefits of incorporating break crops for sustainable brome grasses management.

TRIAL DETAILS (2024 & 2025)

Trial location	CR & R Cail & Sons, Jibberding, WA	
Stubble cover	Low (<10%)	
Plot size & replication	10 m x 2 m x 4 replications	
Soil type	Sandy loam	
Paddock rotation	2023 fallow, 2022 wheat, 2021 wheat	
Sowing date	17/05/2024	05/05/2025
Sowing rate	80 kg/ha wheat, 90 kg/ha barley, 100 kg/ha lupins	80 kg/ha wheat, 4.4 kg/ha canola
Target crop density (m^2)	180 wheat, 140 barley, 45 lupins, and 40 canola	
Fertiliser	17/05/2024 Urea (50 kg/ha) – cereal only 17/05/2024 Macro Pro Extra (100 kg/ha) 09/07/2024 UAN (100 L/ha)	05/05/2025 Urea (50 kg/ha) – cereal only 05/05/2025 Macro Pro Extra (100 kg/ha) 05/07/2025 UAN (100 L/ha)
Trial management	17/05/2024 glyphosate 940 g a.i./ha 17/05/2024 chlorpyrifos 500 g a.i./ha 17/05/2024 bifenthrin 10 g a.i./ha	05/05/2025 glyphosate 940 g a.i./ha 05/05/2025 chlorpyrifos 500 g a.i./ha 05/05/2025 bifenthrin 10 g a.i./ha
Desiccation	14/11/2024 diquat 400 g a.i./ha	14/10/2025 diquat 400 g a.i./ha
Growing season rainfall	223 mm	232.4 mm
Harvest date	01/11/2024	01/11/2025

TREATMENTS

Treatments in this three year trial (2024 to 2026) involve crop rotations with different numbers of break crops, including wheat-wheat-wheat (i.e. conventional wheat, no break crop), lupin-wheat-wheat (1 year break crop), barley-canola-wheat (2 year break crop) and barley-canola-imi wheat (3 year break crop). Note that all rotations have CL wheat in the final year for ease of sowing, but imi herbicides are only applied to the CL wheat in the 3 year break crop rotation. Each rotation has a low or high input herbicide program.

An outline of the different crop sequences and weed management treatments (with all herbicides in g a.i./ha).

Strategy	Herbicide input program	Year 1 - 2024	Year 2 - 2025	Year 3 - 2026
Traditional (no break)	**Control**	**Wheat (Calibre)** PRE: trifluralin 960 g + sulfosulfuron 18.75 g	**Wheat (Calibre)** PRE: bixlozone 500 g + trifluralin 960 g	**CL Wheat** PRE: pyroxasulfone 100.3 g + tri-allate 1200 g POST: sulfosulfuron 18.75 g
1-year break	**Low inputs**	**Lupins (PBA Jurien)** PRE: propyzamide 900 g + simazine 900 g POST: quizalofop 38 g + clethodim 120 g	**Wheat (Calibre)** PRE: bixlozone 500 g + trifluralin 960 g	**CL Wheat** PRE: pyroxasulfone 100.3 g + tri-allate 1200 g
2-year break		**CL Barley (Maximus CL)** PRE: trifluralin 960 g POST: imazamox/imazapyr 24.75/11.25 g	**XC Canola (Regiment)** Knockdown (herbicides other than glyphosate) POST: glyphosate 621 g a.i./ha	**CL Wheat** PRE: pyroxasulfone 100.3 g + tri-allate 1200 g
3-year break		**CL Barley (Maximus CL)** PRE: trifluralin 960 g POST: imazamox/imazapyr 24.75/11.25 g	**XC Canola (Regiment)** POST: imazamox/imazapyr 24.75/11.25 g + glyphosate 621 g	**CL Wheat** PRE: trifluralin 960 g POST: imazamox/imazapyr 24.75/11.25 g
1-year break	**High inputs**	**Lupins (PBA Jurien)** PRE: propyzamide 900 g + simazine 900 g POST: quizalofop 38 g + clethodim 120 g + butroxydim 45 g	**Wheat (Calibre)** PRE: bixlozone 500 g + trifluralin 960 g POST: sulfosulfuron 18.75 g	**CL Wheat** PRE: pyroxasulfone 100.3 g + tri-allate 1200 g POST: sulfosulfuron 18.75 g
2-year break		**CL Barley (Maximus CL)** PRE: trifluralin 960 g + metribuzin 101.25 g POST: imazamox/imazapyr 24.75/11.25 g	**XC Canola (Regiment)** PRE: propyzamide 900 g POST: glyphosate 621 g	**CL Wheat** PRE: pyroxasulfone 100.3 g + tri-allate 1200 g POST: sulfosulfuron 18.75 g
3-year break		**CL Barley (Maximus CL)** PRE: trifluralin 960 g + metribuzin 101.25 g POST: imazamox/imazapyr 24.75/11.25 g	**XC Canola (Regiment)** PRE: propyzamide 900 g POST: imazamox/imazapyr 24.75/11.25 g + glyphosate 621 g	**CL Wheat** PRE: pyroxasulfone 100.3 g + tri-allate 1200 g POST: imazamox/imazapyr 24.75/11.25 g

RESULTS

2024: In 2024 (Year 1), initial brome density was similar across most rotations (Table 1). The exception was lupins under the high-input herbicide program, which had a lower density (205 plants/m^2) than several of the barley crops. Despite these differences in early density, brome grass seed production was lower in barley crops compared to wheat or lupins, reflecting the stronger competitive ability of barley.

2025: In 2025 (Year 2), canola in the barley-canola rotations had the lowest brome grass density, due to reduced seed production in 2024. Density was higher in wheat following lupins and highest in the wheat-wheat rotation. Over 2024-2025, density changed very little in the continuous wheat (Figure 1; Table 1). In contrast, using a 1 year break crop (lupins) reduced brome grass density by 16% (Figure 1). In all rotations in 2025, brome grass density did not vary between herbicide input programs.

Table 1. Densities (m^2) of brome grass across crop rotation sequence and herbicide input programs in 2024-25.

Rotation sequence	Herbicide input	Weed density (m^2)		Seed production (m^2)	
		2024 (Year 1)	2025 (Year 2)	2024 (Year 1)	2025 (Year 2)
Wheat – wheat (no break)	Control	295^{abc}	289^{c}	4841^{b}	8170^{c}
Lupins – wheat (1 year break)	Low	238^{ab}	210^{b}	3931^{b}	7087^{c}
	High	205^{a}	161^{b}	4707^{b}	4391^{b}
Barley – canola (2 year break)	Low	367^{c}	59^{a}	644^{a}	0^{a}
	High	316^{bc}	13^{a}	847^{a}	0^{a}
Barley – canola (3 year break)	Low	298^{bc}	79^{a}	1033^{a}	0^{a}
	High	307^{ab}	28^{a}	1062^{a}	0^{a}
LSD		93	73	1874	1024

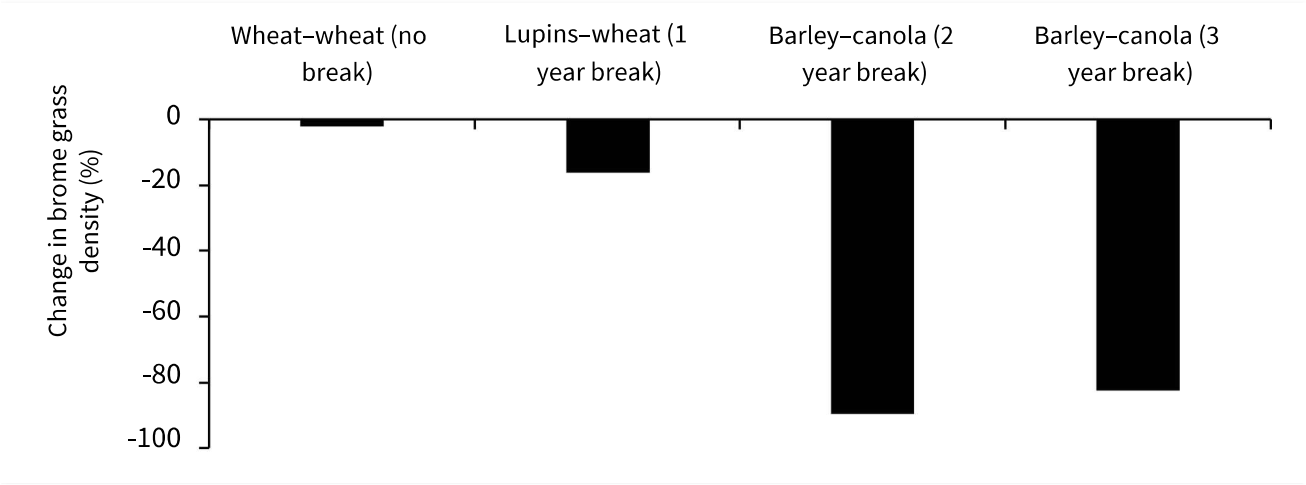

Figure 1. Percent change in brome grass density from 2024 to 2025, i.e. year 1 to year 2 in each 3 year crop rotation.

Crop density in 2025 varied with crop type and rotation. Wheat establishment was low in the wheat-wheat rotation (93 plants/m^2) and higher following lupins (121 plants/m^2). Canola establishment was 71 to 82 plants/m^2 ($p < 0.001$, LSD: 16.39 plants/m^2). The improved establishment of wheat after lupins (1 year break) compared to wheat after wheat (no break) was likely due to reduced brome grass density. Herbicide programs had no effect on crop establishment.

Brome grass seed production was greatest in the wheat-wheat rotation and increased from 2024 to 2025 by 69% (Figure 2, Table 1). In the lupin-wheat rotation, seed production reduced due to high herbicide inputs (i.e. 4392 compared to 7087 seeds/m^2) (Table 1). The Clearfield® Barley-XC® canola rotation eliminated seed production.

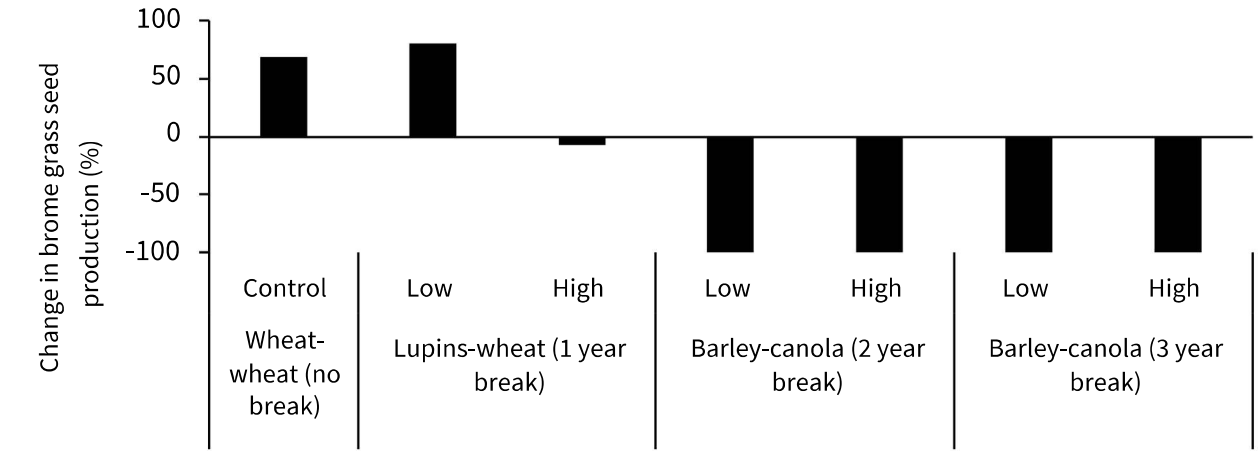

Figure 2. Percent change in brome grass seed production from 2024 to 2025, i.e. year 1 to year 2 in each 3 year crop rotation, across the low and high input herbicide programs.

In the wheat-wheat rotation, wheat yields were reduced by 59% from 5.0 t/ha in 2024 to 2.0 t/ha in 2025 (below the state average of 2.7 t/ha), due to high brome grass density. The wheat yield of the lupin-wheat rotation was 3.6–4.1 t/ha across herbicide input levels during 2025. In the barley-canola sequence, barley yields in 2024 (5.9 t/ha) and canola yields in 2025 (2.3 t/ha) exceeded the state average of 3.3 t/ha and 1.64 t/ha, respectively (GIWA, 2024). The improved crop performance in this sequence likely reflects improved brome grass control.

COMMENTS

The results from 2025 clearly demonstrate the significance of crop rotation as a major driver of changes in brome grass density, seed production, and crop performance. The rotation sequence of Clearfied® barley followed by XC® canola provided optimal brome grass control. Continuous wheat maintained high brome grass density regardless of herbicide choice.

ACKNOWLEDGMENTS

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REFERENCES

1. GIWA. (2024) Crop Report – October 2024. Grain Industry Association of Western Australia. Perth, Western Australia.

PEER REVIEW

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