Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

# Crop rotations and herbicide inputs for brome grass management in no-till wheat-based systems in Western Australia

**Arslan Peerzada, Research Scientist, and Catherine Borger, Principal Research Scientist, Department of Primary Industries and Regional Development, Northam.**

## Key Messages

- Barley reduced seed production of brome grass (i.e., great brome, *Bromus diandrus* Roth) in the first year, demonstrating superior weed suppression compared to wheat and lupins.
- Lupins offered limited reproductive suppression (i.e. brome still had high seed set), despite initially suppressing weed density in addition to herbicide application.

## Aims

To compare different combinations of crop sequences and intensities of herbicide programs for control of in-crop brome grass infestations and soil seed banks in western grain regions.

## Background

This research is exploring the effectiveness of break crops in the management of brome grass populations under low and high herbicide input strategies, compared to continuous wheat cropping systems during the period 2024-2026. Over the next two years, the study will assess different break crop strategies to identify rotation sequences and herbicide programs that would effectively suppress the brome grass populations and seedbanks while maintaining crop productivity. Comparing low and high herbicide input approaches in break crop rotations will highlight the potential of reducing chemical use without compromising weed control efficiency. Contrasting these strategies with continuous wheat cropping will quantify the long-term benefits from incorporating break crops for sustainable management of brome grasses in wheat-based cropping systems. This study will also monitor the development of herbicide resistance in brome grass populations under varying levels of herbicide input pressure.

## Trial details

**Trial Details**

| | |
|---|---|
| Project duration | 2024–2026 (3-years) |
| Trail location | Jibberding |
| Stubble cover | Low (<10%) |
| Plot size and replication | 10 m x 2 m x 4 replications |
| Soil type | Sandy loam |
| Paddock rotations | 2023 fallow, 2022 fallow, 2021 fallow |
| Sowing date | 17/05/2024 |
| Sowing rate | 80 kg/ha wheat, 90 kg/ha barley, 100 kg/ha lupins |
| Target crop density ($m^2$) | 180 plants (wheat), 140 plants (barley), and 45 plants (lupins) |
| Fertiliser | 17/05/2024 Urea (50 kg/ha) – cereal only<br>17/05/2024 Macro Pro Extra (100 kg/ha)<br>09/07/2024 UAN (100 L/ha) |
| Pesticides | 17/05/2024 Nufarm WeedMaster DST (2000 mL/ha)<br>17/05/2024 Chlorpyrifos 500 1 L/ha<br>17/05/2024 Bifenthrin 100EC (100ml/ha) |
| Desiccation | 14/11/2024 Reglone non-residual herbicide (2 L/ha) |
| Harvest date | 01/11/2024 |

**Treatments**

An outline of the different crop sequences and weed management treatments is provided in Table 1.

**Table 1. Crop Rotation Strategies and Herbicide Programs for Weed Management Over a Three-Year Period (2024–2026)**

| Treatment | Strategy | Input level | Year 1- 2024 | Year 2 - 2025 | Year 3 - 2026 |
|---|---|---|---|---|---|
| **1** | **Traditional (no break)** | **Control** | **Wheat (Calibre)** | **Wheat (Calibre)** | **CL Wheat** |
| | | | Trifluralin 480 (2 L/ha) + Monza® (25 g/ha) | Overwatch® (1.25 L/ha) + Trifluralin 480 (2 L/ha) | Sakura® 850 WG (118 g/ha) + Avadex® Xtra (2.4 L/ha) *fb* Monza® (25g/ha) |
| **2** | **1-year break** | **Low Input rotations** | **Lupins (PBA Jurien)** | **Wheat (Calibre)** | **CL Wheat** |
| | | | Propyzamide 900 WG (1 L/ha) + Simazine 900 WG (1 kg/ha) *fb* Quizalofop 200 (190 mL/ha) [+ Clethodim 240 EC (500 mL/ha)] | Overwatch® (1.25 L/ha) + Trifluralin 480 (2L /ha) | Sakura® 850 WG (118 g/ha) + Avadex® Xtra (2.4 L/ha) |
| **3** | **2-year break** | | **CL Barley (Maximus CL)** | **XC Canola** | **CL Wheat** |
| | | | Trifluralin 480 (2 L/ha) *fb* Intervix® (750 mL/ha) | Knockdown* *fb* Roundup Ready® with Plantshield®) (0.9 kg L/ha) | Sakura® 850 WG (118 g/ha) + Avadex® Xtra (2.4 L/ha) |
| **4** | **3-year break** | | **CL Barley (Maximus CL)** | **XC Canola** | **CL Wheat** |
| | | | Trifluralin 480 (2 L/ha) *fb* Intervix® (750 mL/ha) | Intervix® (750 mL/ha) + Roundup Ready® with Plantshield®) (0.9 kg L/ha) | Trifluralin 480 (2 L/ha) *fb* Intervix® (750 mL/ha) [and Diuron 900 at 550g/ha as pre-emergent for volunteer canola] |
| **5** | **1-year break** | **High Input rotations** | **Lupins (PBA Jurien)** | **Wheat (Calibre)** | **CL Wheat** |
| | | | Propyzamide 900 (1 L/ha) + Simazine 900 (1kg/ha) *fb* Quizalofop 200 (190 mL/ha) + [Clethodim 240 EC (500 mL/ha) + Butroxydim 250WG (180 g/ha)] | Overwatch (1.25 L/ha) + Trifluralin 480 (2 L/ha) *fb* Monza® (25 g/ha) | Sakura® 850 WG (118 g/ha) + Avadex® Xtra (2.4 L/ha) *fb* Monza® (25 g/ha) |
| **6** | **2-year break** | | **CL Barley (Maximus CL)** | **XC Canola** | **CL Wheat** |
| | | | Trifluralin 480 (2L/ha) + Metribuzin 750 WG (135g/ha) *fb* Intervix® (750 mL/ha) | Propyzamide 900 (pre) (1 L/ha) *fb* Roundup Ready® with Plantshield® (0.9 kg L/ha) | Sakura® 850 WG (118 g/ha) + Avadex® Xtra (2.4 L/ha) *fb* Monza® (25g/ha) |
| **7** | **3-year break** | | **CL Barley (Maximus CL)** | **XC Canola** | **CL Wheat** |
| | | | Trifluralin 480 (2L ha) + Metribuzin 750 WG (135g/ha) *fb* Intervix® (750 mL/ha) | Propyzamide 900 (pre) (1 L/ha) *fb* Intervix® (750 mL/ha) + Roundup Ready® with Plantshield® (0.9 kg L/ha) | Sakura® 850 WG (118 g/ha) + Avadex® Xtra (2.4 L/ha) *fb* Intervix® (750 mL/ha) |

*** = other than glyphosate**

**Results**

At 30 days after sowing (DAS), the density of brome grass (plants/$m^2$) was not affected by the level of herbicide inputs applied in barley or lupins, compared to those used in wheat (, i.e. the continuous wheat rotation acting as the control) during the first year. The recorded densities were 244 plants/$m^2$ in wheat, as compared to 228 and 250 (plants/$m^2$) with high or low herbicide input treatments in rotation crops, respectively (P = 0.722, LSD = 70 plants/$m^2$). However, at crop maturity, herbicide inputs (both low and high) in barley or lupin crops significantly reduced brome grass seed production as compared to the herbicide treatment in the wheat crop (Figure 1).

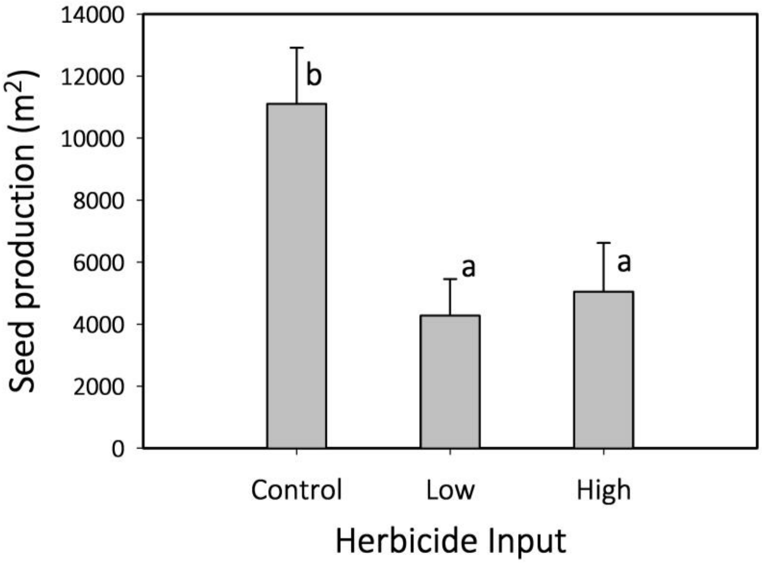


Figure 1. Seed production of brome grass (P = 0.056, LSD = 5074 seeds/$m^2$) averaged over the three herbicide regimes, where control is the continuous wheat system and low and high herbicide inputs are averaged over barley and lupin crops, with all rotations and herbicide treatments specified in Table 1.

While herbicide inputs influenced weed seed suppression, the competitiveness of crop species also played a role in reducing weed densities during the first year (Figure 2). The lupin crop (64 plants/$m^2$) had the lowest plant density at 30 DAS, compared to wheat (115 plants/$m^2$) and barley (158 plants/$m^2$) (P=<0.001, LSD = 16.02 plants/$m^2$). Despite the lower crop density, brome grass density in the lupin crop was less (183 plants/$m^2$) compared to wheat (244 plants/$m^2$) and barley (266 plants/$m^2$). This indicates that propyzamide and clethodim, the specific herbicide options available for broadleaf crops, suppressed brome grass populations in lupins to a greater extent than those herbicides used in the cereal crops.

Brome grass density is directly related to seed production (Borger et al. 2020). However, in spite of low brome density in the lupin crop, this crop allowed high seed production (9916 seeds/$m^2$), statistically similar to wheat (11113 seeds/$m^2$) (P < 0.001, LSD= 2987 for seeds/$m^2$). Barley, however, restricted brome seed production to 2059 seeds/$m^2$. This confirms that barley had superior competitive ability, even under high weed density. Despite the high weed density, crop yield recorded in the first year of the rotation exceeded the average yields estimated for the Kwinana Port Zone of WA in 2024 (GIWA, 2024). Recorded yields were 6.95 t/ha for barley, 5.73 t/ha for wheat, and 3.3 t/ha for lupins.

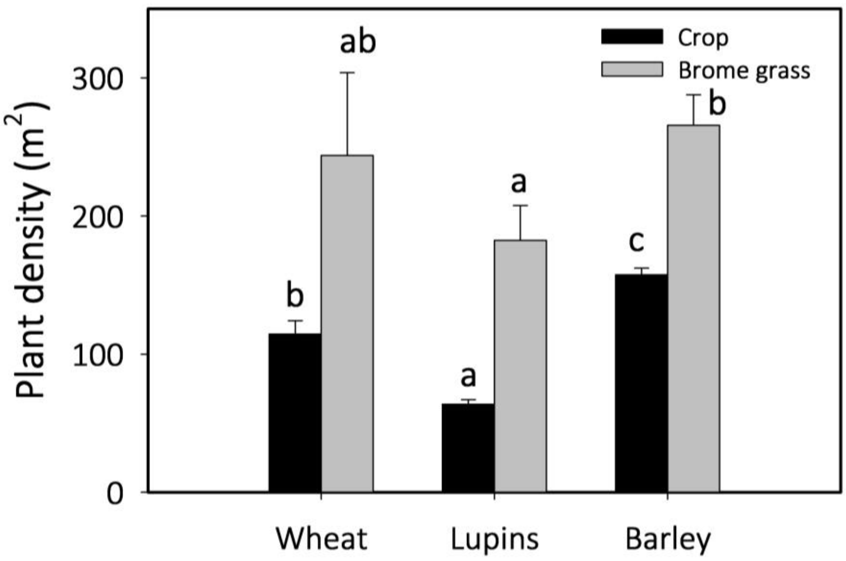


Figure 2. Impact of different crop's density on brome grass density ($m^2$) in the first year of rotation recorded at 30 days after sowing ($P = 0.004$, LSD=57 brome grass plants/$m^2$; $P < 0.001$, LSD =16 crop plants/$m^2$).

**Comments**

The trial results indicated that crops other than wheat, such as barley and lupins, had varying capacity for the suppressing seed production of brome grass in the first year. Barley demonstrated strong suppression due to its high plant density and competitiveness during later growth stages. In contrast, lupins, though having effective herbicide options, were less effective in reducing the weed's reproduction. These findings suggest that rotating wheat with highly competitive crops can complement herbicide strategies for managing brome grass more effectively than continuous wheat systems. However, it is too early to draw any definitive conclusions. Over the next two years, the study will assess the cumulative impact of crop sequences and herbicide regimes on brome grass populations and seedbank depletion. The long-term benefits of crop sequence and herbicide strategies will be evaluated in terms of yield sustainability, economic returns and resistance management.

**Acknowledgments**

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**References**

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**Peer review:** Harmohinder Dhammu, Geoff Thomas, and Helen Spafford (DPIRD)

**Contact**

Arslan M. Peerzada
arslan.peerzada@dpird.wa.gov.au
0460040840