2024 OATSPO AGRONOMIC SHOWCASE

Final Report

Processed Oat Partnership

Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

GIWA

ConsultAg Advancing Agriculture

Field Day Co-hosts

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Thank you to our Field Day Sponsors

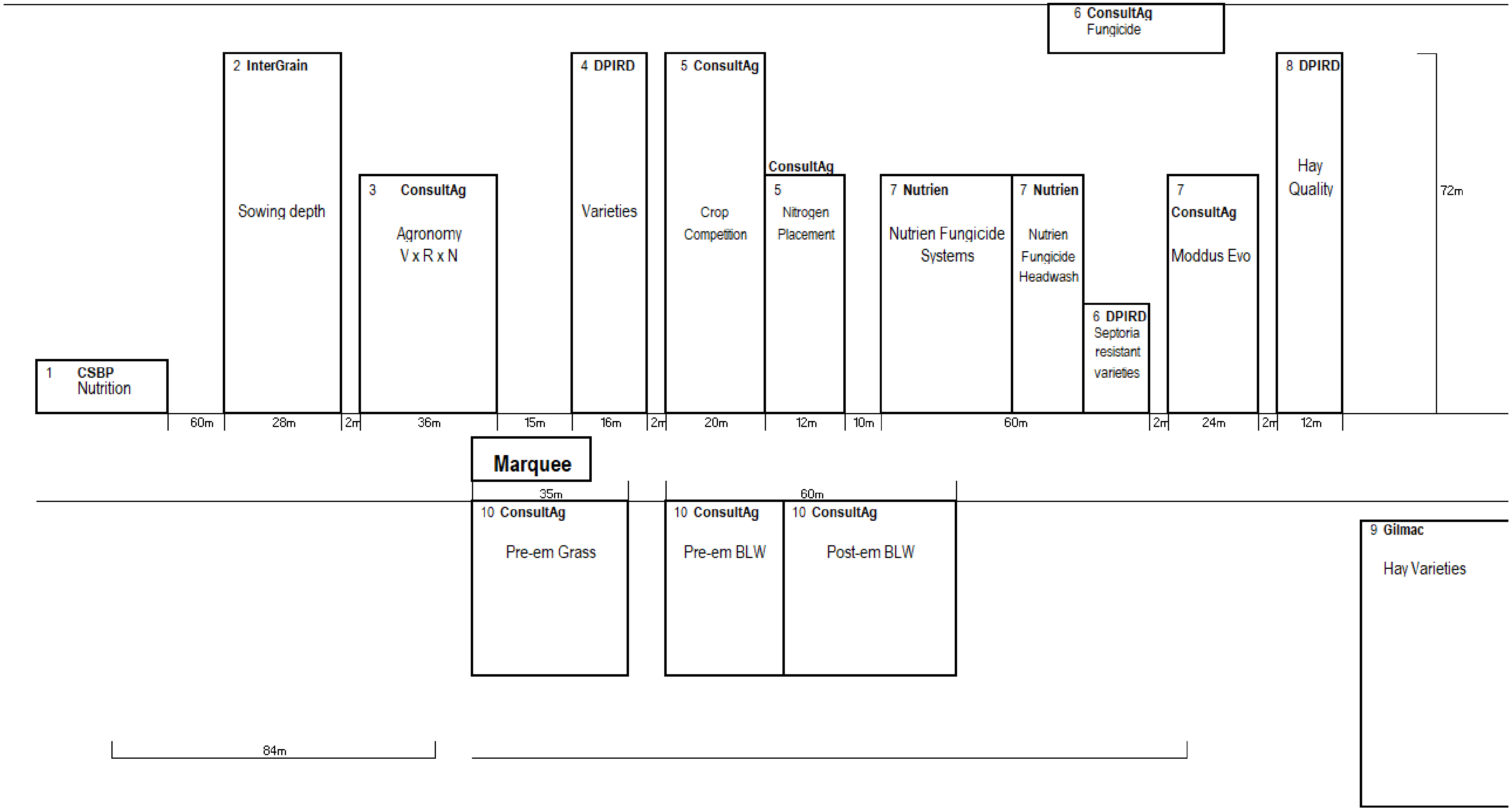
This booklet summarises the results of the trials showcased at the 2024 OATSPO Field Day held at Highbury in Western Australia on 10 September 2024. It contains a description of each trial site taken from the OATSPO Field Day booklet, followed by a summary of the final results from each trial. All data included is presented as submitted by the organisation or business responsible for each trial. Questions concerning the trials or the data presented should be directed to those responsible.

Field Day Program

	11.45am	Arrival and registration
	11.45am	Lunch on site Proudly sponsored by Quaker Oats
	12.00pm	Field Day commences Whinbin Rock Road, Highbury
	12.40pm	Tours 1. Nitrogen and Phosphorus strategy – Pete Rees (CSBP) 2. Breeding Trial – Allan Rattey (InterGrain) 3. Goldie and Bannister Agronomy – Blakely Paynter (DPIRD) 4. Yield formation – Hamid Shirdelmoghanloo (DPIRD) 5. Crop Competition – Jordy Medlen (ConsultAg) 6. Fungicide products and Moddus Evo – Trent Butcher (ConsultAg) 7. Fungicide Strategies – Brad Westphal (Nutrien) 8. Hay Quality Management – Kylie Chambers (DPIRD) 9. Hay Variety Selection – Garren Knell (ConsultAg) 10. Broadleaf and Grass Herbicide options – Gray Yates (ConsultAg)
	5.00pm	Sundowner Proudly sponsored by Essantis
	5.00pm	Tips and tricks discussion for setting up harvesters – Local Growers
	7.00pm	Event Concludes

Oat Field Day Trial Site

OATSPO Trial Site Layout



Introduction

OATSPO was an agronomic showcase that took place on 10 September 2024, in Highbury, Western Australia, and was designed to introduce both new and experienced oat and hay growers to the latest oat research being undertaken with the support of the Western Australian Government funded and industry led Processed Oat Partnership (POP), the Grains Research Development Corporation (GRDC) and others in the oat supply chain all gathered in one location.

OATSPO and the ongoing research and industry development it showcased, will make a lasting and significant contribution to the future development and sustainability of the WA oat industry.

OATSPO followed the journey of growing an oat crop throughout the season. It showcased variety selection, nutrition strategies, seeding practices (rates/depths), pre- and post-emergent weed and disease control options, canopy management strategies, and finished with tips on how to harvest oats to maximise grain quality.

OATSPO had two major objectives:

1. Present the latest oat research funded by the POP and collaborators including the GRDC, Department of Primary Industries and Regional Development (DPIRD) and agribusiness.
2. Showcase current and evolving agronomic practices for growing oats to give growers the confidence to include oats in their cropping system.

Site Information

The Trial sites were dry sown between the 18th and 22nd of April 2024 and received a germinating rain event of 28mm on the 2nd of May.

Small Plot Trials

Dry Sown on 22nd April 2024

Fertiliser at seeding 70kg/ha MAP + 30kg/ha SoP + 80L/ha UAN banded (41kg/ha N, 16kg/ha P, 12.5kg/ha K)

Nitrogen was topped up post emergent to take total nitrogen to 85kg/ha N

Farmer Sown Trials

Dry Sown on 18th April 2024

Paddock was spread with 2t/ha lime + 2t/ha of Compost (HR80) and incorporated.

Fertiliser at seeding was 65kg/ha MAP+50L/ha Liquid compost extract (LCE13.5)

Total nutrition supplied is 103kg/ha N, 20kg/ha P and 16kg/ha K

Base herbicide

Boxer Gold 2.5L/ha + Voraxor 200mL/ha was applied prior to seeding unless otherwise specified.

Paddock History

Year	Crop/Pasture	Amelioration Treatments
2023	Canola	2t/ha Lime

Rainfall

Month (mm)	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	GSR (Apr-Oct)
Highbury East	4	3	7	7	22	0	40	30	66	66	21	19	242

CSBP
RESEARCH +
AGRONOMY

1. Nitrogen and Phosphorus Strategies on Oats

Research Aim

To determine the best nitrogen (N) and phosphorus (P) strategies to maximise economic returns in high-yielding oat crops.

Background

Reaching maximum yield potential in high yielding environments requires adequate supply of nitrogen (N) and phosphorus (P) amongst other nutrients. P is ideally supplied to the crop through fertiliser application prior to or at seeding, with little capacity to influence P availability in-season. However, N can be supplied at any growth stage and can have highly variable requirements throughout the growing season depending on conditions.

With increasing interest in oats as a crop in WA this trial seeks to investigate the N and P response of oats and to see if N response changes at different levels of P supply to help improve fertiliser recommendations and economic returns for growers.

Soil Analysis: February 2024

Depth (cm)	pH ($CaCl_2$)	EC (dS/m)	O C (%)	Nit N (mg/kg)	Amm N (mg/kg)	Col P (mg/kg)	PBI	Col K (mg/kg)	S (mg/kg)	Ex Al (%)
0-10	5.8	0.1	0.8	2	5	32	56	99	8	0.1
10-20	5.8	0.0	0.7	1	1	9	42	50	3	0.1
20-30	6.0	0.0	0.7	<1	3	10	66	72	6	0.1

Management

Seeding:	23 Apr	Goldie oats at 80 kg/ha to 4 cm, dry sown
Fertiliser:	13 Mar	100 kg/ha SoP basal topdressed
	23 Apr	All Phos rates and 50 L/ha Flexi-N banded to select plots
	04 Jun	Flexi-N rates streamed to select plots
Spray applications:	23 Apr	150 mL/ha Callisto, 2.5 L Boxer Gold, 1.8 L/ha TriflurX and 300 mL/ha Lorsban
	05 Jun	500mL/ha Precept for volunteer canola
	04 Aug	800mL/ha AmistarX and 30mL/ha Trojan

Treatments 2024

Trt	Description	March Topdress (kg/ha)	Seeding Banded (kg/ha)	Seeding Banded (L/ha)	2-4 Leaf Streamed (L/ha)	6-8 Leaf Streamed (L/ha)	N	P	K	S
1	Nil	100 SoP					-	-	42	17
2	Low P	100 SoP	44 All Phos				-	9	42	17
3	High P	100 SoP	88 All Phos				-	18	42	18
4	Nil P, Low N	100 SoP		50 Flexi-N	25 Flexi-N	20 Flexi-N	40	-	42	17
5	Low P, Low N	100 SoP	44 All Phos	50 Flexi-N	25 Flexi-N	20 Flexi-N	40	9	42	17
6	High P, Low N	100 SoP	88 All Phos	50 Flexi-N	25 Flexi-N	20 Flexi-N	40	18	42	18
7	Nil P, Mid N	100 SoP		50 Flexi-N	60 Flexi-N	80 Flexi-N	80	-	42	17
8	Low P, Mid N	100 SoP	44 All Phos	50 Flexi-N	60 Flexi-N	80 Flexi-N	80	9	42	17
9	High P, Mid N	100 SoP	88 All Phos	50 Flexi-N	60 Flexi-N	80 Flexi-N	80	18	42	18
10	Nil P, High N	100 SoP		50 Flexi-N	100 Flexi-N	135 Flexi-N	120	-	42	17
11	Low P, High N	100 SoP	44 All Phos	50 Flexi-N	100 Flexi-N	135 Flexi-N	120	9	42	17
12	High P, High N	100 SoP	88 All Phos	50 Flexi-N	100 Flexi-N	135 Flexi-N	120	18	42	18
13	High P, Max N	100 SoP	88 All Phos	50 Flexi-N	150 Flexi-N	155 Flexi-N	150	18	42	18

Observations and Results

- Early nitrogen uptake is higher at higher P rates (*figure 1)*
- Higher P uptake with higher P rates (*figure 2)*
- Increasing N rate improved P uptake (*figure 2).*
- Increasing P rates appeared to decrease the severity of rhizochtonia at the site

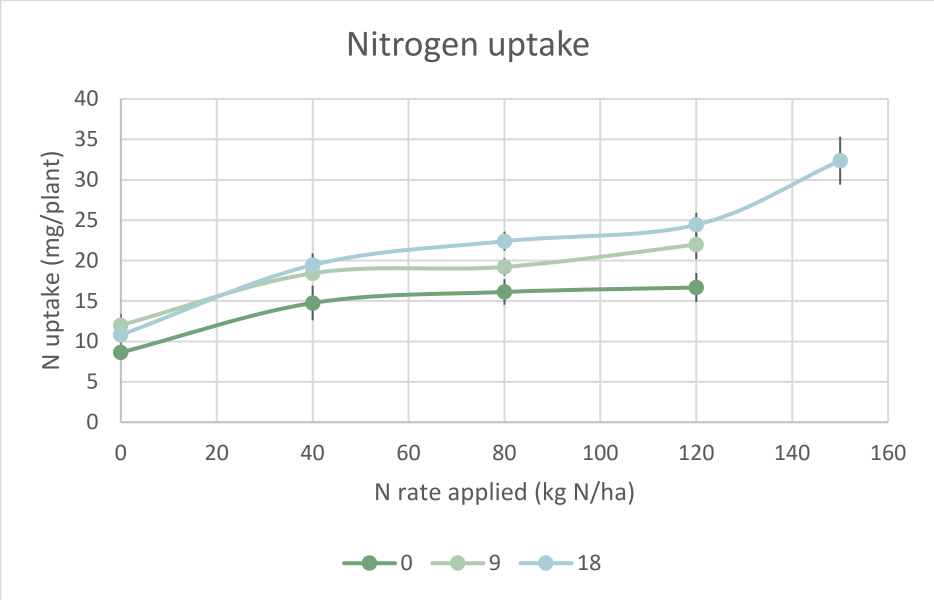


Figure 1. Early Nitrogen uptake (mg/plant) from tissue tests taken 16 DA first N application

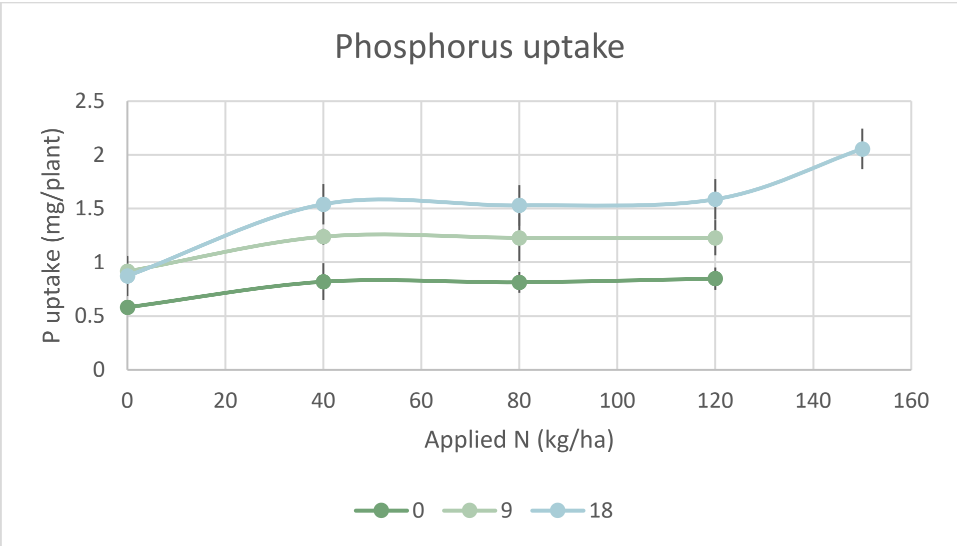


Figure 2. Phosphorus uptake (mg/plant) from tissue tests taken 45 DAE

Further information

Peter Rees, CSBP peter.rees@csbp.com.au

CSBP RESEARCH + AGRONOMY

Nitrogen and Phosphorus Strategies on Oats

Highbury

Grower:	Wiesse
Location:	Highbury (-33.0840293, 117.2651525)
Year:	2024
Crop:	Oats (Goldie)
Code:	GRS_HI_N_P_OA_2024

Trial Aim

To determine the best nitrogen (N) and phosphorus (P) strategies to maximise economic returns in high-yielding oat crops.

Key Messages

- The site was highly responsive to nitrogen application up to 80 kg N/ha
- There was a slight P response at the site, but this was only to 9 kg P/ha. Increasing P rates to 18 kg/ha did not increase yield. Despite this, the crop removed over 11kg/ha of P and this should be the minimum application rate in this environment.
- Fertiliser applications were very profitable at this site. Applying 80kg/ha N and 9kg/ha P increased returns by $680/ha.

Background

Reaching maximum yield potential in high yielding environments requires adequate supply of nitrogen (N) and phosphorus (P) amongst other nutrients. P is ideally supplied to the crop through fertiliser application prior to or at seeding, with little capacity to influence P availability in-season. However, N can be supplied at any growth stage and can have highly variable requirements throughout the growing season depending on conditions.

With increasing interest in oats as a crop in WA, this trial seeks to investigate the N and P response of oats and to see if N response changes at different levels of P supply to help improve fertiliser recommendations and economic returns for growers.

Paddock History:

Year	Crop/Pasture
2023	Canola
2022	Oats
2021	Pasture

Soil Analysis: *February 2024*
Soil Type: *Grey Loam*

Depth (cm)	pH ($CaCl_2$)	EC (dS/m)	O C (%)	Nit N (mg/kg)	Amm N (mg/kg)	Col P (mg/kg)	PBI	Col K (mg/kg)	S (mg/kg)	Ex Al (%)
0-10	5.8	0.1	0.8	2	5	32	56	99	8	0.1
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CSBP RESEARCH + AGRONOMY

Nitrogen and Phosphorus Strategies on Oats

Highbury

Management

Seeding:	23 Apr	Goldie oats at 80 kg/ha to 4 cm, dry sown
Fertiliser:	13 Mar 23 Apr 04 Jun 04 Jul	100 kg/ha SoP basal topdressed All Phos rates and 50 L/ha Flexi-N banded to select plots Flexi-N rates streamed to select plots Flexi-N rates streamed to select plots
Spray applications:	23 Apr 05 Jun 04 Aug	150 ml Callisto, 2.5 L Boxer Gold, 1.8 L TriflurX and 300 ml Lorsban 500 ml Precept for volunteer canola 800 ml AmistarX and 30 ml Trojan
Sampling	Feb 20 Jun	Soil sampling Plant sampling
Harvest:	26 Nov	

Rainfall (mm)

Month	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	GSR (Apr-Oct)
Highbury East	4	3	7	7	22	0	40	30	66	66	27	15	244

Source: https://weather.agric.wa.gov.au/station/NA002

Treatments

Trt	Description	March Topdress (kg/ha)	Seeding Banded (kg/ha)	Seeding Banded (L/ha)	2-4 Leaf Streamed (L/ha)	6-8 Leaf Streamed (L/ha)	N	P	K	S
1	Nil N & P	100 SoP					-	-	42	17
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3	High P, Nil N	100 SoP	88 All Phos				-	18	42	18
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6	High P, Low N	100 SoP	88 All Phos	50 Flexi-N	25 Flexi-N	20 Flexi-N	40	18	42	18
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12	High P, High N	100 SoP	88 All Phos	50 Flexi-N	100 Flexi-N	135 Flexi-N	120	18	42	18
13	High P, Max N	100 SoP	88 All Phos	50 Flexi-N	150 Flexi-N	155 Flexi-N	150	18	42	18

Nitrogen and Phosphorus Strategies on Oats

Highbury

Results

Trt	Description	N (kg/ha)	P (kg/ha)	Yield (t/ha)		Protein (%)		Screenings (%)		Hectolitre (kg/hl)		Grade	Carbon Intensity (kg CO2e/t yield)
1	Nil	0	0	3.55	e	7.7	f	1.4	cd	56.9	bc	OAT1	146
2	Maint P, Nil N		9	3.89	d	7.8	ef	1.8	cd	57.2	ab	OAT1	148
3	High P, Nil N		18	3.76	de	7.8	f	1.4	cd	58.0	a	OAT1	150
4	Nil P, Low N	40	0	4.74	c	8.1	def	1.6	cd	56.8	bc	OAT1	181
5	Maint P, Low N		9	4.79	c	8.0	def	1.3	cd	57.1	abc	OAT1	182
6	High P, Low N		18	4.90	bc	7.8	ef	1.2	d	56.7	bc	OAT1	183
7	Nil P, Mid N	80	0	5.23	ab	8.7	c	2.4	cd	56.2	bcd	OAT1	209
8	Maint P, Mid N		9	5.36	a	8.3	cd	2.4	c	55.3	d	OAT1	209
9	High P, Mid N		18	5.35	a	8.2	de	2.1	cd	56.1	cd	OAT1	211
10	Nil P, High N	120	0	4.94	bc	9.8	b	4.9	b	53.6	e	OAT1	248
11	Maint P, High N		9	5.21	ab	9.7	b	5.1	b	54.0	e	OAT1	244
12	High P, High N		18	5.19	ab	9.7	b	5.0	b	53.6	e	OAT1	246
13	High P, Max N	150	18	5.03	abc	10.6	a	6.5	a	52.3	f	OAT1	275
			Prob(F)	< 0.001		< 0.001		< 0.001		< 0.001			
			LSD	0.34		0.42		1.2		1.1			

All treatments received 100 kg/ha SoP topdressed 5 weeks prior to seeding (42K, 17S)
Different letters denote statistical significance (ns = not significant).
Grain grades as per CBH 2024/25 Receival Standards (accessed Nov 2024) https://www.cbh.com.au/harvest/receival-standards
Carbon intensity based on The University of Melbourne's G-GAF calculator ((G-GAF) Cropping GHG Accounting Framework V10.9 in Tools | Primary Industries Climate Challenges Centre (piccc.org.au)

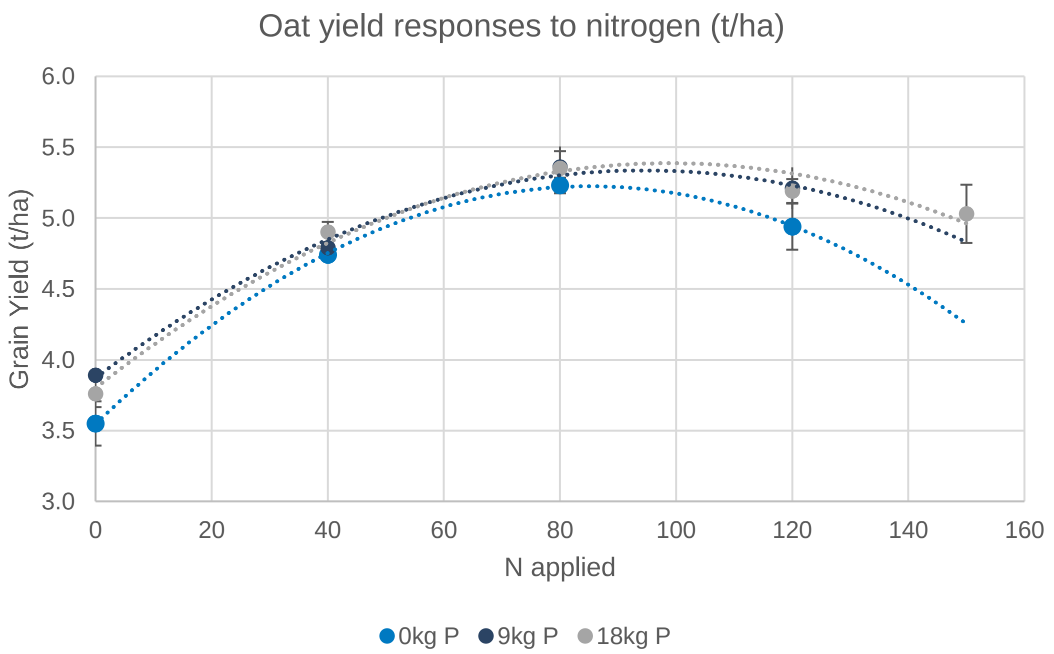

Figure 1. Oat yield response to applied P and N at Highbury site. Each result is the mean of three replicates and vertical lines represent standard errors.

Nitrogen and Phosphorus Strategies on Oats

Highbury

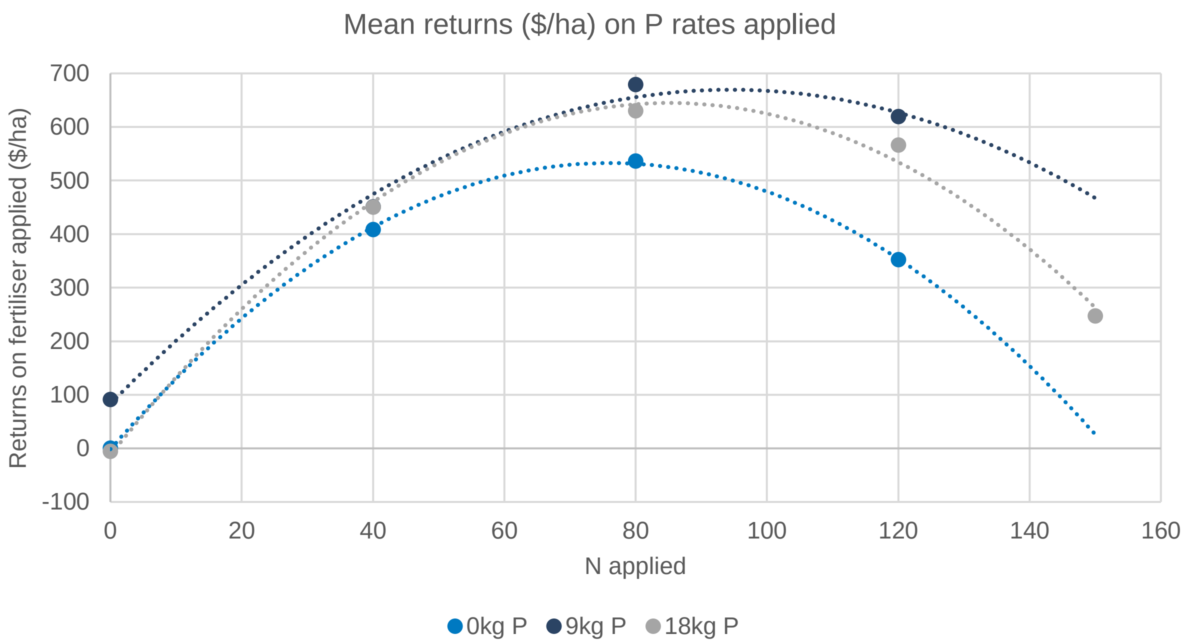

Figure 2. Mean returns on fertiliser applications at Highbury. OAT1 at $400 ex farm, N at $1.7/kg and P at $5/kg. Results are calculated as improvements on the return of the Nil fertiliser treatment.

Table 1. Phosphorus removal rates (kg P/ha) for each treatment determined by laboratory analysis of grain and harvest yields. Each result is the mean of three replicates.

	0 kg P	9 kg P	18 kg P
0 kg N	9.5	12.9	12.3
40 kg N	10.8	12.5	11.0
80 kg N	10.8	9.8	12.7
120 kg N	11.2	11.1	11.2
150 kg N			11.0
Average	**10.6**	**11.6**	**11.7**

Discussion

Oats were more responsive to applied N than to applied P at this site. Optimum yields were achieved at 80kg/ha N for all P rates, although yield potentials may have been hurt by a dry spring. Highest returns at this site were achieved with 9kg/ha of P and 80kg/ha N (Figure 2).

While application of more nitrogen above this rate did increase screenings and decrease hectolitre weight, both remained well above the minimum receival standards for OAT1 in all treatments.

While the best returns were achieved at 9kg of P, Table 1 shows that the removal of P at the site was higher than this, averaging over 11kg/ha across all treatments. As such, when designing a fertiliser program for this paddock it would be recommended to apply at least 12kg/ha P to balance removals and prevent a decline in fertility.

2. InterGrain Breeding Trial

Since 2021, InterGrain has led the Australian grain and oaten hay breeding programs. InterGrain has increased the size of the program with a threefold increase in the number of locations, plots and genotypes being tested annually. These increases are largest in WA (Table 1).

Table 1: Overview of WA Oat Breeding Trials in 2024

Program	Genotypes	Number of trial locations	Number of trial plots
Grain	7,414	12	13,454
Hay	4,878	7	6,936

This OATSPO trial involves two demonstrations:

1. New and improved genetics for WA grain, hay and dual-purpose cropping systems:
   - Carrolup and Williams are outclassed; and
   - Bannister improvements are available.

2. Early sowing and depth of sowing for oats:
   - potential for oats to be sown deeper (~70 - 100mm below soil) and earlier (before ANZAC day) than other cereals if moisture is only available at depth.

Deep and Early Sown Oats to Help Mitigate Risk of Variable Break

1. With increased variability of the season break, growers require extra tools to mitigate this risk. Compared to other cereals, oats offer several tools to help mitigate this risk, due to more appropriate maturity for early sowing, reduced frost sensitivity and the ability for emergence from depth (~70-100mm below soil).

2. With Processed Oat Growth Partnership (POP) investment, a Masters' student demonstrated oats typically emerge from deep sowing better than other cereals (Figure. 1). Even Halberd (a tall, non-dwarf old wheat variety) does not emerge as well as most oat lines tested. Further, the maturity of current wheat varieties (eg LRPB Bale^{A}, Calibre^{A}, Magenta^{A}, Cultass^{A}) discussed as deep sowing options do not allow them to be sown before ANZAC day without vastly increasing frost risk.

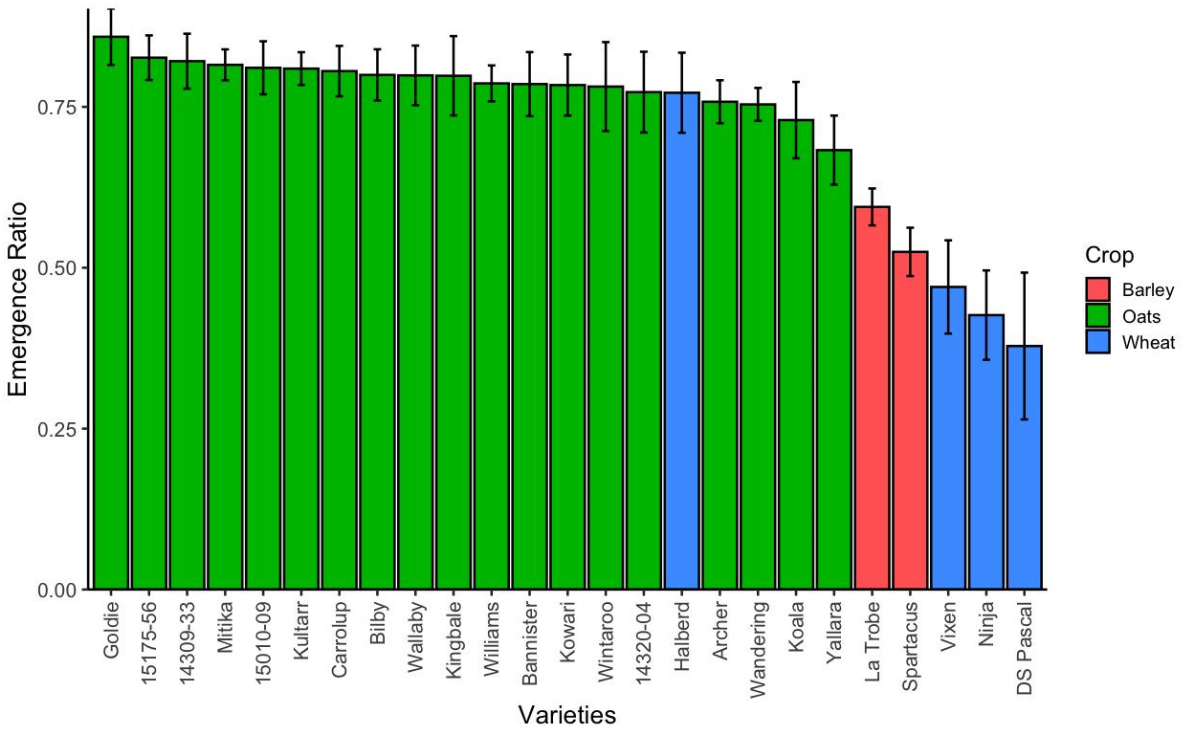

Figure. 1: Emergence ratio (deep/shallow sown) for oat, wheat and barley varieties across five sites in 2023 and 2024. Sowing depths were Shallow (~30-40mm) vs Deep (~100-110mm). A ratio of ~75% (e.g. Bannister) means that ~25% of seed sown deep did not emerge when compared to shallow sown plots. All trials were sown before ANZAC day. Data are from Angelia Tanu, Masters at UWA with CSIRO support possible via POP investment.

New and Improved Genetics

InterGrain nominated NVT lines

Goldie[A] - Milling accredited Bannister replacement across WA. Goldie[A] has the highest yield, lowest screenings with high test weight in NVT across 2021-2023. Five-year NVT predicts Goldie[A] as 5% and 7% ahead of Bannister and Koala[A]; 2023 predictions have Goldie[A] 9% and 17% ahead of Bannister and Koala[A]. Dual-purpose of Goldie[A] is being assessed.

Minnie[A] (15010-09) - Milling classification pending. Highest yielding-genotype in InterGrain program, suits mid-late April sowing in high to medium rainfall zones, where standability may be an issue for Bannister types. Short stature, medium maturity, solid grain package with good beta-glucan.

15175-56 - Milling classification pending. Suited to late April/May sowing in low to medium rainfall zones. Short stature, quick maturity (like Durack). Higher grain protein and good beta-glucan. Solid grain package.

16108-13 - First year in NVT, with high grain yield, good protein and beta-glucan. More suited to the Eastern states.

Hay varieties commercialised by InterGrain

Wallaby[A] - Market leading export hay quality. Mid-slow maturity for April sowing, with excellent colour, with high biomass and strong standability.

Archer[A] - IMI tolerant (IBS only) export hay quality. Mid maturity and height, excellent biomass with good colour and quality. For best quality results with Archer[A], please maintain a high seeding density (~10% higher than other varieties).

Kingbale[A] - IMI tolerant (IBS only) export hay quality. Mid-slow maturity, tall height, excellent biomass with good colour and quality. In high rainfall zones, the standability of Kingbale[A] should be monitored.

Kultarr[A] – Highest biomass variety with export quality, best suited to low to medium rainfall zones. Mid maturity with tall plant height. In high rainfall zones, the standability of Kultarr should be monitored.

Additional InterGrain Research Linkages

Septoria tolerance - We've increased screening field testing, and are working with researchers (Murdoch, DPIRD, CCDM). Several breeding lines are MRMS rated; several research lines are MR or RMR, and breeding with some of these has begun.

Increasing value of oaten grain via quality - InterGrain are leading multiple projects with POP and the GRDC around increasing the knowledge and uses of oat grain as a human food.

Physiology - We're excited to be part of DPIRD led research in this area. This will be discussed at another trial today.

Phenology - InterGrain is aiming to provide new varieties with earlier (eg 15175-56) or later flowering (maybe 2-3 weeks later than Bannister) to extend the sowing window for farmers to further help mitigate increased risks of the variable season break.

Acknowledgements

Further information

Allan Rattey, InterGrain arattey@intergrain.com

2. FINAL REPORT

InterGrain Breeding Trial

Since the 2021 season, InterGrain have led the Australian Grain and Oaten Hay breeding programs. InterGrain has increased program size with approx. threefold increase in number of locations, plots and genotypes being tested annually. These increases are largest in WA. In WA during 2024 they evaluated 7414 genotypes for oat grain across 12 sites and 13454 plots; for hay, they have 4878 genotypes across seven sites and 6936 plots.

This trial has two major demonstrations:

1. To display new and improved genetics for WA grain, hay and dual-purpose cropping systems.
    - Carrolup, Williams and Yallara are completely outclassed by Goldie for Dual-Purpose.
    - Bannister improvements are available for Grain (Goldie and Minnie) and Dual-Purpose (Goldie).
    - Hay only variety Wallaby offers market-leading quality and high biomass when sown in correct window.
2. Oats are *Just Right* for early and deep sowing to take advantage of stored soil moisture. Oats have the correct maturity for early sowing (before ANZAC Day) and can be sown deeper (~80-110mm below soil) than other cereals.

New and improved genetics

InterGrain varieties released from NVT:

Goldie* – *Dual-Purpose, Bannister replacement across WA; Milling accredited, Highest yield (Table 1), lowest screenings with high test weight in NVT across 2021-2024. InterGrain national hay data (Table 4) shows Goldie has superior hay biomass and overall quality than all other varieties here in Table 1.

Table 1: 2020-2024 WA Oat NVT predicted MET yield performance, represented annually as a % of average site mean yield.

Variety	2020 (2.62, 10)	2021 (3.77, 11)	2022 (4.54, 11)	2023 (3.02, 11)	2024 (3.59, 9)
Goldie	113*	109	111	109	112
Minnie	110*	105*	111	105	106
Bannister	105	108	110	101	104
Koala	101	109	112	96	101
Williams	99	105	104	101	103
Carrolup	85	90	87	90	88

*Varieties are ranked by their overall mean yield; *Indicates predicted yield data*

Minnie (tested as 15010-09) – Milling accredited. Highest yielding-genotype in InterGrain program, and 2nd only to Goldie in NVT (Table 1). Minnie suits April sowing in HRZ to MRZ, where standability may be an issue for taller Bannister types. Short stature and mid-maturity with solid grain package and disease profile like Goldie. The picture below highlights the height difference between Minnie and Archer in background.

Oats are Just Right for deep and early sowing

With increased variability around the season break, farmers require extra tools to mitigate this risk as well as the impact of frost and heat sensitivity on crop productivity. Compared to other cereals, Oats offer several tools to help mitigate risks associated with season break, being:

- Ability for deep sowing if stored soil moisture is present (Fig. 1)
- More appropriate maturity for early sowing without greatly increased frost sensitivity.

The OATSPO field day site again demonstrated Oats emerged better than conventional wheat (Mace), with Mace having only ~40% of plants emerging from ~100mm depth. Halberd was like Oats, with ~75% emergence, whilst Oat lines ranged from 72-90% emergence. As this site was dry sown and germinated on rain 29th April, it is noteworthy that deep sown plots emerged 1-2 days later than shallow sown plots.

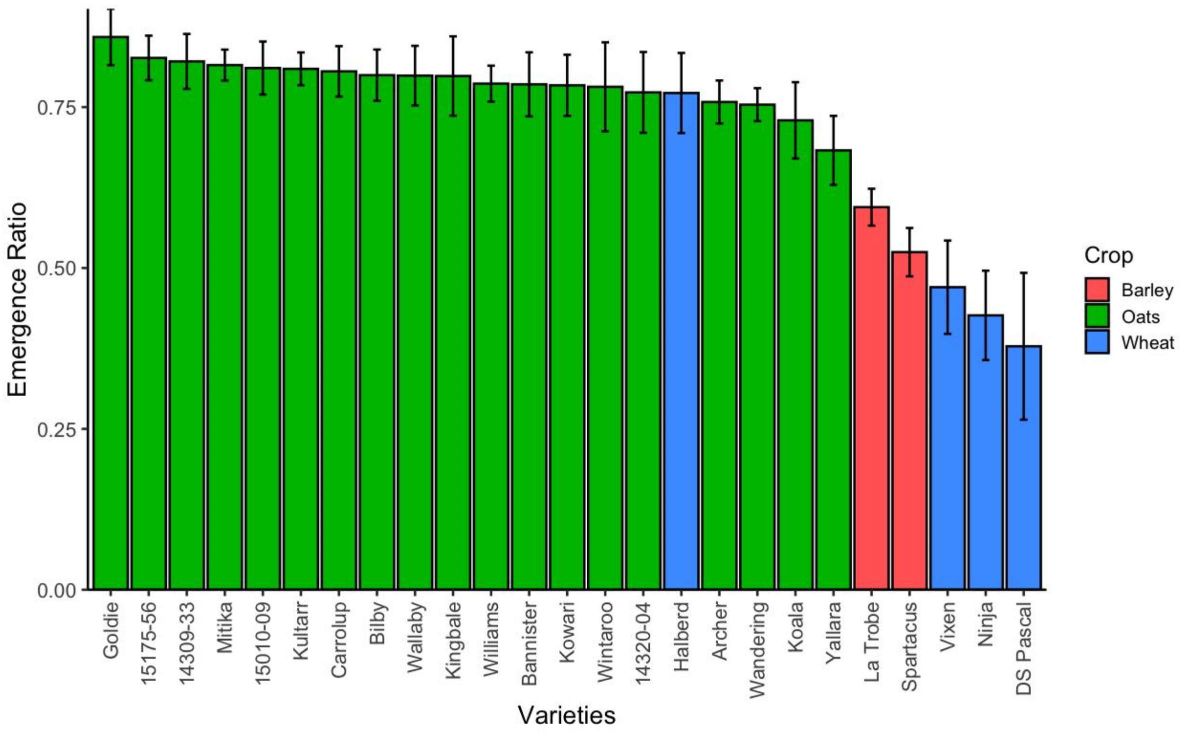

Fig. 1: Emergence ratio (deep/shallow sown) for oat, wheat and barley varieties across five sites in 2023 and 2024.

Sowing depths were Shallow (~20-30mm) vs Deep (~100-110mm). A ratio of ~75% (e.g. Bannister) means that ~25% of seed sown deep did not emerge. All trials were sown before ANZAC day. Data are from Angelia Tanu Masters project at UWA with CSIRO and InterGrain support via POP investment.

From associated research in this deep sowing area, InterGrain had another trial via POP investment east of Corrigan, sown on 16th April. Deep (~110mm) sown plots germinated from stored soil moisture, whilst shallow (~30mm) sown plots germinated from rain ~2 weeks later. Zadok growth stage data from 27th July (Table 2) highlights deep sown plots of conventional main season wheat flowered (zadok 61-69) too early, when frost risk is very high. Longer spring wheat like Valiant and DS Pascal flowered in a more appropriate window, along with Oats (Table 2).

In addition to having a more appropriate phenology for early sowing with lower frost risk, it should be remembered oats have superior frost tolerance to wheat, albeit Oats have inferior heat stress tolerance. So, planting Oats early offers multiple benefits in a farming system.

Table 2: Growth stage (zadok#) across dates (27th July and 8th August) and sowing depths (Deep, ~110mm vs Shallow, ~30mm) sown 17th April near Corrigan, WA. Deep sown plots germinated at sowing; shallow plots ~2 weeks later from subsequent rain.

Variety	Deep 27/07/24	Shallow 27/07/24	Deep 08/08/24	Shallow 08/08/24
Vixen	67	55	71	63
Calibre	65	51	70	60
La Trobe	55	49	67	61
Ninja	54	48	63	60
15175-56	49	45	59	54
Halberd	50	43	56	53
Goldie	45	43	55	50
Archer	45	43	55	49
Minnie	45	43	51	48
Williams	45	43	51	47
Bannister	45	43	49	47
Carrolup	45	43	51	45
DS Pascal	45	41	49	45
Koala	43	41	49	43
Valiant	45	41	49	41

 # Zadok scale goes from 0-110, where 0 is imbibed seed and 100 is crop harvest. Zadok 31 indicates 1st node across all cereals; Zadok 45, 49 and 65 in oats and wheat indicate mid booting, head emergence and mid-flowering, respectively.

Across all 17 Oat varieties with Deep and Shallow sown plots, there was no significance difference between sowing depths for any trait (Table 3). This is most likely due to emergence date being similar across depths, meaning environmental influences were similar between sowing depths.

Goldie crop exhibiting similar plant height as Williams to the immediate right.

Whilst some variation across sowing depths for different varieties were present (Table 3), the interaction effect was not significant herein. Variations for a variety across sowing depths for a given trait (e.g. Bilby; mbi and Tillers/m^2) are due more to measurement variation than variety or sowing depth impact.

Across depths, Goldie, Minnie, Bannister, Koala and Archer were highest yielding varieties (~4.8t/Ha), whilst Williams, Wandering and Bilby were 4.5-4.7t/Ha. Carrolup had lowest yield at 3.7t/Ha, whilst hay varieties Wallaby and Kultarr were ~4.0t/Ha (Table 3). Goldie had less tillers than Bannister at deep sowing, but not shallow sowing, again highlighting variation across plots.

Table 3: Estimated data for traits from Deep (~100mm) and Shallow (~30mm) sown plots at OATSPO field day site, April 2024.

Variety	Deep					Shallow				
	hyld	mbi	hi	Tillers	gyld	hyld	mbi	hi	Tillers	gyld
14309-33	9.12	10.79	0.44	346.7	4.70	8.19	8.75	0.54	255.5	4.71
14320-04	9.08	9.55	0.40	482.7	3.79	9.07	9.63	0.45	200.0	4.29
15175-56	7.91	10.02	0.49	368.5	4.88	8.94	9.75	0.50	223.0	4.87
16108-13	8.59	11.25	0.46	357.2	5.16	8.19	10.88	0.46	469.0	5.04
Archer	7.35	10.16	0.46	252.8	4.67	7.91	9.98	0.45	217.0	4.49
Bannister	8.96	10.35	0.46	359.1	4.74	7.30	10.89	0.44	375.1	4.74
Bilby	7.47	9.04	0.48	237.8	4.41	8.66	10.33	0.46	307.9	4.73
Carrolup	8.85	10.82	0.35	317.8	3.84	8.63	8.91	0.41	332.6	3.65
Goldie	12.52	11.44	0.41	294.5	4.54	9.94	10.81	0.48	341.0	5.15
Koala	8.05	9.42	0.48	220.1	4.57	9.35	10.89	0.46	255.6	5.04
Kowari	7.85	8.80	0.49	317.6	4.30	8.94	9.11	0.47	301.5	4.34
Kultarr	10.69	11.26	0.37	285.4	4.17	7.27	11.50	0.38	389.3	4.31
Minnie	8.67	9.89	0.48	348.5	4.79	8.84	10.04	0.48	279.8	4.80
Mitika	9.94	9.69	0.48	221.2	4.69	9.03	9.44	0.49	314.0	4.62
Wallaby	13.24	12.54	0.30	226.4	3.72	11.5	14.69	0.28	316.1	4.15
Wanderin	7.30	9.71	0.48	250.1	4.70	7.01	11.49	0.41	318.0	4.75
Williams	9.26	12.64	0.37	257.2	4.65	9.07	11.03	0.43	238.0	4.77
zz Av	**9.13**	**10.49**	**0.44**	**300.9**	**4.52**	**8.72**	**10.50**	**0.45**	**305.8**	**4.67**

Hyld = Hay biomass/Ha, mbi = final biomass/Ha, hi = harvest index, Tillers = tillers/m^2 and gyld = Grain yield/Ha

Consistent with data from other sites, Goldie has slightly heavier tillers than Bannister, with overall slightly higher final biomass and similar harvest index (Ratio of grain yield to final biomass), resulting in slightly higher grain yields for Goldie over Bannister across NVT (Table 1). From Hay data (Table 4), Goldie has higher WSC than Bannister, which presumably enables Goldie to fill grain better and provide higher test weight/lower screening losses compared to Bannister (see NVT online).

Of the other varieties, shorter lines Minnie, Kowari, 15175-56 had best harvest index, while Carrolup, Kultarr and Wallaby had poor harvest index.

Hay varieties commercialised by InterGrain

Wallaby – Market leading export hay quality. Mid-slow maturity for April sowing, with excellent colour, high biomass and strong standability.

Archer – IMI tolerant (IBS only) export hay quality. Mid maturity and height, excellent biomass with good colour and quality. For best quality results with Archer, please maintain a high seeding density (~10% higher than other varieties).

Kingbale - IMI tolerant (IBS only) export hay quality. Mid-slow maturity, tall height, excellent biomass with good colour and average quality. In HRZ, the standability of Kingbale should be monitored.

Kultarr – Highest biomass variety with export quality, best suited to MRZ to LRZ. Mid maturity with tall plant height. In HRZ, the standability of Kultarr should be monitored.

Data collected from the OATSPO site was utilized in InterGrain National Hay MET (Table 4). These data are colour coded within each trait, so that green is good, and red is poor, noting low fibre (adf and ndf) is preferred. These data are then sorted by biomass. So, Kingbale has the highest biomass but is below average for quality traits.

Table 4: 2018-2024 National Hay oat predicted MET performance across key traits, represented across all 56 environments as a % of average trait mean.

Genotype	hyld	WSC	Ndf	adf	NDFdom30	CP	Digest
Kingbale	107%	97%	102%	103%	98%	92%	99%
Kultarr	107%	104%	100%	102%	100%	92%	100%
Wallaby	105%	108%	98%	96%	103%	99%	104%
Goldie	105%	109%	98%	96%	103%	102%	103%
Brusher	104%	103%	100%	99%	100%	101%	101%
Archer	102%	95%	100%	100%	100%	109%	100%
Bannister	102%	102%	100%	96%	103%	103%	103%
Koala	101%	99%	99%	96%	100%	105%	102%
Williams	100%	95%	100%	99%	99%	107%	100%
Yallara	99%	104%	99%	99%	99%	101%	100%
Carrolup	99%	99%	100%	101%	97%	103%	99%

From Table 4, Wallaby can be seen to have high hay yields with market leading hay quality. Wallaby is a slow maturing variety, so needs planting earlier and/or harvested later than other hay lines like Brusher and Archer for optimal performance. Kultarr has highest biomass and acceptable Quality, also suitable for export hay.

Amongst the Dual-Purpose varieties, Goldie meets Export hay quality standards and has highest biomass and WSC, with overall high Digestibility/low fibre. Williams has low WSC, whilst Carrolup and Yallara are generally poor across all traits. (Table 4). More data is required for Koala to understand its' suitability for Hay.

3. Agronomy Trial – Variety x Sowing Rate x Nitrogen

Research Aim

Does Goldie respond to seeding rate and nitrogen rate in a similar way to Bannister? Three sowing rates x four nitrogen rates will be applied across the two varieties to assess differences in yield and grain quality.

Methods

The trial was sown on 22nd April into dry soil at 30mm depth (germinated 6th May). Both varieties had two seeding rates- 60 and 90kg/ha with a target plant density of 160 and 240 plants/m^2 respectively. 70kg MAP + 30kg SoP was banded with the seed.

The four different nitrogen rates tested in the trial were 0, 40, 80 and 120 (kg/ha Nitrogen). All treatments received 30L/ha of Flexi N banded below the seed as well as 7.7kg N/ha in the compound fertiliser. Nitrogen was applied post-emergent by streaming Flexi N.

Timing	N Treatments (kg N/ha)			
	0	40	80	120
Seeding	7.7	20	20	20
Early tillering (29th May)		20	30	50
Stem elongation (8th July)			30	50

Treatment List

Trt	Variety	Seed Rate	N Rate (unit)
1	Goldie	90kg/ha	0
2	Goldie	90kg/ha	40
3	Goldie	90kg/ha	80
4	Goldie	90kg/ha	120
5	Goldie	60kg/ha	0
6	Goldie	60kg/ha	40
7	Goldie	60kg/ha	80
8	Goldie	60kg/ha	120
9	Bannister	90kg/ha	0
10	Bannister	90kg/ha	40
11	Bannister	90kg/ha	80
12	Bannister	90kg/ha	120
13	Bannister	60kg/ha	0
14	Bannister	60kg/ha	40
15	Bannister	60kg/ha	80
16	Bannister	60kg/ha	120

Further information

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3. FINAL REPORT

Management of Goldie and Bannister Oats in Highbury 2024

Trent Butcher and Gray Yates, ConsultAg Narrogin

Key messages

- Goldie offers higher grain yield, lower screenings and similar hectolitre weight to Bannister under comparable management.
- Goldie and Bannister behave very similarly to agronomic practices.
- Increasing nitrogen rates has negative impacts on grain weight, screenings and hectolitre weight.
- Excessive nitrogen applications lead to greater biomass and reduced harvest indexes.
- Excessive nitrogen applications can result in negative yield responses.
- Grain protein is a strong indicator of higher nitrogen rates, but its use as a tool for determining whether excessive nitrogen has been applied needs further exploration.

Background

Goldie is a newly released variety from InterGrain that offers a faster maturity and similar area of adaptability as Bannister, which, is the most grown variety in the region. Goldie offers the potential for higher yield and improved grain quality aspects over Bannister. This trial aims to identify whether the established agronomic practices for Bannister are transferable to the management of Goldie.

As another point of intertest, local growers report a yield ceiling in oats, unlike barley, suggesting a challenge in achieving higher grain yield. This may stem from higher biomass and a source-sink imbalance, making oats more vulnerable to environmental stress. Historical trials have indicated that yields plateau around 80N in this environment. To determine where this extra nutrition is being utilised and to identify what aspects influence the yield ceiling, harvest index and yield components need to be explored.

Aims

- Determine whether the agronomic package for Bannister is the same for the newly released variety Goldie.
- To identify whether Goldie responds to higher rates of nitrogen the same as Bannister.
- Identify how biomass translates into yield for Goldie vs Bannister.
- Determine whether Goldie offers an improvement in grain yield and/or grain quality parameters.

Method

The trial was dry sown as a randomised complete block to both Goldie and Bannister oats sown at 60 and 90kg/ha to target 160 and 240 plants per square metre respectively at a depth of 30mm. The site was seeded on the 22nd of April with 70kg/ha MAP + 30kg/ha SOP + 30L/ha UAN (on all plots other than the 0 treatment). The germination event occurred on the 2nd of May with 28mm of rain recorded. Weeds were managed with an application of 2.5L/ha Boxer Gold + 200ml Voraxor. Two nitrogen top ups were applied prior to stem elongation giving the treatments their total target nitrogen, all nitrogen applications were in the form of UAN as seen in table 1.

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Table 1: Timing of nitrogen applications

Timing	N Treatments (kg N/ha)			
	0	**40**	**80**	**120**
Seeding	7.7	20	20	20
Early tillering		20	30	50
Beginning of Stem elongation			30	50

Assessments in season were made of plant establishment and tiller number. Harvest index cuts were taken prior to harvest and assessed for grain number, panicle number and biomass. Grain yield was recorded at harvest and 1kg samples were analysed for screenings, protein and hectolitre weight.

Table 2: Treatments included in the trial, comparable seeding rates and nitrogen were used for Bannister and Goldie.

	Variety	Seeding rate	N rate (units)
1	Goldie	90kg/ha	0
2	Goldie	90kg/ha	40
3	Goldie	90kg/ha	80
4	Goldie	90kg/ha	120
5	Goldie	60kg/ha	0
6	Goldie	60kg/ha	40
7	Goldie	60kg/ha	80
8	Goldie	60kg/ha	120
9	Bannister	90kg/ha	0
10	Bannister	90kg/ha	40
11	Bannister	90kg/ha	80
12	Bannister	90kg/ha	120
13	Bannister	60kg/ha	0
14	Bannister	60kg/ha	40
15	Bannister	60kg/ha	80
16	Bannister	60kg/ha	120

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Results

Seasonal Conditions

The conditions prior to the seeding of the trial were extremely dry with very little rainfall recorded. As a result, the crop was dry seeded but received a very gentle starting rain of 28mm which allowed for an even germination across the entire OATSPO site. There was steady rain through most of the growing season though totals fell well short of the long-term average. Spring conditions offered some rain in early September, but only small amounts were recorded in early October. The lack of favourable spring conditions is likely to have impacted on the grain filling ability of the oats in this trial.

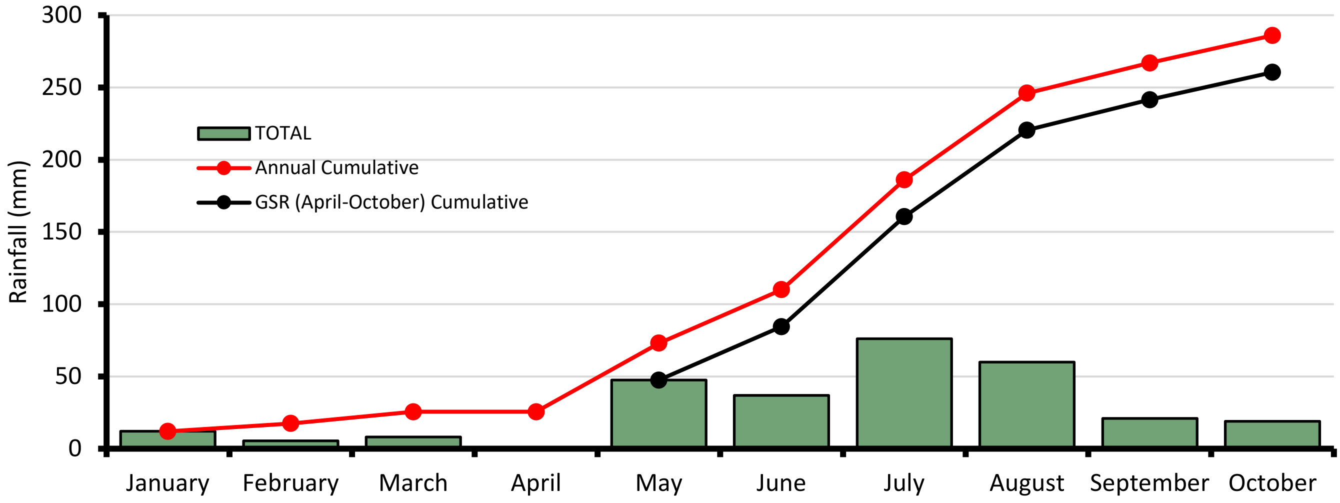

Figure 1: Cumulative and monthly 2024 rainfall in Highbury.

Crop establishment and tiller number

As expected, there was a greater establishment of plants when sown at 90kg/ha compared to 60kg/ha. Goldie and Goldie and Bannister had comparable establishment and nitrogen treatments did not influence oat establishment. Though Bannister did have a higher average tiller number (50.6) when compared to Goldie (46.8). Variations between treatments however was not significantly different (table 3).

Table 3: Plant establishment and tiller number by treatments. Letters denote significant difference at 0.05

Variety	SR	N	Treatment	Establishment (plants/m2)		Tillers/m2)	
Goldie	90kg	0	1	43.6	ab	44.2	d
		40	2	41.6	abc	46.0	cd
		80	3	44.9	a	47.3	bcd
		120	4	45.1	a	48.2	abcd
	60kg	0	5	36.1	cd	49.1	abcd
		40	6	33.2	d	44.6	d
		80	7	33.6	d	46.1	cd
		120	8	34.4	d	48.6	abcd
Bannister	90kg	0	9	45.0	a	48.3	abcd
		40	10	45.0	a	49.1	abcd
		80	11	46.4	a	53.4	a
		120	12	46.3	a	48.1	abcd
	60kg	0	13	36.9	cd	50.9	abc
		40	14	36.1	cd	51.6	abc
		80	15	37.9	bcd	52.1	ab
		120	16	33.8	d	51.6	abc
P value				<0.001		0.0502	
LSD				5.74		16.96	
CV				20.61		5.75	

Harvest Index and Yield Components

Variation in nitrogen resulted in significant changes in the yield components of both Goldie and Bannister. When analysed as a factorial by nitrogen treatment some clear trends were revealed. Panicles per square metre was higher for greater nitrogen rates, however, these panicles were lighter as their measured 100 grain weights declined. For the treatments of 0N to 80N this decline in grain weight was compensated for by total higher grain number which resulted in higher grain yields. When the rate was increased to 120N this trend flatlined and the lower grain weight was not able to deliver higher yields than the 40N on average.

The total biomass showed an increase as nitrogen rates were increased going from 12.25t/ha at 0N up to 14.88t/ha in 120N. When accounting for the weight of grain this revealed a vegetative biomass of 6.33 and 8.21t/ha respectively. When harvest index was calculated it showed a consistent 0.41-0.42 for the 0N,40N and 80N but dropped to 0.36 when the nitrogen rate was increased to 120N.

There was no significant difference in major trends between varieties, which may be indicative of a relative uniform response to nitrogen between Goldie and Bannister. Seeding rate had a significant impact on panicles per square metre with a greater number at 90kg (280) than 60kg (242) but the panicle weight was greater in the 60kg (4.95g) than the 90kg (4.56g).

Table 4: Plant yield components as influenced by nitrogen rate. Letters denote significant difference at 0.05

N Rate	Panicles per sqm		Panicle weight (g)		Grain weight (g)		100 grain weight (g)		Total Biomass (t/ha)		Vegetative Biomass t/ha		Harvest Index	
0	201	b	5.37	a	214.3	c	4.02	a	12.25	c	6.33	**c**	0.41	a
40	233	b	4.98	ab	237.8	b	3.79	b	12.69	bc	6.59	**bc**	0.42	a
80	286	a	4.58	bc	259.7	a	3.45	c	13.88	ab	7.64	**ab**	0.41	a
120	324	a	4.08	c	226.9	bc	3.02	d	14.88	a	8.21	**a**	0.36	b
CV	22.6		14.6		12.9		8.96		16.3		20.4		12.9	
P	<0.001		<0.001		<0.001		<0.001		0		0.0018		<0.001	
LSD	41.94		0.49		21.51		0.23		1.56		1.04		21.51	

Grain yield and quality

Goldie yielded significantly more than Bannister on average. Though there was no difference between the 60kg/ha and 90kg/ha seeding rates. All nitrogen treatments yielded higher than the untreated control, thought 120N yielded no better than 40N with 80N offering the highest yield. Goldie did appear not to have the same degree of negative response to the highest rate of nitrogen when sown at 60kg but this trend was not significant.

When looking at Goldie vs Bannister overall, there was no difference in the hectolitre weights but there was a significant decline when excessive nitrogen was applied with 0, 40 and 80N showing no difference (54.27-54.76) but 120N dropping to 51.94. Seeding rate was not significant at 0.05 but at 0.15 suggested a higher hectolitre weight with lower seeding rates.

Goldie (5.8%) had significantly better screenings than Bannister (10.7%) with screenings worsening as higher nitrogen rates were applied. There was no difference between 0 and 40N but at 80N there was a drop which was worse again at 120N.

Grain protein levels were not different between 0 and 40N (8.15-8.18%) but rose at 80N (9.13%) and again at 120N (9.93).

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Table 5: Grain yield, hectolitre weight, screenings and protein measurements by treatments. Letters denote significant difference at 0.05

Variety	SR	N	Treatment	Yield t/ha		Hectolitre		Screenings		Protein	
Goldie	90kg	0	1	4.72	g	53.98	abc	1.9	g	8.0	de
		40	2	5.21	cdef	54.82	abc	2.0	fg	8.0	e
		80	3	5.74	ab	54.22	abc	7.2	cdefg	9.5	ab
		120	4	5.39	abcd	53.00	cde	11.5	c	9.8	a
	60kg	0	5	4.86	efg	54.93	ab	3.8	efg	8.7	bcde
		40	6	5.35	bcd	54.96	ab	4.6	efg	8.6	bcde
		80	7	5.59	abc	54.63	abc	5.0	defg	9.1	abcd
		120	8	5.80	a	51.97	de	10.4	cd	10.1	a
Bannister	90kg	0	9	4.85	fg	54.15	abc	7.8	cde	8.3	cde
		40	10	5.36	bcd	53.54	bcd	7.9	cde	8.1	de
		80	11	5.44	abc	54.24	abc	11.0	c	9.3	abc
		120	12	4.90	efg	51.22	e	18.2	a	10.2	a
	60kg	0	13	4.88	efg	55.24	ab	3.5	efg	7.7	e
		40	14	5.29	cde	55.75	a	7.5	cdef	8.1	de
		80	15	5.49	abc	54.03	abc	12.2	bc	8.7	bcde
		120	16	4.98	defg	51.58	e	17.5	ab	9.6	ab
P value				<0.001		<0.001		<0.001		<0.001	
LSD				0.438		1.91		5.56		1.08	
CV				5.88		2.496		47.47		8.6	

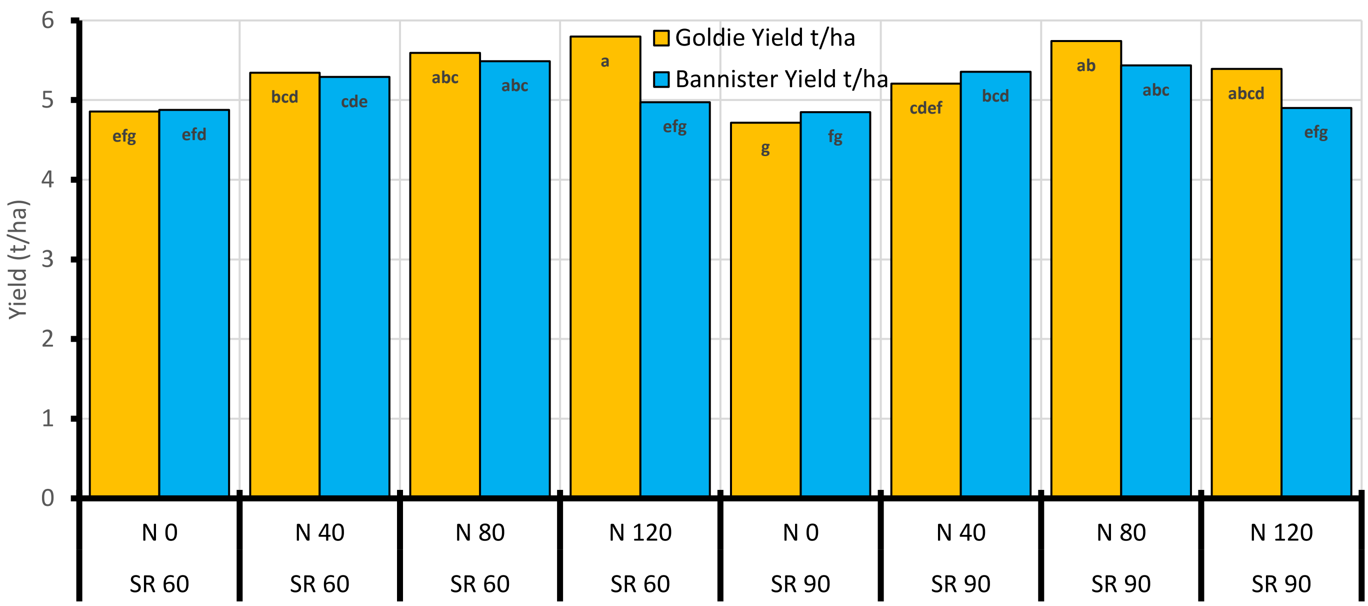

Figure 2: Grain Yield for Goldie (yellow bars) and Bannister (blue bars) for each nitrogen and seeding rate.

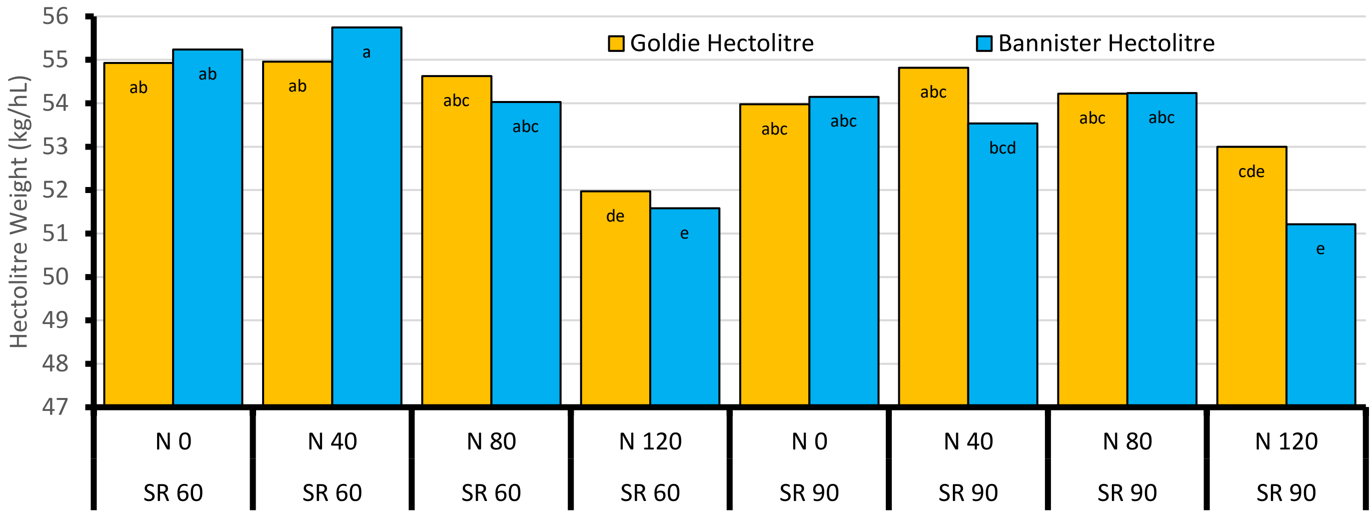

Figure 3: Hectolitre weight for Goldie (yellow bars) and Bannister (blue bars) for each nitrogen and seeding rate.

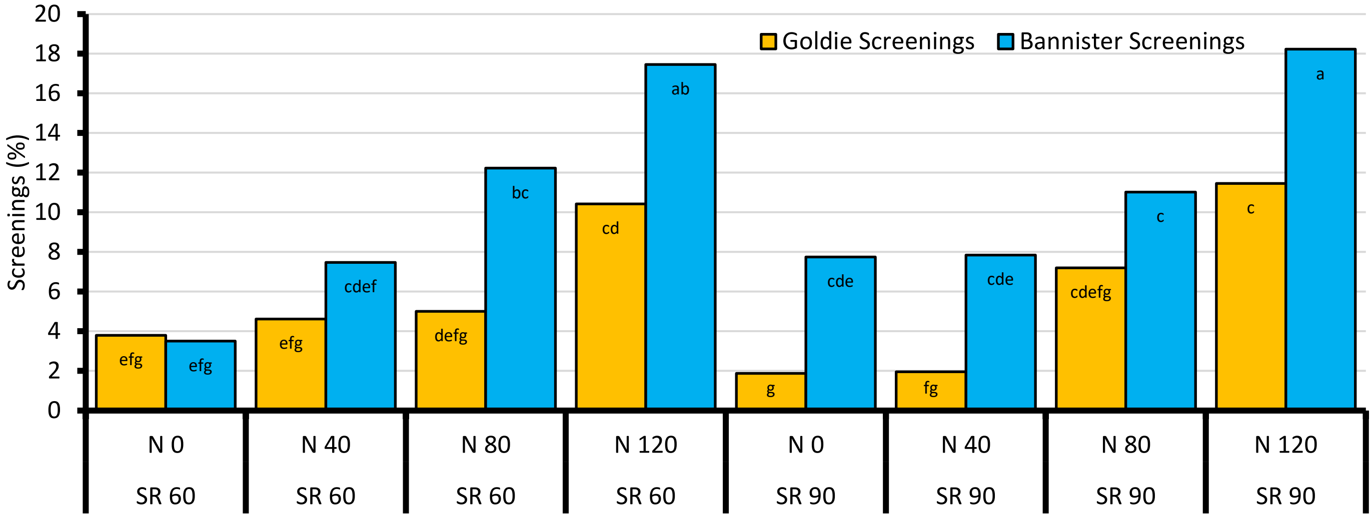

Figure 4: Screenings for Goldie (yellow bars) and Bannister (blue bars) for each nitrogen and seeding rate.

Economics

Optimised returns were achieved at 40N for Bannister and around 80N for Goldie. At the higher nitrogen rate in Bannister the quality decline from 40N to 80N caused the oats to drop to Oat2, this coupled with the increased cost of urea and minor yield improvement resulted in a similar to lower gross return than 80N. This reduction in grade was not apparent in Goldie which resulted in an increased gross margin from the 80N. The 120N had a large drop off in return from Bannister as the collapse in yield and reduction in quality to Oat3 reduced the gross margin. With Goldie the quality also dropped at the higher rate which made returns less favourable.

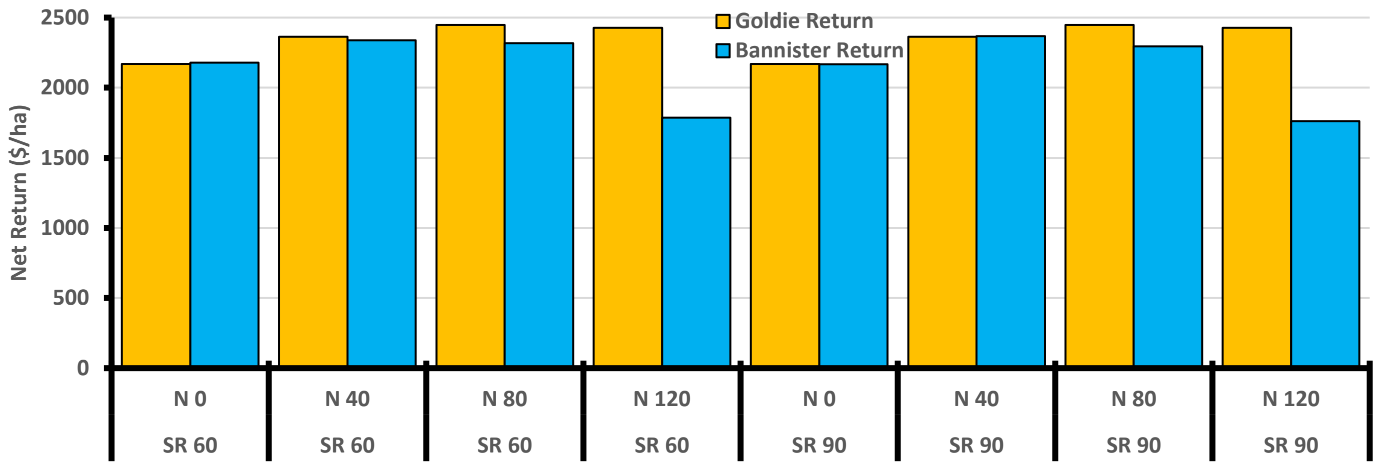

Figure 5: Gross returns for each treatment. Oat prices: $350 Oat1, $335 Oat 2, $278 Oat3. Nitrogen was priced at $0.65 per unit.

Conclusion

Goldie offers a strong alternative over Bannister with higher grain yield and lower screenings. This should particularly help in marginal areas where often screenings compromise oats meeting delivery grade. Agronomically, it has acted very similarly to Bannister to seeding rate and nitrogen. Though shows a trend toward being more robust at higher nitrogen rates. The shorter growing season in 2024 likely benefited Goldie over Bannister with its faster maturity. The terminal drought impacts are likely to have been greater on Bannister than Goldie as a result. Quicker season oats have shown a propensity to flower in a quicker window. This should be closely looked at, as I believe it may possibly lead to a greater susceptibility to frost in oats. If Goldie is very similar to Bannister though this is unlikely to be an issue.

The harvest index analysis revealed why growers are seeing a yield plateau in their oats. Additional yield cannot be achieved by applying more nitrogen. The high rates of nitrogen have negative impacts on both screenings and hectolitre weight which will make them more difficult to deliver. Growers need to be vigilant not to over apply nitrogen to meet these standards. Of further concern is the risk of negative yield impacts from excessive nitrogen. The harvest index data revealed that excessive nitrogen inputs are contributing to greater biomass at the expense of grain weight. This combination is leading to a decline in the harvest index, which in this trial averaged 0.41-0.42 but declined to 0.36 when excessive nitrogen was applied. Excessive nitrogen application on taller varieties such as Goldie, increases the risk of lodging, though this was not observed in 2024.

Future work should explore the relationship between biomass and grain yield to determine whether tools can be developed to avoid excessive biomass growth. It's likely the impacts of this growth are exacerbated by terminal drought with theoretically higher biomass drawing more water from the soil. Even if this is not the case, there is a need for more energy to fill more grains which would require a longer period of sunlight capture. In high rainfall areas of the world often high nitrogen rates in oats lead to a yield plateau as a result as sunlight starts to become a limiting factor. Time of sowing seems like an easy lever to pull but a better understanding of the photoperiod hold of varieties will be essential to make sure they aren't overcome by the high thermal load of early seeding. Winter oats may also have a place but their tendency toward very high grain number would take a conscious breeding effort to overcome. Alternatively, a deeper exploration into canopy management techniques to avoid excessive biomass could be explored, or whether higher harvest index varieties (like Minnie) have a better fit in high production areas.

Key words

Oats, Goldie, Bannister, Harvest Index, Hectolitre Weight, Screenings, Grain Protein

Acknowledgments

This trial was conducted using funds from the Processed Oat Partnership investment into the OATSPO showcase and the generous contributions of InterGrain to harvest index analysis.

4. Grain Yield Formation in Oats

Hamid Shirdelmoghanloo[1], Blakely Paynter[1], Allan Rattey[2], and Hammad Khan[1]
[1]Department of Primary Industries and Regional Development, Northam WA, [2]InterGrain, Bibra Lake WA.

Research Aim

1. Determine if grain oat yields are source or sink-limited in WA.
2. Understand yield pathways of oat genetics from different countries and across time in Australian genetics.

The project seeks to ensure that the future rate of genetic gain in milling oats matches or exceeds what barley and wheat are achieving by providing Australian oat breeders with a:

1. Selection toolbox to breed milling oats with higher yield potential.
2. Proposed ideotype for milling oats when grown in WA.
3. Better understanding of the number of production environments in WA.

The plots on display today represent some of the different genetics being studied.

Research Background

Industry issue – Before the release of Goldie in 2023, growers of milling oats in WA have not seen any genetic gain for grain yield since the release of Bannister and Williams in 2012.

It is hypothesised that the grain yield of oats can be increased by focusing on traits that increase biomass production (without drying out the soil) and increase the number of grains surviving through to grain filling while maintaining or improving the harvest index.

Yield formation is under the control of source and sink limitations. A source limitation reflects a lack of assimilates to meet potential grain weight. A sink limitation is imposed by the number of grains set and how much starch they can store. In conclusion, as the source and sink work in close balance and are strongly influenced by the environment, a sound understanding of the source and sink ratio of different oat genotypes, and the limiting environmental factors is required for WA environments.

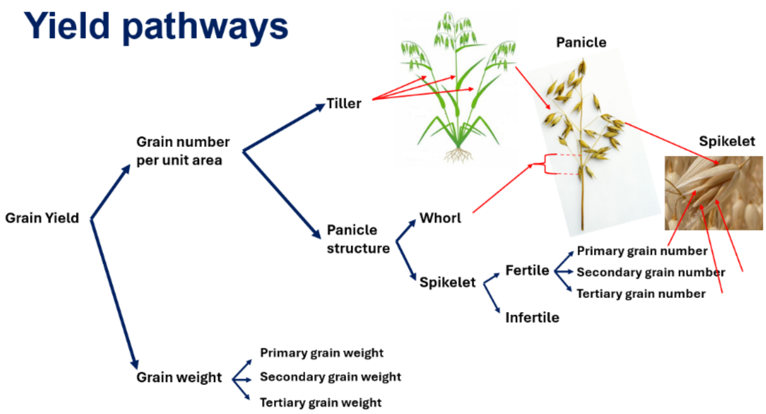

Figure 1. Yield pathways in grain oats.

The proposed project investigates the yield formation of oats across the WA environment (Figure 2). It requires a multi-step and multi-layered approach that seeks fundamental knowledge of the diversity of physiological traits in Australian and international germplasm (with appropriate phenology), a scoping of the ET(s) that may exist in WA and the environmental characteristics (EC) that influence the breeder's capacity to improve productivity in each ET.

To the best of our knowledge, no source and sink studies have been conducted with oats in WA. Research of Victor Sadras in South Australia, Catherine Howarth in Wales, Robert Beattie in Scotland, the late John Finnan in Ireland, and others, plus reviews such as Finnan and Spink (2017), provide a framework for the proposed physiological research.

Finnan JM and Spink J (2017) Identification of yield limiting phenological phases of oats to improve crop management. *Journal of Agricultural Science* **155**: 1-17. https://doi.org/10.1017/S0021859616000071

Funding

The project "Building grain yield (without neglecting physical grain quality) in milling oats through a better understanding of source and sink relationships and developing a targeted selection toolbox for future breeding gains" is funded by the Processed Oat Partnership (a state government initiative) in collaboration with DPIRD and InterGrain.

Demonstration Layout

The demonstration plots (sown to establish 240 plants/m2) include varieties from the following environments:

1. Australia (12078-13BG, 14088-23, Bilby, Brunswick, Dalyup, Durack, Mortlock, Murray, Needilup, Wandering, Williams),
2. Brazil (UFRGS 037031-3, UFRGS 097032-2, UPF-9),
3. Canada (AAC Pontiac, CDC Dancer, Millauquen, Ogle, Optimum, Stainless),
4. China (Avoine Nue),
5. Europe (Ardo, Alpha <, Bison, Germany 72281, Sang),
6. India (India 1)
7. UK (Margam, Storm King),
8. Unknown (CD92), and
9. USA (Classic, Coronado, Gem, Lang, ND Heart, Warrior

1001	Bilby	Australia	2001	AAC Pontiac	Canada	3001	Ardo	Czech Republic	4001	UFRGS 037031-3	Brazil	5001	Avoine Nue	China	6001	Classic	USA
1002	Williams	Australia	2002	CDC Dancer	Canada	3002	Alpha <	France	4002	UFRGS 097032-2	Brazil	5002	12078-13BG	Australia	6002	Coronado	USA
1003	Dalyup	Australia	2003	Millauquen	Canada	3003	Bison	Germany	4003	UPF-9	Brazil	5003	14088-23	Australia	6003	Gem	USA
1004	Durack	Australia	2004	Ogle	Canada	3004	Germany 72281	Germany	4004	Margam	UK	5004	Brunswick	Australia	6004	Lang	USA
1005	Mortlock	Australia	2005	Optimum	Canada	3005	India 1	India	4005	Storm King	UK	5005	Murray	Australia	6005	ND Heart	USA
1006	Wandering	Australia	2006	Stainless	Canada	3006	Sang	Sweden	4006	CD 920	unknown	5006	Needilup	Australia	6006	Warrior	USA

Further information

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4.1 FINAL REPORT

Oat Yield Formation in Oats

Research funded by the Processed Oats Partnership – a WA State government initiative.
Research undertaken by: Hamid Shirdelmoghanloo & Blakely Paynter of the Department of Primary Industries and Regional Development

This valuable research has been undertaken by Hamid Shirdelmoghanloo and Blakely Paynter. At the time of publishing Hamid was on extended leave, so the below content was extracted from Hamid's presentation at the 2025 GRDC crop Updates. Further details and clarification can be gained from Hamid (hamid.shirdelmoghanloo@dpird.wa.gov.au) or Blakely Paynter (Blakely.Paynter@dpird.wa.gov.au).

Aim

The aim of this research is to better understand how oat varieties from around the world generate yield (e.g. tiller number, spikelet number and grain number, size, weight) and the influence of these traits on grain quality. This data can be then used by oat breeders to better select traits for high yield and quality oats.

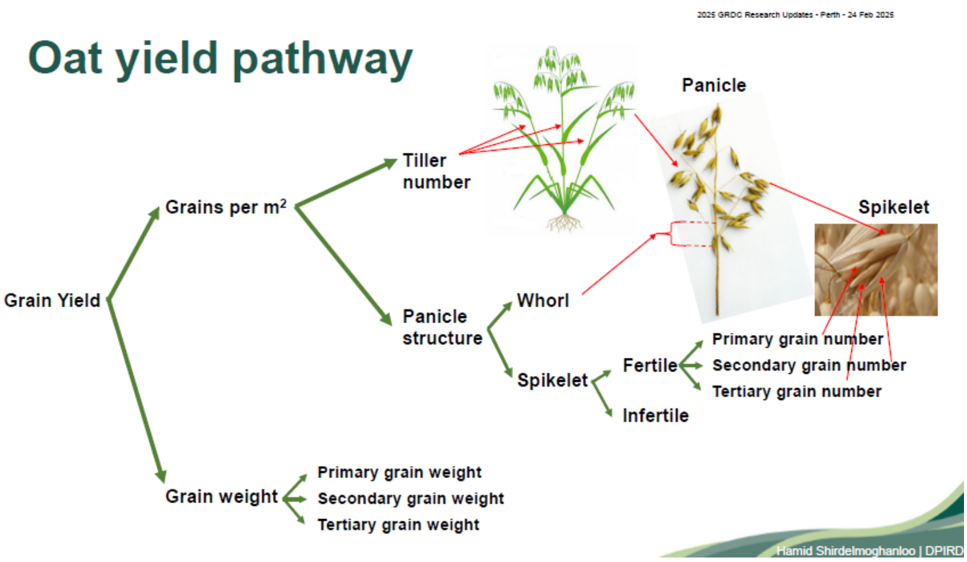

Figure 1: The below image shows the different grain components that contribute to final oat yield.

Table 1: Key physiological differences of newly released grain varieties compared to Bannister.

Variety	Grain filling rate	Grain filling duration	Stay-green	Radiation use efficiency	Stem reserve utilisation	Harvest index	Plant height	Phenology
Goldie	faster	shorter	longer	higher	lower	lower	taller	earlier
Koala	faster	shorter	shorter	lower	higher	lower	taller	later
Minnie	faster	shorter	longer	lower	lower	higher	shorter	earlier

The photos in Figure 2 show the number of primary grains (left), secondary grains (middle) and tertiary grains (Right) that form in each spikelet.

The spider plots show how grain yield is achieved in different varieties. For example, Williams can be seed in to achieve yield by high grain number, whereas Bilby achieves yield by grain size. This explains how Williams has a very high yields in a good season but struggles with screenings in dry seasons. Whereas Bilby always has good grain size but cannot boost yield in a good season because it is limited by grain number.

Figure 2: This figure shows how each variety achieved grain yield.

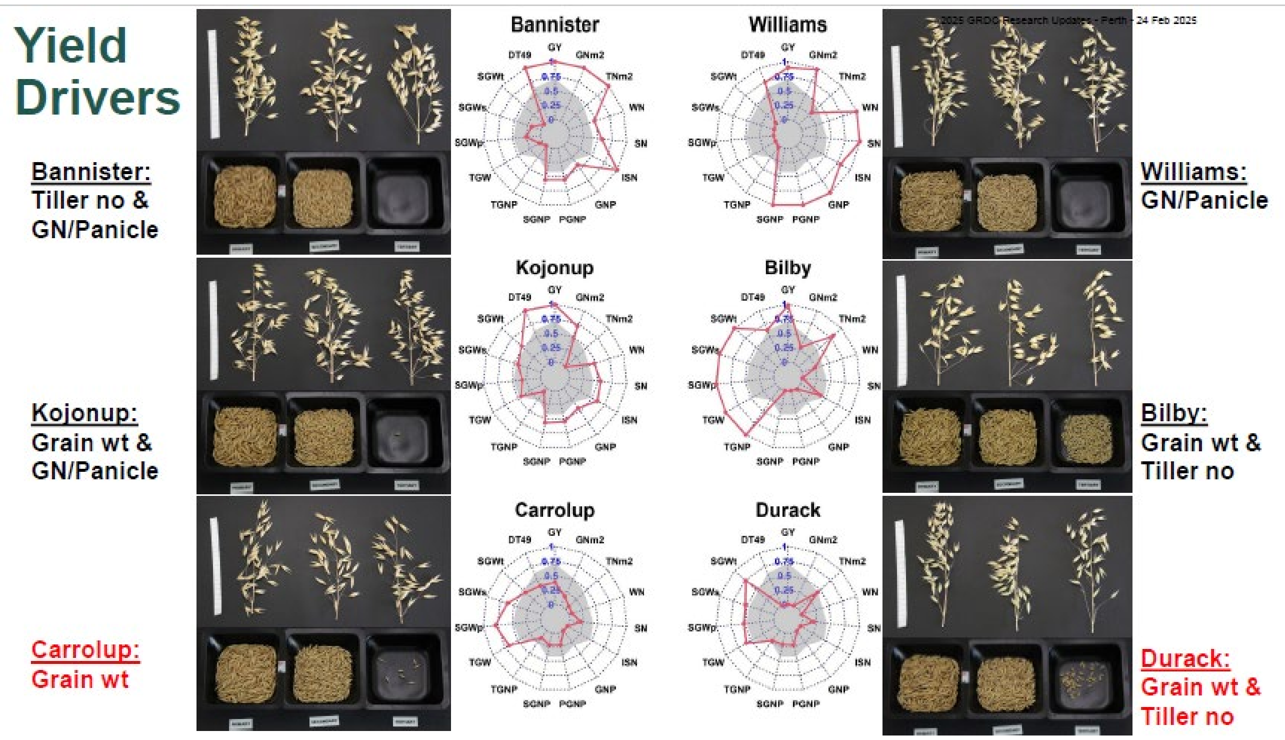

Figure 3: This image shows that in the wet season of 2022 Goldie and Koala grew more tertiary grains compared to the dry season of 2023.

Figures 4 and 5 show how the varieties respond to the environment to achieve yield. You can compare the charts from low and High yielding environments.

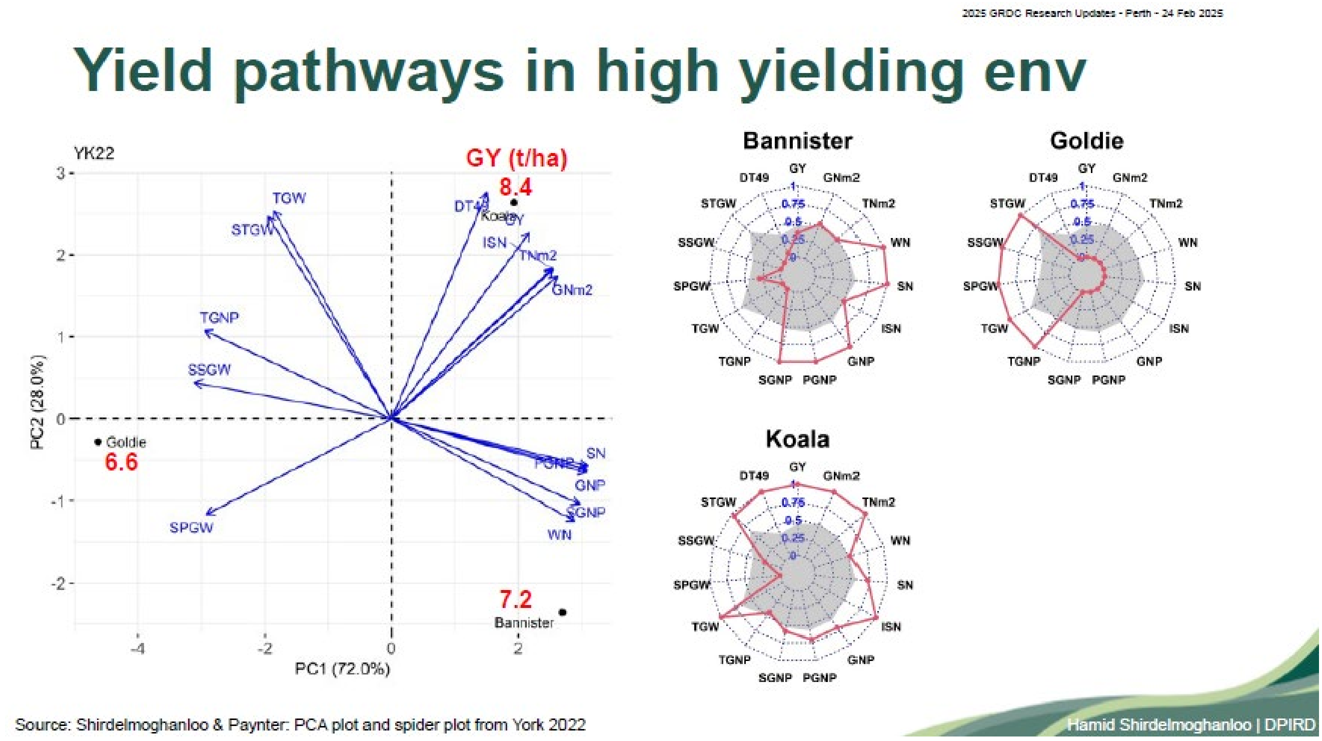

Figure 4: The yield pathways in high yielding environments for Bannister, Goldie and Koala.

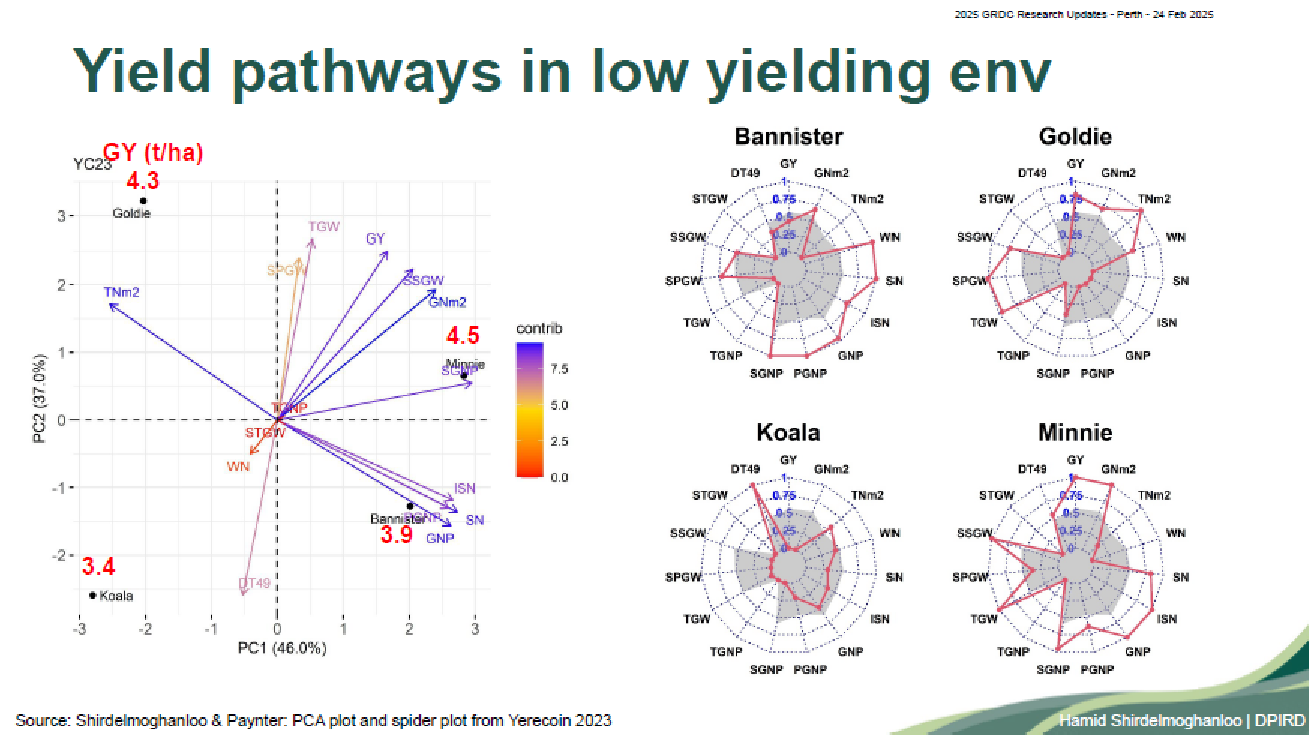

Figure 5: The yield pathways in high yielding environments for Bannister, Goldie, Minnie and Koala

4.2 FINAL REPORT

Department of
Primary Industries and
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Do Goldie, Koala, and Minnie respond differently to nitrogen fertiliser than Bannister?

Blakely Paynter, Department of Primary Industries and Regional Development

Potential nitrogen management strategies

Goldie

While Goldie may show a similar yield responsiveness to fertiliser N as Bannister, there is an increased risk of lodging (leaning) at higher N rates. However, the probability of Goldie meeting GIWA Oat1 receival specifications should be higher than Bannister due to its enhanced grain plumpness (lower screenings) at all levels of N at a similar hectolitre weight risk. Aside from the increased lodging (leaning) risk, the N fertiliser strategy typically used for Bannister looks suitable for Goldie.

Koala

A slightly different N fertiliser approach to high fertiliser N rates may be relevant to Koala. Application of high rates of N to Koala (i.e., above 100 kg N/ha) should be avoided in most situations. Koala is less responsive to N than Bannister, has an increased lodging (leaning) risk with higher N applications, and has a lower hectolitre weight at a similar grain plumpness at all supply levels (in DPIRD trials). Fertiliser N application rates should be similar to those suggested for Bannister, targeting around 50 to 60 kg N/ha in many situations.

Minnie

Minnie has the lowest lodging (leaning) risk of the three new milling oat varieties. Combined with a higher yield potential at all levels of N supply, a marginally higher response to applied N, a lower screenings risk at a slightly higher hectolitre risk (in DPIRD trials), a modest increase in the target N application rate (10 to 20 kg N/ha) over what works for Bannister may be suitable.

Research question

WA growers and the WA milling industry have three new milling oat varieties available for planting in 2025 and procuring at the 2025/26 harvest. All three varieties share 50 per cent of their pedigree from Bannister:

- Goldie = 02095-9/Bannister
- Koala = 02088-70/Bannister
- Minnie = Bannister/07251-9

Can you treat them with the same N strategy as you would Bannister?

DPIRD research activity

Between 2022 and 2024, DPIRD conducted internally funded research to examine the relationship between new oat varieties targeted for a milling end use against rates of fertiliser applied N ranging from 10 to 150 kg N/ha at four sites per annum in the Kwinana Port Zone. Goldie and Koala were evaluated in all three years (2022 to 2024), while Minnie was only evaluated for two years (2023 to 2024). These trials are ongoing in 2025.

What did DPIRD learn?

Goldie, Koala and Minnie do, in fact, show (relative to Bannister):

- differences in their trait values, and
- subtle differences in how they respond to fertiliser applied N.

Department of Primary Industries and Regional Development
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Early vigour (as measured by NDVI at 6 WAS) – Figure 1

- Goldie, Koala and Minnie had lower NDVI scores at 6 WAS than Bannister, which may influence the smothering effect of their canopy on weeds.
- Increasing N increased early biomass.
- Biomass accumulation early in the season for Koala was slightly less responsive to applied N than for Bannister, Goldie, and Minnie.

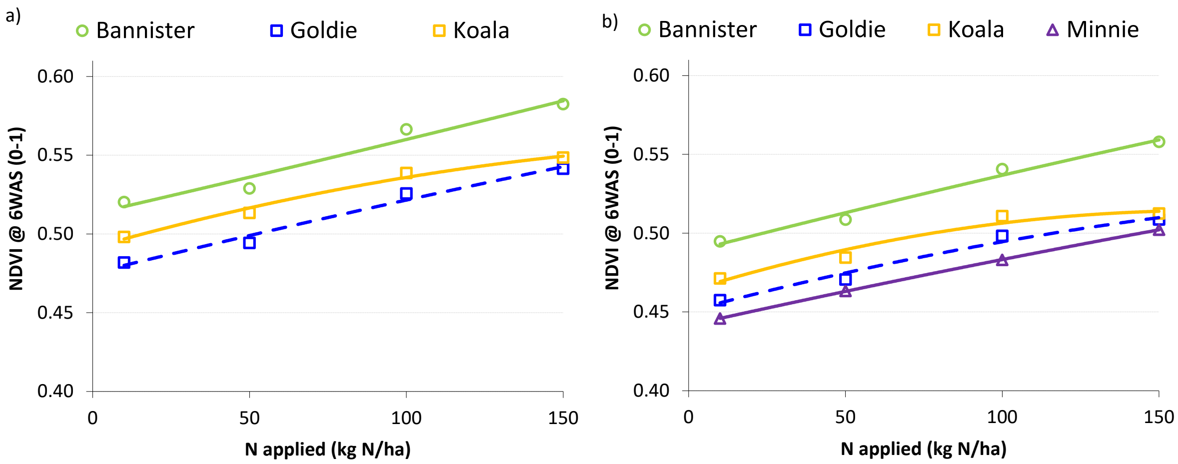

Figure 1: NDVI score at 6 WAS for a) 12 sites (2022-2024), and b) 8 sites (2023-2024).

Straw length at maturity – Figure 2

- Goldie was taller than Koala, which was of a similar height to Bannister. Minnie was the shortest oat.
- Increasing N increased the straw length.
- The change in straw length due to N was similar across the four varieties.

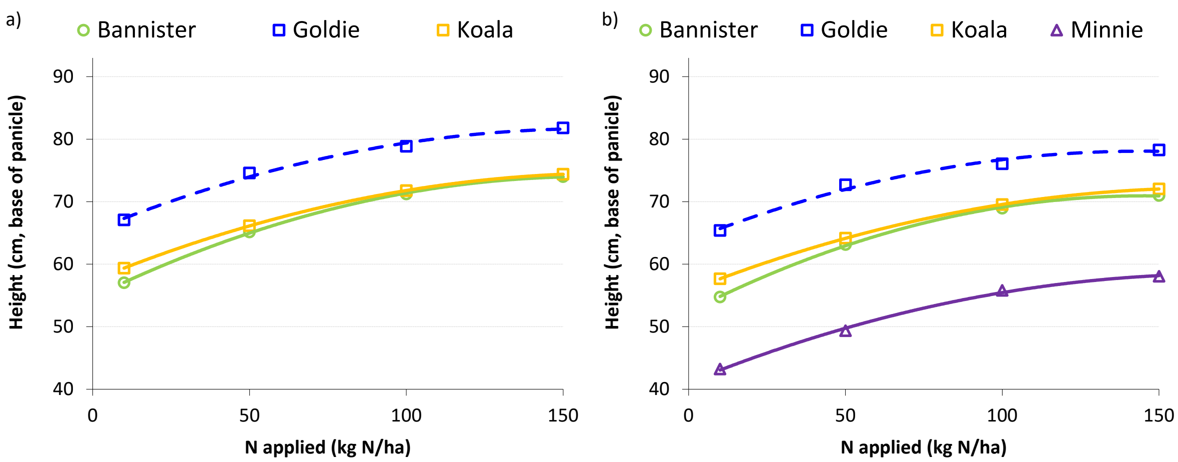

Figure 2: Straw length at maturity for a) 12 sites (2022-2024), and b) 8 sites (2023-2024).

Lodging score close to harvest – Figure 3

- The straw strength of Goldie and Koala was weaker than that of Bannister, resulting in the potential for more crop leaning. Minnie had improved straw strength relative to Bannister.
- Increasing N increased the lodging (leaning) risk.
- The straw strength of Goldie and Koala was more sensitive to increasing fertiliser applied N than Bannister. Minnie was the least sensitive.

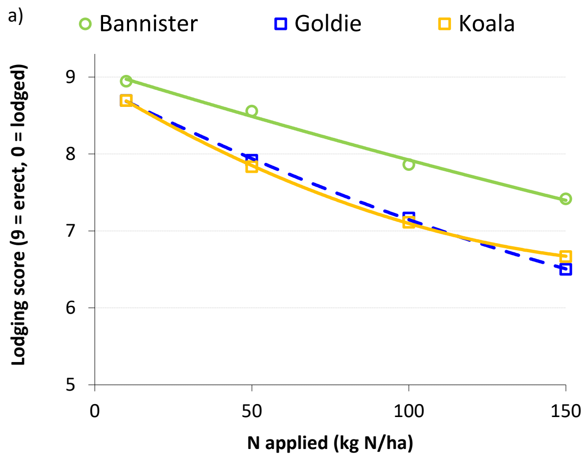

Figure 3: Lodging score near harvest for a) 12 sites (2022-2024), and b) 8 sites (2023-2024).

Grain yield – Figure 4

- Subtle yield differences were noted depending on the level of fertiliser N applied. At low N supply (10 kg N/ha), Koala and Minne had a slight yield advantage over Bannister and Goldie. At a very high N supply (150 kg N/ha), Minnie out-yielded Goldie. Goldie was similar to Bannister but out-yielded Koala. Koala had the lowest grain yield at high N.
- Increasing N increased grain yield before plateauing.
- Koala was less responsive to applied N than Goldie, which was similar to Bannister. Minnie was slightly more responsive. On average, 95% of the maximum yield was achieved with around 50 to 60 kg N/ha. Applying more than 100 kg N/ha did not increase grain yield, while it negatively impacted yield in Koala.

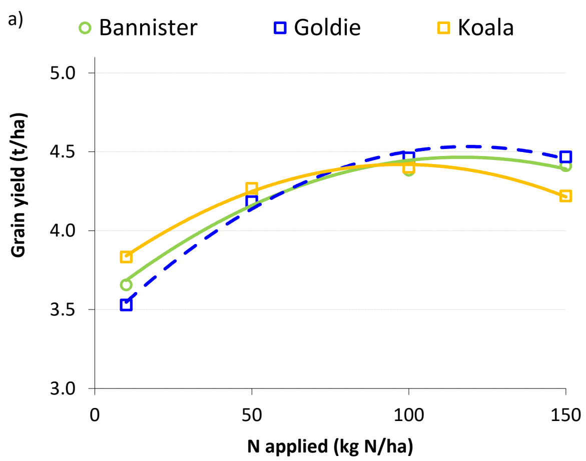

Figure 4: Grain yield for a) 12 sites (2022-2024), and b) 8 sites (2023-2024).

Hectolitre weight – Figure 5

- Koala had a lower hectolitre weight than Goldie, which was similar to Bannister. The hectolitre weight of Minnie was just below Bannister, but higher than Koala.
- Increasing N decreased hectolitre weight.
- The hectolitre weight change due to N was lower in Goldie than in Bannister, Koala, and Minnie.

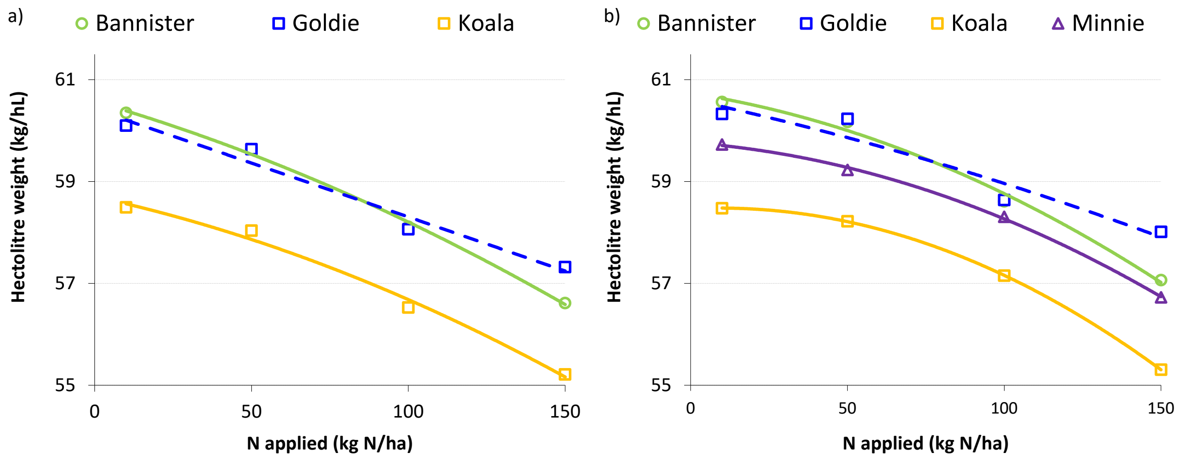

Figure 5: Hectolitre weight for a) 12 sites (2022-2024), and b) 8 sites (2023-2024).

Screenings – Figure 6

- Bannister and Koala had similar plumpness. Goldie and Minnie's plumpness was similar to each other, and an improvement over Bannister's.
- Increasing N increased the number of screenings (reduced plumpness).
- With increasing N, the change in screenings was lower in Goldie and Minnie than for Bannister and Koala. Goldie and Minnie's screening risks were similar to each other, while Koala's was similar to Bannister's.

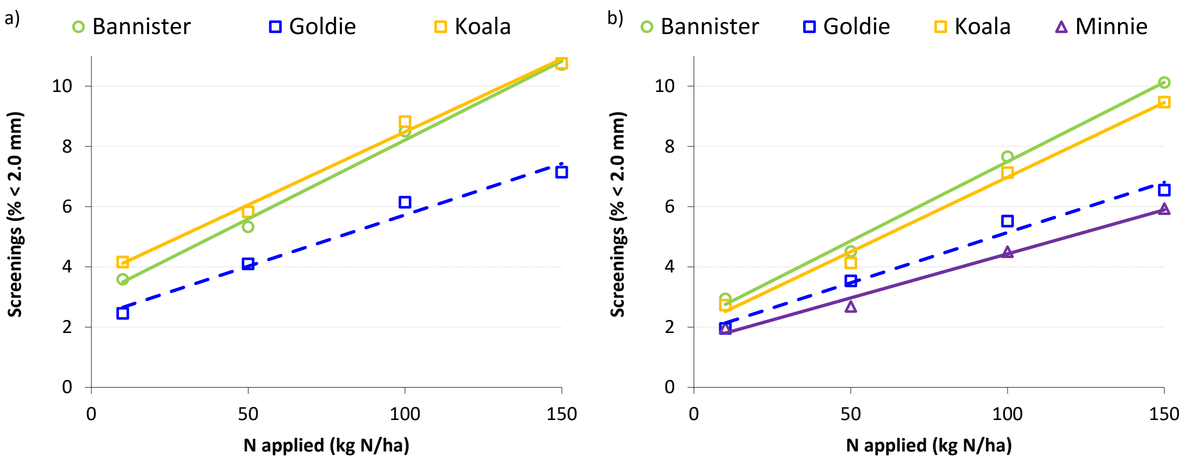

Figure 6: Screenings for a) 12 sites (2022-2024), and b) 8 sites (2023-2024).

Acknowledgement

DPIRD funded this research. Technical support was provided by Kate Beilken, Jenny Flint, and DPIRD's Field Research Units.

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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

5.1 Impact of Crop Competition on Annual Ryegrass

Research Aim

To quantify how changing three agronomic levers - sowing depth, sowing rate and herbicide use, impact oats competition with annual ryegrass.

Methods

The trial was dry sown on 22nd April (germinated 6th May) at two seeding depths (30mm and 80mm), three seeding rates (100, 75 and 50kg/ha) and plus and minus a pre-emergent herbicide. The pre-emergent herbicide brew was 2L/ha Trifluralin + 500mL/ha Dual Gold. 70kg MAP + 30kg SoP was banded with the seed, and 80L/ha of Flexi N was deep banded. The trial has had 85 units of N in total.

Ryegrass was spread at 5kg/ha which achieved a density in the untreated control of 200 plants/m2 to create an even pressure across the trial block and then incorporated into the soil at 5-10mm. The pre-emergent herbicide was then applied to the soil surface and then incorporated by sowing.

Treatment List and Current Results

Seeding Rate (kg/ha)	Depth (mm)	Herbicide	Ryegrass 28DAA (plants/m^2)	Plant emergence (plants/m^2)
50	30	no	176	126
75	30	no	168	159
100	30	no	192	216
50	30	yes	71	140
75	30	yes	92	167
100	30	yes	51	202
50	80	no	216	108
75	80	no	197	148
100	80	no	199	183
50	80	yes	70	107
75	80	yes	64	131
100	80	yes	64	181

Key Messages

- The addition of Trifluralin + Dual Gold provided 65% ryegrass control 28DAA.
- Increasing sowing rate did not influence ryegrass germination.
- Ryegrass panicle counts will determine crop competition.

Further Information

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The impact of oat seeding rate and sowing depth on ryegrass competition

Project Number: PROC-9177043

Further information

Trent Butcher tb@consultag.com.au

Summary

Crop competition by means of increasing seeding rate has significant benefits on the reduction in ryegrass growth under high pressure and potential to increase grain yield. Under high ryegrass pressure this reduction in ryegrass numbers can lead to improved grain quality outcomes. However more broadly, higher seeding densities need to be managed to account for the potential risks of grain quality issues in lower rainfall environments. Crop density as a tool, however, offers an inexpensive opportunity to further reduce grass numbers when used correctly.

Deep seeding into dry soil resulted in lower plant establishment and reduced competition against ryegrass when compared to conventional sowing depth (3cm). Ultimately this led to lower yields. However, there is potential upside in conditions which favour deeper seeding. These being when topsoil is dry and no successful emergence can be achieved from a conventional seeding depth. This potentially gives the crop a chance to get a head start on the weeds, making it more competitive. Deep seeding (8cm) needs to be targeted for net benefits and avoided when those benefits are not present.

Background

Whilst there have been recent additions to the list of registered ryegrass control products in oats, there are still limitations when compared to other cereal crops. Oats are thought to grow a competitive canopy early in the season which should give them better competition against ryegrass. Historical data has shown that higher seeding rates offer a higher degree of competition and reduction in weed numbers. The unique characteristics of oats having a long coleoptile/mesocotyl and frost tolerance allow them to be sown early in autumn onto subsoil moisture and grow rapidly to outcompete weeds. Peak brome and ryegrass germination usually occurs in mid-May. So, an earlier establishment will allow the oat crops to potentially be at the 3-4 leaf stage before these weeds emerge. This head start creates a significant competitive advantage for oats. Leading oat growers utilize this; however, the benefits have never been quantified.

This trial explores the impact of seeding rate and time of sowing on ryegrass competition to quantify the impact on grain yield, quality and grass weed reduction.

Objectives

This investment aims to provide growers with:

- Knowledge of the impact of higher seeding rates on weed competition under two different ryegrass burdens.
- Understanding whether sowing depth can be used as a tool to gain earlier competition against weeds.

Experimental details - Narrogin

Site details

Location	Highbury (OATSPO)
GPS co-ordinates	33.0844318, 117.2678679
Soil description	Sandy loam into granite loam
Soil pH	
Crop type	Oats cv Goldie
Previous crop type/year	Triazine tolerant Canola

Experimental design

Trial design type	Factorial
Replicates	4
Plot size (width x length)	1.7m x 12m

Target(s) description

Common name	**Scientific name**
Annual Ryegrass	Lolium Rigidum cv Safeguard

Product details

Product name(s)	Active ingredient(s) (ai)	Active concentration (g ai/kg or L)	Formulation type
Trifluralin	Trifluralin	480g/L	EC (Emulsifiable Concentrate)
Dual Gold	S-Metolachlor	960g/L	EC (Emulsifiable Concentrate)

Treatment list

Treatment	Seeding Rate (kg/ha)	Depth (mm)	Herbicide
1	100	30	Yes
2	75	30	Yes
3	50	30	Yes
4	50	30	Yes
5	75	30	No
6	50	30	No
7	100	80	Yes
8	75	80	Yes
9	50	80	Yes
10	100	80	No
11	75	80	No
12	50	80	No

Application details

The trial was dry sown on April 22nd (germination occurred on May 6th) with two seeding depths (30mm and 80mm) and three seeding rates (100, 75, and 50 kg/ha), along with treatments with and without a pre-emergent herbicide. The herbicide mixture consisted of 2 L/ha Trifluralin and 500 mL/ha Dual Gold. Fertilizer was applied with the seed in the form of 70 kg/ha MAP and 30 kg/ha SoP, while 80 L/ha of Flexi N was deep banded. In total, the trial received 85 units of nitrogen.

Safeguard ryegrass was spread at a rate of 5 kg/ha, achieving a density of approximately 200 plants/m² in the untreated control to ensure consistent ryegrass pressure across the trial block. The ryegrass was then incorporated into the soil at a depth of 5-10 mm. Following this, the pre-emergent herbicide was applied to the soil surface and incorporated during sowing.

Assessment details

	Assessments	Timing	Date Completed
1	Plant establishment counts	28 days after emergence	6th June
2	Ryegrass counts. 5 counts per plot	28 Days after emergence, Panicle counts	6th June
3	Tiller counts	stem elongation	1st August
4	Ryegrass Biomass	Pre-Harvest	30th October
5	Yield	Harvest	19th November
6	Grain Quality	Post-Harvest	December

Results and Discussion

Climate Data

The conditions prior to the seeding of the trial were extremely dry with very little rainfall recorded. As a result, the crop was dry seeded but received a very gentle starting rain of 28mm which allowed for an even germination across the entire OATSPO site. There was steady rain through most of the growing season though totals fell well short of the long-term average. Spring conditions offered some rain in early September, but only small amounts were recorded in early October.

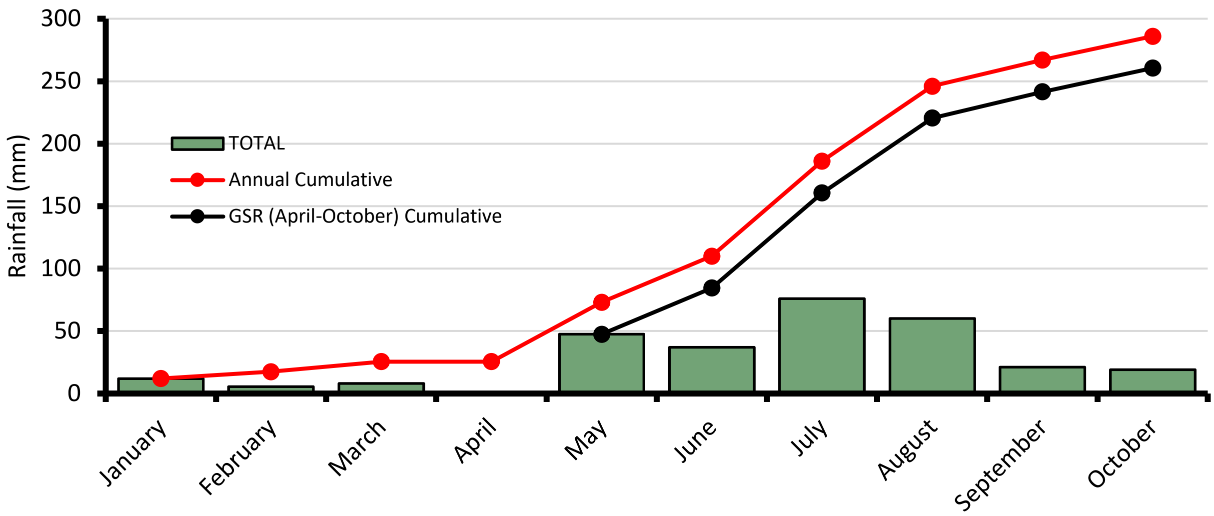

Figure 1: Cumulative and monthly 2024 rainfall in Highbury.

Oat Establishment Counts

As expected, there was a continuing greater number of plants as sowing rates increased. The application of herbicide had no impact on plant number indicating that safe seeding practice was implemented. Deep sowing into dry soil however, resulted in a lower number (149 plants per square meter) of plants than shallow sowing (165 plants per square metre).

28DA-E Ryegrass Control

There was a significant reduction in early season ryegrass counts when looking at herbicide as a major treatment effect. The plots with herbicide averaged 70 plants per square metre whereas those with no treatment averaged 191 plants per square metre. At this time there was no significant interaction between sowing rate or depth on total ryegrass plants.

The influence of herbicide at this timing is likely to be the only observable treatment difference. No other treatment is likely to reduce the amount of ryegrass plants that has potential to emerge at this stage. This inference was supported by the results.

Table 1: Difference in ryegrass populations per square metre 28 days after emergence (letter denote significant differences)

Treatment	Herbicide	Depth	Seeding rate	Ryegrass plants per square metre	
1	No	Deep	100	198	ab
2	No	Deep	50	215.55	a
3	No	Deep	75	196.73	ab
4	Yes	Deep	100	62.28	c
5	Yes	Deep	50	74.97	c
6	Yes	Deep	75	61.63	c
7	No	Shallow	100	196.31	ab
8	No	Shallow	50	175.25	ab
9	No	Shallow	75	166.18	b
10	Yes	Shallow	100	56.75	c
11	Yes	Shallow	50	77.07	c
12	Yes	Shallow	75	87.75	c

Tiller Counts

Higher seeding rates resulted in higher tiller numbers as did shallow sowing over deeper sowing. This data closely reflects the establishment data. Greater number of tillers should contribute to greater competition.

Table 2: Factorial analysis of major treatment effects on oat tiller numbers per square metre (letter denote significant differences)

Tiller number (plant per square metre)	
100kg	380a
75kg	343b
50kg	301c
P value	<0.01
LSD	2.88
CV	19.07

Tiller number (plant per square metre)	
Shallow	355a
Deep	328b
P value	<0.01
LSD	2.88
CV	19.07

Ryegrass Biomass

As indicated in the early ryegrass control counts, there was no difference between seeding rates and depth on early ryegrass numbers but there was from herbicide. Differences from these late season measurements taken just prior to harvest will give a strong indication of the impacts of their competitive impact.

The untreated plots had significantly higher ryegrass biomass (1.89t/ha) than those treated with herbicide (1.05t/ha). Seeding deeper (8cm) resulted in a greater pressure of ryegrass (1.71t/ha) than seeding at a conventional (3cm) depth (1.23t/ha). As both depths of sowing emerged on the same rainfall event, the difference in competition is likely a result of both delayed emergence and a reduction in vigour during the early growth stages for the deeper sown treatment. Initial ryegrass counts showed no difference in ryegrass burdens at crop establishment. Ryegrass density did not significantly differ between the 50kg rate (1.74t/ha) and 75kg/ha (1.58t/ha) seeding rates, however, there was a significant reduction in ryegrass biomass at the 100kg seeding rate (1.09t/ha). The trend toward lower ryegrass biomass was clear across the seeding rates, despite no significant differences between 50kg and 75kg seeding rates.

Table 3: Interactions between seeding rate and depth on weed control (letter denote significant differences at P <0.05)

Treatment	Herbicide	Depth	Seeding rate	Ryegrass biomass (g/m)	
1	No	Deep	100	201.38	ab
2	No	Deep	50	223.18	a
3	No	Deep	75	242.6	a
4	Yes	Deep	100	72.62	e
5	Yes	Deep	50	170.88	abcd
6	Yes	Deep	75	120.63	bcde
7	No	Shallow	100	112.37	cde
8	No	Shallow	50	188.59	abc
9	No	Shallow	75	167.36	abcd
10	Yes	Shallow	100	51.03	e
11	Yes	Shallow	50	115.82	cde
12	Yes	Shallow	75	103.7	de

Grain Yield

The reduction in ryegrass numbers had an impact on the crop yield. The reduction in ryegrass numbers and biomass from the application of herbicide resulted in a significant yield increase of 210kg/ha. The biggest impact on yield came from depth of sowing. The shallow seeded crop on average yielded 270kg/ha more than the deep seeded. Delayed emergence and lower vigour from seeding at 80mm may have caused this difference. Deep-seeded, no-herbicide plots performed worst for ryegrass biomass reduction, but improved with treatments containing herbicides and higher sowing rates. The deeper, no herbicide plots were the worst yielding plots of the trial. Grain yields were significantly higher at the 75kg (4.79t) and the 100kg (4.84t) seeding rates compared to the 50kg (4.66t) seeding rate. As stated previously, seeding very deep (8cm) when dry sowing is a disadvantage. It becomes a viable practice when early establishment can be achieved on subsoil moisture.

Table 4: Grain yield by treatment (letter denote significant differences P<0.05)

Treatment	Herbicide	Depth	Seeding rate	Grain Yield (t/ha)	
1	No	Deep	100	4.58	ef
2	No	Deep	50	4.35	g
3	No	Deep	75	4.5	fg
4	Yes	Deep	100	5	ab
5	Yes	Deep	50	4.7	de
6	Yes	Deep	75	4.69	de
7	No	Shallow	100	4.82	cd
8	No	Shallow	50	4.75	de
9	No	Shallow	75	4.94	abc
10	Yes	Shallow	100	4.98	abc
11	Yes	Shallow	50	4.85	bcd
12	Yes	Shallow	75	5.04	a

There was no significant difference with higher seeding rates on hectolitre weights and screenings. If this difference was significant, it would be inferred that the reduced ryegrass burden providing better conditions for grain fill. Under weed-free conditions in dryer environments, this trend may likely be opposite which should be considered.

Table 5: Factorial analysis of major treatment effects on hectolitre weight and screenings (letter denote significant differences)

Seeding Rate	Hectolitre Weight (kg/hL)	Screenings (%)
50kg	53.6a	2.9a
75kg	53.8a	2.2a
100kg	54.5a	1.9a
P value	0.079	0.058
LSD	0.86	0.82
CV	2.22	49.16

Adding herbicide, increasing seeding rate, and shallower seeding depth likely improve grass control and grain yield. This interaction was not significantly different from others in the analysis.

Conclusion

Herbicides were highly effective on the safeguard ryegrass which resulted in a clear distinction in ryegrass burden between those plots which had been sprayed and those which hadn't. The higher ryegrass pressure whilst influencing all treatments appeared to have a much greater impact on the deeper sown plants. The reduction in establishment from the deep sown plots is an indication of the reduced vigour which would have occurred due to the additional energy requirement from emerging from a depth of 8cm. This reduction in early vigour is likely to have compromised its competitiveness when compared to the oats sown at a conventional depth. Maximum ryegrass competition (and grain yield) was achieved by increasing seeding rates. This is an inexpensive tool for growers to access; however, care must be taken on the implications of high seeding rates on grain quality parameters. In dryer environments high seeding rates run the risk of lower hectolitre weights and increased screenings.

Recommendations

- Higher seeding rates are better able to compete against ryegrass. However, higher seeding rates in low rainfall environments run the risk of lower hectolitre weights and higher screenings. Therefore, the decision to seed heavier should be balanced on the risk of ryegrass competition and grain quality. In higher rainfall environments there it is a more compelling argument to keep seeding rates higher due to the lower grain quality risk from terminal drought.
- If there is no advantage from deeper sowing in terms of establishing a crop before the grass then there are potential downside risks. The loss of vigour and later emergence hindered these plants' ability to compete with the ryegrass when compared to more conventional depths. If the deeper seeded oats were able to hit moisture and emerge before the conventionally seeded plants, then there may have been an upside. It is theorised that the early emerged oats will have additional biomass before the ryegrass emerges giving them a substantial competitive advantage. In this trial without that advantage, the result was negative. The opportunity for this earlier establishment needs further exploration.

5.2 Nitrogen Placement

Research Aim

Determine if nitrogen placement has an impact on crop competition with ryegrass. The trial will compare nitrogen applied deep banding, spreading pre-seeding and spreading post seeding.

Methods

The trial was sown on 22nd April (germinated 6th May) into dry soil at 30mm depth. To ensure that there was a significant ryegrass density, no pre-emergent herbicide was used. 70kg/ha MAP + 30kg/ha SoP was banded with the seed.

The paddock has a very low background burden of ryegrass. As a result, to achieve improved uniformity, safeguard ryegrass was spread at 5kg/ha to create an even pressure across the trial block and then incorporated into the soil at 5-10mm depth before seeding. This action achieved an average ryegrass density of 200 plants/m^2.

Treatment 1 - UAN was streamed pre seeding and then incorporated by sowing.

Treatment 2 - UAN deep banded below the seed.

Treatment 3 - UAN streamed at the 3-leaf crop stage.

Treatment 4 - Nil, received 7.7 units with the compound fertiliser.

Treatment List

	Treatment	Product rate /ha	Flexi N applied at Z25 (L/ha)	Total N (kg/ha)
1	1/3N IBS	70L UAN	140	95
2	1/3N at Seeding	70L UAN	140	95
3	1/3 N Post-emergent	70L UAN	140	95
4	Nil N			7.7

Further information

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5.2 FINAL REPORT

Effects of nitrogen placement on oat competitiveness against annual ryegrass

Project Number: PROC-9177043

Further information

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Summary

This trial investigated the influence of nitrogen timing and placement on the competitive ability of oats on annual ryegrass (*Lolium rigidum).* The ryegrass competitiveness of oats was evaluated when the crop was supplied with 1/3 of the nitrogen prior to seeding, banded in furrow or at 3 leaf stage as well as a nil nitrogen treatment that only received 7kg of Nitrogen in the starter fertiliser. All plots (excluding the nil treatment) were topped up to 90kg of N at Z30.

This site had a significant yield response to applied nitrogen. The nil N plot that received only 7kg of nitrogen with the starter fertiliser had lower yield (3.26t/Ha) than the plots that received 95kg of nitrogen (4.18-4.5t/ha). The plots that received 90 units of N all had the same yield regardless of whether the first third of N was banded at seeding, applied pre seeding or delayed until the crop reached 3 leaf stage (see figure 1).

All other measurements including ryegrass biomass and crop biomass were found to be unresponsive. We feel that site variability and high nitrogen supply may have contributed to the lack response.

Background

Annual ryegrass is the most abundant grass weed in Western Australian cropping systems. Oats face challenges in herbicide use due to increased susceptibility to herbicide damage and limited pre-emergent options, reducing the use of available weed control products. The smaller market for oats, in comparison to wheat and barley has constrained herbicide product development and registration in oats.

Non-chemical, and cultural grass weed management strategies are more important for oats due to the lack of effective grass herbicide options. While oats are renowned for being the most competitive cereal with a long coleoptile, big root system and high accumulation of biomass there is very little local data to support this claim.

The incorporation of Integrated Weed Management (IWM) strategies will be essential for a crop with limited herbicide options, presenting opportunities to validate methods for suppressing and controlling problematic grass weeds such as annual ryegrass. This trial, part of the Grass Weeds Project, investigates a non-chemical strategy to reduce the competitiveness of ryegrass in oats through targeted nitrogen placement.

Growers who band nitrogen in the furrow at seeding observe improved early growth. In this trial we wish to evaluate if banding or supplying up front nitrogen to oat crops will improve the competitive ability of the crop with annual ryegrass. Furthermore, concentrating nitrogen in the furrows where the oats are growing may limit nutrient availability to the ryegrass, thereby enhancing the competitive advantage of the oats.

A study by Blackshaw et al. (2018) in Canada found that side-banded phosphorus significantly increased oat shoot biomass and improved competitiveness against wild oat across multiple environments. Oat biomass increased by up to 49% with phosphorus application in some site-years, demonstrating the benefit of early nutrient availability on crop vigour. This enhanced early growth was associated with reduced wild oat biomass, supporting the idea that improving early crop access to key nutrients can shift the competitive dynamics in favour of the crop.

However, Blackshaw et al. also commented that the magnitude of response in oats was generally smaller than previously reported in wheat and barley. They noted that “the impact of P fertilizer on early-season shoot biomass and weed suppression was not as pronounced in oat as in other cereal crops such as wheat and barley,” suggesting that oats may depend less on precise nutrient placement due to their naturally vigorous early growth. Still, the modest yet consistent improvement reinforces the broader principle that strategic nutrient placement even in competitive crops like oats can enhance early vigour and weed suppression.

Objectives

The primary objective of this trial is to evaluate the impact of nitrogen placement on crop competition with annual ryegrass. The trial will compare three application methods for the initial third of the crops nitrogen requirements: Banded in furrow, surface spreading before seeding, and surface spreading after seeding.

Experimental details

Site details

Location	Highbury (OATSPO)
GPS co-ordinates	33.0844318, 117.2678679
Soil description	Sandy loam into granite loam
Soil pH	5.6
Crop type	Oats - Goldie
Previous crop type/year	Triazine tolerant canola

Experimental design

Trial design type	RCB
Replicates	4
Plot size (width x length)	1.7m x 12m

Target(s) description

Common name	**Scientific name**
Annual Rye grass	*Lolium rigidum*

Treatment list

	Treatment	Product Rate / ha	Flexi N applied at Z25 (L/ha)	Total N (kg/ha)
1	1/3 N Immediately before sowing (IBS)	70L UAN	140	95
2	1/3 N banded at seeding	70L UAN	140	95
3	1/3 N Post-emergent	70L UAN	140	95
4	Nil N	NIL	NIL	NIL

Application details

The trial was sown on 22nd April (germinated 6th May) into dry soil at 30mm depth. To ensure that there was a significant ryegrass density, no pre-emergent herbicide was used. 70kg/ha MAP + 30kg/ha SoP was banded with the seed (supplying 7.7N, 16P and 15K at seeding).

The site had a low background level of ryegrass. As a result, to achieve improved uniformity, safeguard ryegrass was spread at 5kg/ha to create an even pressure across the trial block and then incorporated into the soil at 5-10mm depth before seeding. This action achieved an average ryegrass density of 200 plants/m2. No ryegrass herbicides were applied at seeding.

Treatment 1 - UAN was streamed pre seeding and then incorporated by sowing (N thrown to interrow).
Treatment 2 - UAN banded below the seed in furrow.
Treatment 3 - UAN streamed at the 3-leaf crop stage (delayed Starter N).
Treatment 4 - Nil, received 7.7 units with the compound fertiliser.

Assessment details

	Assessments	Timing	Date Completed
1	Ryegrass counts	2 leaf of ryegrass	6/6/24
2	Crop tiller count	28 Days after emergence, Panicle counts	1/9/24
3	Ryegrass biomass	Senescence	11/11/24
4	Crop Biomass	Senescence	14/11/24
5	Crop Yield	Harvest	19/11
6	Grain Quality	Post harvest	December

Results and Discussion

Growers who band nitrogen in furrow at seeding observe improved early growth. In this trial we endeavoured to evaluate if banding or supplying up front nitrogen to oat crops improve the competitive ability of the crop with annual ryegrass. Furthermore, concentrating nitrogen in the furrows where the oats are growing may limit nutrient availability to the ryegrass, thereby enhancing the competitive advantage of the oats.

Banding nitrogen at seeding is a common but not fully adopted practice amongst oat growers. The banded nitrogen at seeding aids logistics and improves the efficiency of the nitrogen (approx. 20% Pers Com CSBP). If we were able to demonstrate that there was also improved weed control from this practice it would be a good incentive for adoption.

Oat Establishment

The nitrogen treatments that supplied early nitrogen to oats either banded in furrow (T2) or sprayed prior to seeding (T1) produced significantly more tillers (326/m^2) than the plots that either received later nitrogen or Nil (290/m^2). This additional growth will improve the oats competitive ability with ryegrass.

Table 1: ANOVA Analysis of oat tiller number (letter denote significant differences P <0.05)

Treatment		Oat tillers (m2)	
T1. 1/3N IBS		335	a
T2. 1/3N at Banded at seeding		318	ab
T3. 1/3N Early post-emergent		281	c
T4. Nil N		300	bc
P Value	<0.01		
LSD	3.6		
CV	13.0		

Ryegrass and Oat Biomass

This trial site had significant variability between plots, with the first replicate having historical header trail running through the plots which influenced crop and ryegrass biomass. As a result of this variability there was no significant responses to ryegrass biomass or crop biomass (P>0.05) throughout the trial (table 2)

We did observe visual responses to treatments in some reps as shown in the below photo series from Rep 4 with less ryegrass and better oat growth in plots that were supplied with nitrogen at seeding. The plots with no additional N or N applied post emergent can be seen to contain more ryegrass.

Table 2: Wald Analysis of ryegrass and crop biomass (letter denote significant differences P <0.05)

Treatment	Ryegrass Biomass (g/m^2)		Crop Biomass (t/ha)	
T1. 1/3N IBS	182.25	a	10.92	a
T2. 1/3N at Banded at seeding	186.02	a	11.88	a
T3. 1/3N Early post-emergent	249.48	a	10.64	a
T4. Nil N	190.98	a	9.54	a

Oat Grain Yield

This site had a significant yield response to applied nitrogen. The nil N plot that received only 7.7kg of N with the starter fertiliser had significantly lower yield (3.26t/Ha) than the plots that received 90kg of nitrogen (4.18-4.5t/ha). The plots that received 95 units of N all had the same yield regardless of whether the first third of N was banded at seeding, applied pre seeding or delayed until the crop reached 3 leaf stage (see figure 1).

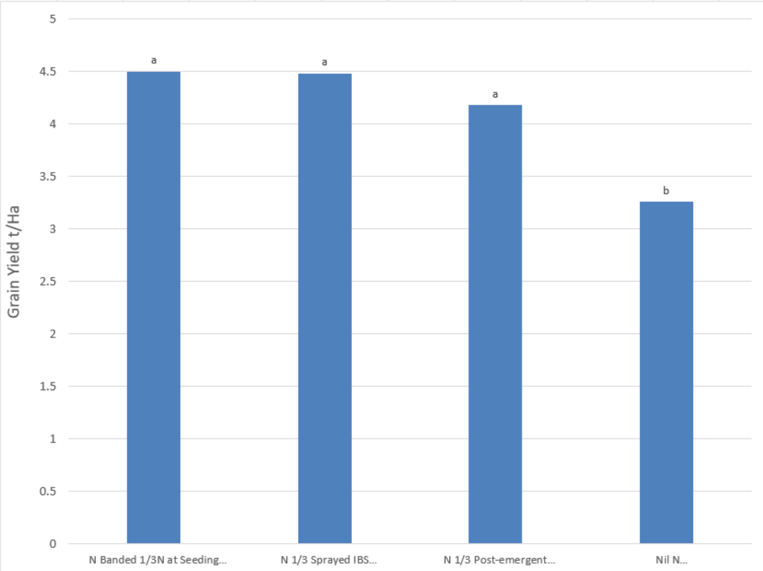


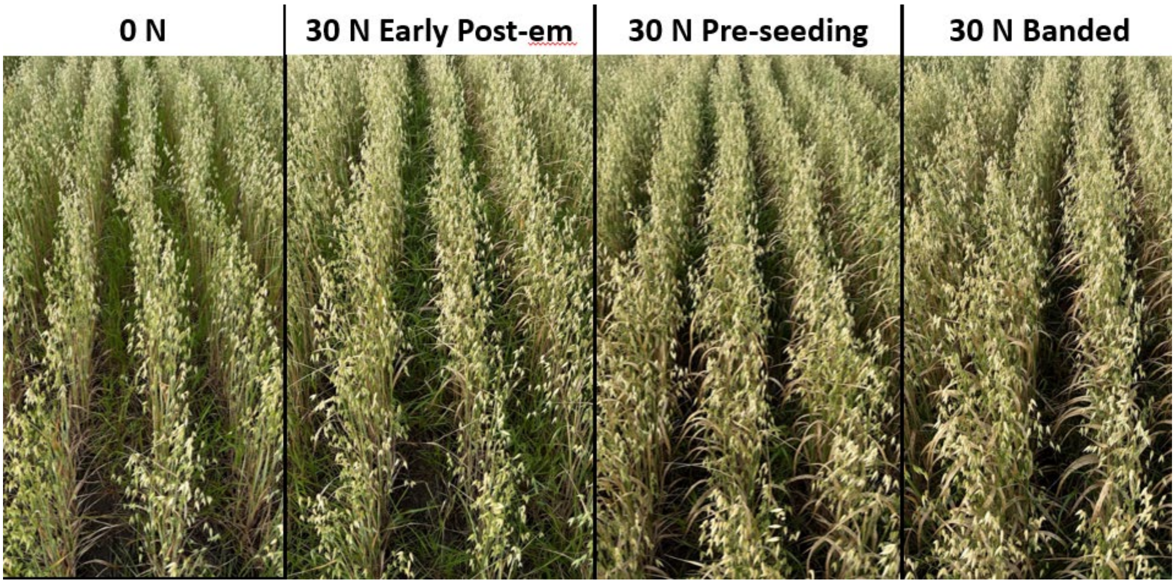
Figure 1: Oat grain yield response to nitrogen treatment (letter denote significant differences P <0.05)

Grain Quality

It is not surprising that the treatments that received nitrogen (95kg/ha) achieved significantly higher grain protein than the treatment that only received 7kg of nitrogen (Table 3). Grain protein did not change in response to the different nitrogen timings.

Table 3: ANOVA Analysis of grain quality (hectolitre weight, screenings and protein) (letter denote significant differences P <0.05)

Treatment	Hectolitre		Screenings		Protein	
T1. 1/3N IBS	53.1	a	3.56	a	9.1	a
T2. 1/3N at Banded at seeding	53.3	a	2.95	a	8.9	a
T3. 1/3N Early post-emergent	54.2	a	2.56	a	8.3	a
T4. Nil N	54.1	a	2.48	a	7.1	b
P Value	0.26		0.28		<0.01	
LSD	1.40		1.26		0.89	
CV	1.69		28.25		6.93	



We feel that there was adequate visual evidence to justify repeating this trial at a site that will hopefully contain less variability.

When this trial is repeated, we will use a lower target rate of nitrogen (eg 80kg N, rather than 95kg) to tease out differences in nitrogen efficiency. Other trials at the site showed that 80kg N was adequate to achieve Maximum yield. The luxurious supply of nitrogen combined with site variability may have contributed to the lack of significant results.

Conclusion

Visually it appeared as though supplying oats with early nitrogen (either applied IBS or banded in furrow) grew a better oat crop that was more competitive with ryegrass. However, due to site variability the data did not support this observation.

We feel that this work should be refined as the potential gains for growers and the oat industry are large, with minimal cost to the grower.

Recommendations

- Banded nitrogen at seeding is known to improve nitrogen efficiency by up to 20%. Where practical growers should adopt this practice for logistics and nitrogen use efficiency and they may gain increased crop competition with ryegrass.
- When this trial is repeated, we will use a lower target rate of nitrogen (eg 80kg N, rather than 95kg) to tease out differences in nitrogen efficiency. Other trials at the site showed that 80kg N was adequate to achieve Maximum yield.

6.1 Fungicide Product Comparison

Research Aim

Compare a range of registered fungicide options in oats for control of *Septoria avenae*.

Methods

The trial was dry sown as per farmer nutrition (see intro) on 15th April (germinated 6th May). 80L/ha of Flexi N was applied at early stem elongation to top up N as the compost nitrogen was slow to mineralise. Oat straw was evenly spread across the trial on 19th June to encourage the spread of Septoria. The fungicide treatments were applied at Z39 on 8th August.

Treatment List

Trt	Product	Rate mL/ha
1	Untreated Control	-
2	Tilt 250	500
3	Proviso	150
4	Amistar Xtra	400
5	Elatus Ace	500
6	TopNotch	400
7	Maxentis	400
8	Radial	420
9	Opera	500
10	Revystar	750
11	Cubo	300
12	Cubo + Maxentis	300 + 400

Further information

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6.1 FINAL REPORT

Managing Septoria Avenae with Fungicide applications at Flag Leaf Emergence

Trent Butcher and Gray Yates, ConsultAg Narrogin

Key messages

- Disease pressure was relatively low which made it difficult to differentiate between products
- A lack of finishing rain resulted in no difference in grain yield or quality effects from treatments

Background

This trial aims to evaluate the relative performance of different fungicide products on their efficacy on septoria avenae and the subsequent impact on grain yield and quality. Previous research has shown that the greatest impact on both yield and quality can be achieved by applications at full flag leaf emergence. The top leaves in the oat canopy are the greatest contributors to final yield and subsequently their protection with favourable spring conditions is likely to show the greatest differences in grain yield. Previous trials have indicated that using the longer residual products at earlier application timings can also have similar yield impacts. However, for the best comparison and a reflection of district practice this timing was selected.

Aims

- Determine which fungicide product delivers the greatest control of Septoria Avenae in oats
- Determine which fungicide products give the greatest grain yield and quality improvements.

Method

The trial was dry sown using farmer scale machinery, which was a Bourgault air hoe drill bar on 10-inch spacings with a split boot. The paddock was seeded on the 15th of April to Goldie oats at 90kg/ha at a depth of 30mm. Nutrition came from 2t/ha of lime + 2t/ha of Compost (HR80) which was incorporated. Additionally at seeding 65kg/ha MAP + 50L of compost extract was applied at seeding giving a total of 103kg/ha N, 20kg/ha P and 15kg/ha K. The organic form of nitrogen meant it was not readily available so additional 80L UAN was applied to the crop at early stem elongation to encourage vegetative growth. The germination event occurred on the 2nd of May with 28mm of rain recorded. Weeds were managed as per the grower's standard herbicide package (fungicides excluded). As the paddock was canola in the 2023 season, oat straw was spread evenly across the site on the 19th of June to encourage the spread of Septoria. Fungicide applications were applied at Z39 on the 8th of August to a dry canopy between 3:00-3:45pm with the products outlined in the table below. Unfortunately, the Radial Opti was applied at the Radial rate which is much higher.

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Table 1: Trial treatments and rates used

Tr #	Product	Active Ingredient	Product rate /ha
1	UTC		
2	Tilt 250	250g/L Propiconazole	500
3	Proviso	250g/L Prothioconazole	150
4	Amistar Xtra	80g/L Cyproconazole + 200g/L Azoxystrobin	400
5	Elatus Ace	250g/L Propiconazole + 40g/L Benzovindiflupyr	500
6	TopNotch	200g/L Propiconazole + 200g/L Azoxystrobin	400
7	Maxentis	100g/L Prothioconazole + 133g/L Azoxystrobin	400
8	Radial Opti	250g/L Epoxiconazole + 320g/L Azoxystrobin	420
9	Opera	62.5g/L Epoxiconazole + 85g/L Pyraclostrobin	500
10	Revystar	100g/L Mefentrifluconazole + 50g/L Fluxapyroxad	750
11	Cubo	4% Copper 3% Phosphorus 3.06 % Nitrogen 2.25% Boron 1.25% Sulphur	300
12	Cubo + Maxentis	As Above	300 + 400

Results

Seasonal Conditions

The conditions prior to the seeding of the trial were extremely dry with very little rainfall recorded. As a result, the crop was dry seeded but received a very gentle starting rain of 28mm which allowed for an even germination across the entire OATSPO site. There was steady rain through most of the growing season though totals fell well short of the long-term average. Spring conditions offered some rain in early September but only small amounts were recorded in early October. The lack of favourable spring conditions are likely to have impacted on the grain filling ability of the oats in this trial. The soil type was slightly heavier where this trial was with a greater granite content which was hoped to increase the biomass of the crop. However, the hard season is likely to have had the opposite effect.

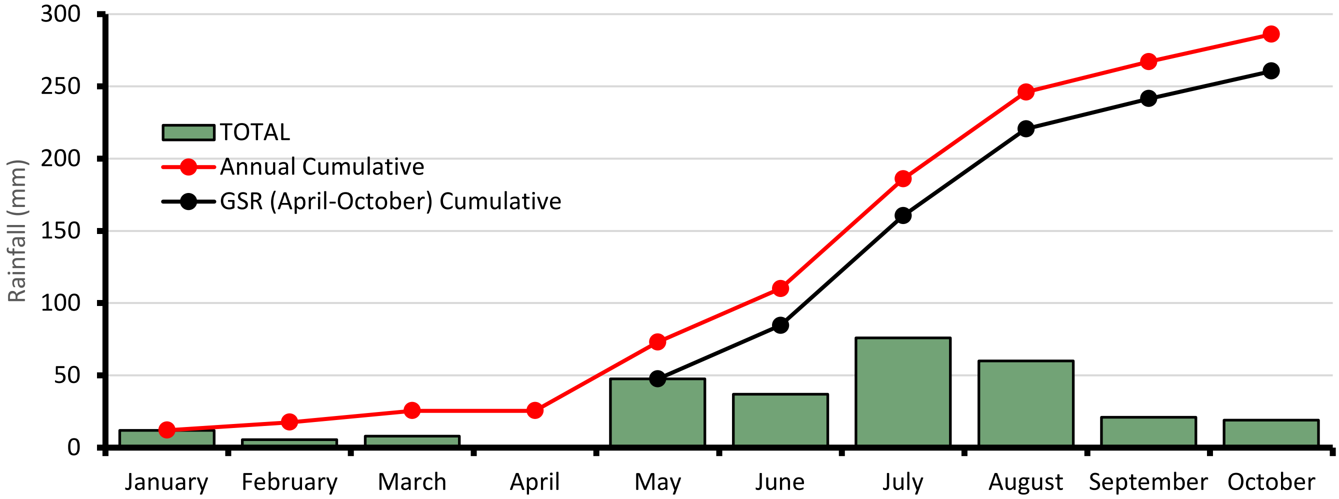

Figure 1: Cumulative 2024 rainfall in Highbury.

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Disease Control

Leaf disease measurements (25 days after application) indicated that there was variable improvement compared to the untreated control on flag -3. Flag -2 showed favourable responses over the untreated control of most fungicides except Proviso, Opera and Cubo. On flag-1 all fungicide treatments gave significantly better control than the untreated. Elatus ace and Revystar gave an edge which at times was better than other fungicide treatments. This carried over to the flag leaf where they gave the highest level of control, High levels were also achieved by Opera, Maxentis (as well as Maxentis + Cubo), Proviso, TopNotch which were significantly better than the untreated control. Control of septoria from Tilt, Cubo and Amistar Xtra were no better than the untreated control.

Table 2: Leaf disease rating for Septoria avenae infection (%) recorded 25DA-A

		Flag		Flag-1		Flag-2		Flag-3	
1	UTC	1.9	a	4.2	a	7.1	a	25.5	a
2	Tilt 250	1.3	ab	1.3	cd	2.8	cd	10.5	b
3	Proviso	0.9	bc	1.3	cd	5.7	ab	24.5	a
4	Amistar Xtra	1.8	a	1.6	bcd	3.6	bcd	10.5	b
5	Elatus Ace	0.4	cd	0.9	d	2.3	d	12.1	b
6	TopNotch	0.7	bcd	2.4	bc	3.8	bcd	20.1	ab
7	Maxentis	0.4	cd	1.7	bcd	3.9	bcd	17.1	ab
8	Radial Opti	1.0	bc	1.3	cd	3.8	bcd	16.7	ab
9	Opera	0.5	cd	1.5	bcd	4.8	abcd	18.9	ab
10	Revystar	0.1	d	0.9	d	2.9	cd	10.2	b
11	Cubo	1.4	ab	2.7	b	4.9	abc	19.7	ab
12	Cubo + Maxentis	0.8	bcd	1.6	bcd	3.8	bcd	15.3	ab
	P value	**<0.0001**		**<0.0001**		**0.0188**		**0.062**	
	LSD	**0.6952159**		**1.231487**		**2.551209**			
	CV	**107.49**		**99.68254**		**89.10213**		**91.43108**	

Grain yield and Grain Quality

There was no difference in grain yields between the untreated and any applied treatment. This was also true of grain quality parameters with no difference in hectolitre weights, screenings or grain protein.

6.1 FINAL REPORT

Table 3: Oat Grain Yield and Quality in response to fungicide treatment

		Yield t/ha		Hectolitre (kg/hL)		Screenings (%)		Protein (%)	
1	UTC	4.0	a	50.8	a	3.8	a	9.4	a
2	Tilt 250	3.9	a	50.2	a	3.7	a	9.3	a
3	Proviso	4.0	a	49.0	a	5.9	a	9.6	a
4	Amistar Xtra	4.1	a	50.4	a	3.9	a	9.4	a
5	Elatus Ace	4.0	a	49.1	a	5.3	a	9.5	a
6	TopNotch	4.2	a	50.5	a	3.1	a	9.2	a
7	Maxentis	4.2	a	49.6	a	4.8	a	9.4	a
8	Radial Opti	4.0	a	48.7	a	5.3	a	9.7	a
9	Opera	3.9	a	49.7	a	5.0	a	9.4	a
10	Revystar	4.1	a	48.5	a	5.8	a	9.8	a
11	Cubo	3.9	a	50.6	a	4.1	a	9.5	a
12	Cubo + Maxentis	4.0	a	49.3	a	3.6	a	9.3	a
	P value	0.955		0.835		0.957		1	
	LSD	0.5732709		2.975332		4.397966		1.363842	
	CV	9.898937		4.174479		67.7147		10.06373	

Conclusion

Early leaf assessments indicated that some of the premium products were giving higher levels of control, however this was inconsistent. The longer residual products which contained either a stobilurin or SDHI chemistry in the mix are likely to have given higher levels of control for longer as well as maintaining a greater green leaf area. Unfortunately, a later assessment was missed as the crop senesced rapidly, this was unlikely to show huge variations due to the seasonal conditions after the applications. Observations were made on the front replicate which managed to hold onto greater green leaf area late into the season and showed the strongest response to Revystar followed by Opera followed by Amistar Xtra. The Cubo treatments were indistinguishable from the untreated control, thought the combination treatment may have had a slight edge over the straight Maxentis treatments. Broadly it appeared that treatments which had their base DMI chemistry as propiconazole struggled to get the same levels of control when compared to those containing, cyproconazole, epoxiconazole and prothioconazole.

The late application of nitrogen looks as though it may have contributed to severe brackling (crop kinking over) in areas of the trial. However, this did not impact on harvestability. The dry spring conditions and resultant low disease levels and soil moisture availability, coupled with the relatively stronger soil type likely contributed to the lack of yield response. Even in high pressure scenarios a lack of favourable conditions in the spring often results in lack of yield response as crop yield was not limited by green leaf area. The premium products with the longer residuals stand out when there is good moisture in spring where the additional leaf protection helps to maximise the use of the season.

Key words

Fungicides, Septoria Avenae, SDHI, Strobilurin, DMI

Acknowledgments

This trial was conducted using funds from the Processed Oat Partnership investment into the OATSPO showcase.

6.2 Lodging Management

Research Aim

Determine if Moddus Evo®, a plant growth regulator, can be used to prevent lodging and assess the impact on grain quality and yield on Bannister (B) and Goldie (G) oats

Methods

The trial was sown to Bannister and Goldie oats (90kg/ha) on 22nd April into dry soil at 30mm depth (germinated 6th May). 70kg/ha MAP + 30kg/ha SoP was banded with the seed and 80L/ha of Flexi N was banded below the seed. Two nitrogen top ups prior to stem elongation were applied to give the crop a total of 140kg N/ha, the aim being to encourage vigorous growth and the best conditions for lodging. The fungicide and Moddus Evo® were applied at the Z31 crop stage with the second node present on 22nd July.

Treatment List

Trt	Product	Rate/ha
1	Untreated Control (B)	-
2	Moddus Evo T1 (B)	400
3	Untreated Control (B)	-
4	Opera (B)	500
5	Revystar (B)	750
6	Untreated Control (G)	-
7	Moddus Evo T1 (G)	400
8	Untreated Control (G)	-
9	Opera (G)	500
10	Revystar (G)	750

Further information

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Management of Lodging and Crop Architecture by use of Moddus Evo or Strobilurin and SDHI Fungicides

Trent Butcher, ConsultAg Narrogin

Key messages

- Moddus reduced plant heights of both Bannister and Goldie but overall lodging at the site was low.
- There was no impact of any applied treatment on Grain yield or quality within varieties.
- Goldie had significantly higher yield and lower screenings than Bannister.

Background

Growing oats in a Mediterranean climate can be particularly challenging given the nature of the high potential for dry finishes in spring. When conditions are favourable this allows for sufficient conditions to maximises grain fill, increasing both yields and quality. Many nitrogen trials in Western Australia have found a yield ceiling for oats where there is an observable biomass increase but no yield increase. Moddus Evo has the potential to reduce the biomass in plants and allow higher partitioning of resources into yield. However, this often comes at the expense of grain quality under normal agronomist practices. This trial aims to see whether lodging can be reduced, and grain yield improved under a high nitrogen nutrition practice by use of either Moddus evo or fungicide applications.

Aims

- Determine if Moddus evo applications under a high nitrogen strategy can increase grain yield and quality.
- Determine if Moddus Evo, Opera or Revystar can be applied to reduce the yield of crop lodging under high nitrogen inputs.
- Determine whether there is any difference between Bannister and Goldie from these approaches.

Method

The trial was dry sown as a randomised complete block to both Goldie and Bannister oats at 90kg/ha at a depth of 30mm. The site was seeded on the 22nd of April with 70kg/ha MAP + 30kg/ha SOP + 80L/ha UAN. The germination event occurred on the 2nd of May with 28mm of rain recorded. Weeds were managed with an application of 2.5L/ha Boxer Gold + 200ml Voraxor. Two nitrogen top ups were applied prior to stem elongation giving the crop a total of 140 N/ha. The goal was to maximise biomass growth to encourage lodging. The fungicide treatments were applied at the the Z31 crop stage with the second node present on the 22nd of July. Moddus evo was applied at 400ml/ha, Opera at 500ml/ha and Revystar at 750ml/ha. Assessments were made of crop height, grain yield and grain quality. Very little uniform distribution of lodging was noted at the site.

Results

Seasonal Conditions

The conditions prior to the seeding of the trial were extremely dry with very little rainfall recorded. As a result, the crop was dry seeded but received a very gentle starting rain of 28mm which allowed for an even germination across the entire OATSPO site. There was steady rain through most of the growing season though totals fell well short of the long-term average. Spring conditions offered some rain in early September, but only small amounts were recorded in early October. The lack of favourable spring conditions are likely to have impacted on the grain filling ability of the oats in this trial. The soil type was slightly heavier where this trial was with a greater granite content which was hoped to increase the biomass of the crop. However, the hard season is likely to have had the opposite effect.

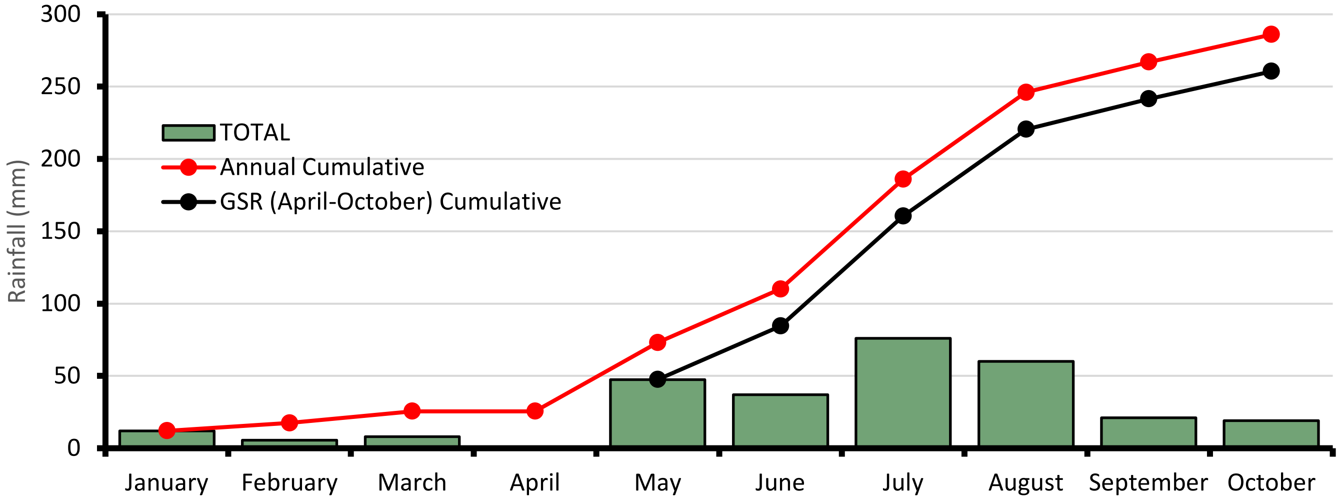

Figure 1: Cumulative and monthly 2024 rainfall in Highbury.

Plant height

The plant heights of Goldie and Bannister were the same at this site. The application of a fungicide caused no reduction in plant heights for either Goldie or Bannister with a very minor trend toward greater height from Revystar for both varieties. Moddus applications did however cause a significant reduction in height for both Goldie and Bannister. For Bannister, an average height reduction of 17% was measured, for Goldie a 13.9% reduction was recorded.

Grain yield

Grain yields from Goldie were on average 0.91t/ha greater than Bannister. Within varieties there was no impact of either Fungicide of Moddus evo on the final grain yield of either variety.

Grain Quality

Hectolitre weights on average were better from Goldie (50.65kg/hL) than Bannister (48.89kg/hL). There was no impact of treatments within varieties on hectolitre weight with only an odd trend toward increase in weight from Revystar on Goldie but a reduction for Bannister. The trend for the Goldie treatment also followed into the protein with the Revystar treatment having the lowest protein, though within Goldie this difference was not significant. Goldie (6.2%) on average had lower screenings than Bannister (9.8%). Within Bannister treatments there was no significant impact of treatments on screenings. However, in the Goldie treatment the application of Moddus significantly increased screenings increasing it from 6.6% to 8%. There was a trend toward a reduction in screenings from fungicide treatments on Goldie however this was not significant.

6.2 FINAL REPORT

Table 1: Plant height, yield, hectolitre weight protein and screenings measurements by treatments (G= Goldie, B=Bannister). Letters denote significant difference at 0.05

	Plant height (cm)		Yield t/ha		Hectolitre		Protein		Screenings	
Control (B)	94.4	ab	4.3	c	48.8	a	10.7	a	9.6	a
Modus T1 (B)	78.8	d	4.3	c	48.9	a	10.1	a	10.1	a
Opera (B)	89.2	bc	4.6	bc	49.5	a	10.4	a	9.3	ab
Revystar (B)	96.7	ab	4.6	bc	48.3	a	10.5	a	10.2	a
Control (G)	96.5	ab	5.2	a	50.1	a	10.2	a	6.6	bc
Modus T1 (G)	83.1	cd	5.1	ab	50.3	a	10.4	a	8.0	ab
Opera (G)	98.4	a	5.5	a	50.8	a	10.2	a	5.1	c
Revystar (G)	100.4	a	5.6	a	51.4	a	9.9	a	5.3	c
P value	<0.0001		<0.0001		0.0799		0.511		0.00237	
CV	10.23		8.83		2.71		5.33		23.51	

Conclusion

The seasonal conditions at the site were not favourable for growing large canopies which are likely to have experienced a greater impact from the treatment effects from the fungicides and the Moddus. With the high nitrogen rate and stronger soil types it was expected that given a typical season this would encourage the oats to grow a large amount of biomass and be more prone to lodging. The low rainfall conditions and stronger soil type likely had a negative effect at achieving the goals of this trial as it didn't allow for maximum biomass growth and reduced water availability in spring giving a poor finish on the site. Compared to other trials at OATSPO the hectolitre weights for this trial were lower than comparable trials but offered similar yields at the higher rate of nitrogen. Most likely a result of the very high nitrogen rates (140kg N) in the trial to encourage lodging risk.

Compared to historic trials looking at the impact of Moddus on oats the effects were very subtle in this trial. Past trials have shown an increase in Grain yield at the expense of Grain quality. This was only observed to a minor extent in this trial with a slight increase in the screenings of the Goldie treatment. Plant height reductions were also minor compared to expectations given the rate of Moddus applied (13.9-17%). The lack of difference in the height of Goldie vs Bannister was unexpected as more broad measurements of the two would indicate that the Goldie should have on average been taller than Bannister. This may indicate that biomass was maximised by the nutrition provided and the excess nitrogen covered the reduction from Moddus resulting in a similar result in the end. This is however highly speculative.

The fungicide treatments offered no improvement in grain yield or quality which was expected given the low levels of disease in the trial and the early application timings (Z31). There is some anecdotal evidence from overseas which indicates that strobilurin fungicides result in a reduction in crop lodging. The low levels of lodging at the site did not allow this potential interaction to be observed.

This work could do with further exploration under conditions which favour excessive biomass growth and better interactions from the selected treatments. Moddus was observed to have greater crop effect on oats and this points toward maybe a lower rate being the better option going forward to reduce both this and the potential impact on grain quality. It could be worth exploring the use of lower rates at timings that reflect standard crop protection timings in mixes to "micro-dose" the regulator to have more subtle impacts on crop development.

Key words

Revystar, Moddus Evo, Opera, Lodging

Acknowledgments

This trial was conducted using funds from the Processed Oat Partnership investment into the OATSPO showcase.

7.1 Septoria in Oat Grain

Sowing date	18th April 2024
Variety	Bannister, 100kg/ha
Depth	2cm
Moisture	Dry topsoil & subsoil
GSR	125 mm
Years rainfall	156 mm
IBS Spray	Treflan 2L/ha, Voraxor 200mL/ha

Research Aim

1. To prevent *Septoria avenae* reaching the grain resulting in either Septoria affected grain or spotted/mould affected grain potentially downgrading quality at harvest
2. What product or combination of products has offered us the best control?

Treatments

Trt	Z39 – 9th August	Z59
1		Untreated Control
2		Prosaro 150mL
3		Fitness 200mL
4		Maxentis 300mL
5	Maxentis 300mL	Prosaro 150mL

401 1	402 3	403 4	404 5	405 2
301 4	302 2	303 5	304 1	305 3
201 5	202 1	203 2	204 3	205 4
101 1	102 2	103 3	104 4	105 5

No assessments collected yet, however, there is 20-25% infected leaf area in the lower canopy as of 13th August 2024.

Further information

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Septoria Management in Bannister Oats
WA2413

Aim

To investigate the most effective foliar fungicide strategy for controlling Septoria avenae in Bannister grain oats in the 2024 season through using a combination of banded fungicides at seeding and Foliar fungicides applied at First node and Flag Leaf.

Method

Seeding fungicides were coated onto the fertiliser, then applied through the plot seeder, banded below the seed. Foliar fungicides were applied by hand boom at Z31(First node) and Z39(Flag Leaf). Assessments of the Lower Canopy Infection % (LAI%) and Mid-Canopy Infection % (MCI%) were taken at 21day intervals post foliar treatment application, and yield and quality was also taken at the end of the year.

Trial site	“Yarranabee”, Highbury WA
Sowing date	**14/4/24 (Dry)**
Variety and Rate	Bannister,
Herbicide	*IBS 2L/ha TriflurX, 200mL/ha Voreaxor,* *PE – 0.8L/ha Brom 200, 40g/ha Lontrel* *BL spray – 80g/ha Lontrel, 700mL/ha Tigrex, 200mL/ha MCPA LVE, 10mL/ha Priority*
Fertiliser	N – 80 kg/ha, P – 23kg/ha, K – 25kg/ha, S – 2 kg/ha,
Treatment applied	Uniform and Flutriafol in furrow on fertiliser, Prosaro at Z31, Maxentis Opti at Z39

Table 1: Rainfall – Highbury East Weather Station 10km E of site

2024 Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Highest Daily	*2.4*	*7*	*13.4*	*0*	*14.8*	*12.4*	*14.6*	*10.8*	*12*	*7.6*	*1.4*	*0*
Monthly Total	*7.4*	*7.4*	21.6	0	*40.4*	*30.4*	*65.6*	*66.2*	*26.8*	*14.6*	*7.2*	*0*
Highest Temp. (Day occurred)	*41.7 (31)*	*44.9 (1)*	35.4 (17)	32.1 (6)	*27.1 (14)*	*22.7 (1)*	*20.9 (17)*	*19.1 (21)*	*28.3 (26)*	*31.8 (31)*	*36.3 (1)*	*39.8 (18)*
Year Total	**287.6**			GSR (Apr-Oct)			244					

Table 2: Treatments applied to trial

Trt No	Seeding	Z31	Z39
1	Untreated	Nil	
2	Untreated	Prosaro 150 ml	
3	Untreated	Nil	Maxentis Opti 200ml
4	Untreated	Prosaro 150 ml	Maxentis Opti 200ml
5	Uniform 400 ml *	Nil	
6	Uniform 400 ml *	Prosaro 150 ml	
7	Uniform 400 ml *	Nil	Maxentis Opti 200ml
8	Uniform 400 ml *	Prosaro 150 ml	Maxentis Opti 200ml
9	Flutriafol 200 ml *	Nil	
10	Flutriafol 200 ml *	Prosaro 150 ml	
11	Flutriafol 200 ml *	Nil	Maxentis Opti 200ml
12	Flutriafol 200 ml *	Prosaro 150 ml	Maxentis Opti 200ml

** is an unregistered application for scientific purposes only.*

The foliar assessments for this trial were taken at 21DAA, as the latent period (time between infection and the expression of the disease) for Septoria avenae is generally recognised to be approximately this long.

Results

Disease was slow to start in 2024 and at the time of spraying at Z31 (Timing A) there was no infection present in the top of the canopy and less than 5% Leaf Area infected on the lower leaves. The assessment at 31 Days after A (Lower canopy infection Table 3) showed that Flutriafol offered a significant decrease in disease pressure earlier in the season compared to uniform, with the flutriafol having 11.3% infection in the lower canopy compared to the Uniform and untreated, which were between 18-20% infected area. The foliar fungicide applied at Z31 resulted in a decrease in disease levels, with an average result of 7.7% leaf area infected which was significantly lower than the control 18.3% or higher where the Prosaro wasn't applied.

At the time of the second assessment, which was 31 Days after the Z39 Flag leaf spray the treatments with Prosaro at Z31 and Maxentis Opti at Z39 had the highest level of control but was not significantly different to just a Prosaro at Z31. Remember that the rainfall for September and October was very low and not conducive for disease development in the upper canopy.

There is no Flag leaf infection data shown as there were no significant differences from any treatment in the top of the canopy at the end of the season.

Table 3: Results of key assessment timings and yield

Trt No	Treatment	Rate L/ha	Lower Canopy Infection % Flag-3 and lower 21DAA	Mid Canopy Infection % Flag-3 to Flag-1 21DAB	Yield T/ha
T1	Untreated		20 a	21.3a	4.39 ab
T2	Untreated; Z31 Prosaro	0.15	4.5 cd	12.1 bcd	4.52 ab
T3	Untreated: Z39 Maxentis Opti	0.2	18.3 a	17.9 ab	4.44 ab
T4	Untreated: Z31 Prosaro, Z39 Maxentis Opti	0.15 +0.2	7.7 bc	9.2 d	4.45 ab
T5	Uniform *:	0.4	19.6 a	23.3 a	4.43 ab
T6	Uniform *: Z31 Prosaro	0.4 +0.15	7.5 bc	10.4 bcd	4.44 ab
T7	Uniform *; Z39 Maxentis Opti	0.4 +0.2	19.6 a	16.3 a-d	4.69 a
T8	Uniform *; Z31 Prosaro, Z39 Maxentis Opti	0.4 + 0.15 + 0.2	6 cd	9.6 cd	4.57 ab
T9	Flutriafol *;	0.2	11.3 b	17.1 abc	4.25 b
T10	Flutriafol *; Z31 Prosaro	0.2 + 0.15	6 cd	11.3 bcd	4.28 b
T11	Flutriafol *; Z39 Maxentis Opti	0.2 + 0.2	11.3 b	21.3 a	4.47 ab
T12	Flutriafol *; Z31 Prosaro, Z39 Maxentis Opti	0.2 + 0.15 + 0.2	2 d	16.3 a-d	4.65 a
	LSD (P=0.05)		4.52	7.51	0.3257
	CV		28.21	33.73	5.07

** is an unregistered application for scientific purposes only.*

The factorial analysis of the trial (Table 4) shows that Flutriafol banded at seeding with the fertiliser significantly decreased Septoria leaf infection up until around Flag leaf emergence, shown in the 21DAA for lower canopy infection. By three weeks after the Flag leaf spray this effect was not present and did not translate into any yield difference at harvest.

The foliar treatments (Factor 2) showed that Prosaro applied at First node had a significant effect at reducing disease levels in the lower canopy as well as a lasting effect at the 21DAB timing in the mid Canopy, which was close to head emergence. However, this did not result in statistically improvements in yield.

Table 4: Factorial assessment of key assessment timings and yield

Trt No	Treatment	Rate L/ha	Lower Canopy Infection % Flag-3 and lower 21DAA	Mid Canopy Infection % Flag-3 to Flag-1 21DAB	Yield T/ha
	FACTOR 1 - Seeding				
	UTC		12.6 a	15.1 a	4.45 a
	Uniform *	0.4	13.2 a	14.9 a	4.53 a
	Flutriafol *	0.2	7.6 b	16.5 a	4.41 a
	Tukey's HSD (P=.05)		2.73	4.53	0.1964
	CV		28.21	33.73	5.0706
	FACTOR 2 – Foliar applications				
	Untreated		16.9 a	20.6 a	4.36 a
	Z31 Prosaro	0.15	6 b	11.3 b	4.41 a
	Z39 Maxentis Opri	0.2	16.4 a	18.5 a	4.53 a
	Z31 Prosaro, Z39 Maxentis Opti	0.15 + 0.2	5.2 b	11.7 b	4.56 a
	Tukey's HSD (P=.05)		3.47	5.77	0.25
	CV		28.21	33.73	5.0706

** is an unregistered application for scientific purposes only.*

Discussion

Decile 1 rainfall is not a very good season to determine best fungicide strategy for higher rainfall and disease pressure years. There were no clear significant differences in yield that could be attributed to one particular fungicide strategy. The yields ranged from 4.28 T/ha from flutriafol + Prosaro Z31 up to 4.69 from Uniform + Maxentis Z39. A single Prosaro spray at Z31 gave an average of 50 kg/ha in yield, A Maxentis Opti spray at Z39 had an average yield increase of 170 kg/ha and a combination of the two foliars was a 200 kg/ha increase, however none of these were statistically significant. Another key factor in the yield difference were the weather conditions in Spring. In late September and early October there were two days of high temperatures (28.3C° and 29.6C° respectively) within 5 days. As it is generally recognised that the maximum cardinal temperature (the temperature at which the disease stops reproducing) for diseases such as Septoria avenae is 30C° It is unlikely that the disease continued to survive and reproduce after this date. Another key factor is the senescing of leaves. By this time, there was an increasing amount of senescing in the canopy, carrying through to the flag leaf, which would have stopped the spread of infection as Septoria relies on green leaf area to survive.

Given the differences in disease infection during winter and early spring would suggest in the future that managing Septoria as a season length strategy would be beneficial in paddocks that have high disease risk and higher rainfall than was experienced at this site.

7.2 Septoria control in Bannister Oats

Background

With the future of oats looking bright increased hectares and tighter rotations are expected especially combined with improved weed control from new chemicals to maintain weed control. This will mean a higher pressure on disease such as *Septoria avenae* and will potentially need a larger focus on fungicide management and strategies to maintain green leaf area and grain yield.

Sowing date	18th April 2024
Variety	Bannister, 100kg/ha
Depth	2cm
Moisture	Dry topsoil & subsoil
GSR	125 mm
Years rainfall	156 mm
IBS Spray	Treflan 2L/ha, Voraxor 200mL/ha

Research Aim

1. To maximise control *Septoria avenae* in oats.
2. By applying in furrow fungicides, can we improve early control of Septoria, leading to better control with foliar fungicides later in the season? Do in furrow fungicides change our foliar strategy?
3. To find the most profitable combination of treatment options for this season and use that data to help make decisions for later years.

Treatments

	IBS – 19th April	Z31 – 11th July	Z39 – 9th August
1			
2		Prosaro 300mL	
3			Maxentis Opti 200mL
4		Prosaro 300mL	Maxentis Opti 200mL
5	Uniform 400mL		
6	Uniform 400mL	Prosaro 300mL	
7	Uniform 400mL		Maxentis Opti 200mL
8	Uniform 400mL	Prosaro 300mL	Maxentis Opti 200mL
9	Flutriafol 200 mL		
10	Flutriafol 200 mL	Prosaro 300mL	
11	Flutriafol 200 mL		Maxentis Opti 200mL
12	Flutriafol 200 mL	Prosaro 300mL	Maxentis Opti 200mL

401 4	402 7	403 11	404 1	405 2	406 6	407 10	408 3	409 5	410 12	411 8	412 9
301 1	302 8	303 3	304 9	305 11	306 4	307 7	308 2	309 12	310 10	311 5	312 6
201 11	202 12	203 7	204 5	205 10	206 2	207 8	208 4	209 3	210 6	211 1	212 9
101 1	102 2	103 3	104 4	105 5	106 6	107 7	108 8	109 9	110 10	111 11	112 12

	IBS	Z31	Z39	Septoria Infection (LAI %) lower canopy		Septoria Infection (LAI %) Flag & F-1		Septoria Infection (LAI %) Lower canopy	
				11/7/24		13/8/24		13/8/24	
1				7.9	a	2.3	ab	20	a
2		Prosaro		9.6	a	2.3	ab	4.5	cd
3			Maxentis	9.2	a	2.3	ab	18.3	a
4		Prosaro	Maxentis	4.4	bc	2.7	ab	7.7	bc
5	Uniform			4.4	bc	3	a	19.6	a
6	Uniform	Prosaro		4.8	b	2	ab	7.5	bc
7	Uniform		Maxentis	2.8	bc	2.7	ab	19.6	a
8	Uniform	Prosaro	Maxentis	4	bc	2.3	ab	6	cd
9	Flutriafol			4.8	b	2	ab	11.3	b
10	Flutriafol	Prosaro		3.1	bc	2.3	ab	6	cd
11	Flutriafol		Maxentis	2.7	bc	1.7	b	11.3	b
12	Flutriafol	Prosaro	Maxentis	1.7	c	2.3	ab	2	d
LSD P=.05				3.03		1.03		4.52	
Standard Deviation				2.11		0.72		3.14	
CV				42.59		30.66		28.21	
Treatment Prob(F)				0.0001		0.5101		0.0001	

Observations

Both in furrow fungicides were statistically better than no in furrow fungicide at reducing Septoria at First node stage (11/7/24) even though pressure was very low.

Prosaro spray at First node (11/7/24) has been very important at keeping the lower canopy clean between first node and Flag leaf emerging.

The effect of Uniform on Septoria in the lower canopy has not continued through to flag leaf.

Flutriafol in furrow had approximately half the amount of Septoria in the lower canopy at Flag leaf stage (13/8/24).

Further information

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8. Management of weather induced fungal staining of oaten hay using late season foliar fungicide application

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Research Question

What is the best management strategy to reduce weather induced fungal staining of oaten hay windrows (with a specific focus on timing of strobilurin management strategies?)

Research Background

Weather induced biological damage of hay prior to baling is an ongoing threat for producers. Strobilurin fungicides are often applied prophylactically to reduce growth of saprophytic fungi and hay staining damage, however this carries residue risks which could impact export markets. Research conducted by the National Hay Agronomy Project showed visual reduction in saprophyte staining by fungicides applied at timings aimed at saprophyte management (at withholding period). Application at earlier timepoints, for in-crop foliar disease control, may be able to provide the off-target effect of saprophyte reduction, whilst reducing the risk of exceeding MRLs.

This field trial aims to demonstrate that strobilurins can be applied earlier and have the same level of impact as application at the withholding period; reducing foliar disease, increasing flexibility with cutting times whilst still providing residual control of saprophytic fungi on the windrow.

Design and Methods

Design: Randomised complete block design with 4 replicates

Fungicide treatments		
1	Untreated	
2	3 weeks prior to cutting - Amistar Xtra® (800mL/ha)	6th August (Z45)
3	4 weeks prior to cutting - Amistar Xtra® (800mL/ha)	30th July (Z43)
4	4 weeks prior to cutting - Maxentis® (600mL/ha)	30th July (Z43)

Cutting date: 27th August (Z57)

Measurements

- Disease severity assessments (at spraying and at cutting)
- Hay yield
- Saprophyte severity assessments, visual area affected
- Hay quality and appearance (nutritional, physical, mycotoxins, chemical residue)

Funding

Department of Primary Industries and Regional Development,
AgriFutures Australia (PRJ-016604 - Understanding and reducing weather induced fungal staining of oaten hay windrows)

For further information

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Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

AgriFutures® Export Fodder

The effect of fungicide choice and timing on saprophyte suppression in oaten hay

Kylie Chambers (WA Department of Primary Industries and Regional Development).

Key messages

- Fungicide choice and application timing influence the level of control of fungal growth (saprophytes) on the windrow.
- SDHI and strobilurin containing fungicides were more effective and persistent than demethylation inhibitor (DMI) fungicides at reducing post-harvest saprophyte staining.
- Strobilurin fungicide applied to manage fungal diseases in-crop 3-5 weeks prior to cutting for hay, can have off-target benefit in saprophyte management.
- The low or high label rate of strobilurin fungicide registered for oats provided the same level of protection when applied 28 days prior to cutting.
- Applying fungicides earlier provides increased flexibility in the cutting window and reduces maximum residue limit (MRL) risk.

Aims

To determine the effectiveness of fungicides registered for disease management in oats, including SDHI, DMI and strobilurin based products, in suppressing saprophytic fungal growth in oaten hay.

To determine the earliest timepoints that fungicides registered for disease management can be applied to suppress saprophyte growth in oaten hay.

Introduction

Rainfall during the hay curing process (between cutting and baling), can encourage the growth of saprophytic fungi on the windrow. These fungi can colonise the senescing plant material on the outer (sun bleached) layer of the windrow, causing dark patches of discoloration. Hay discolouration due to saprophytic fungal growth is a significant issue for oaten hay producers seeking to export the hay as it reduces visual quality, suitability for markets, and economic returns. A common grower practice in the oaten hay industry is the application of strobilurin fungicide at the withholding period (21 days prior to cutting) as an insurance spray against saprophyte damage.

The AgriFutures and Western Australia (WA) Department of Primary Industries and Regional Development (DPIRD) have co-invested in two projects, the “National Hay Agronomy” (PRJ-011029) and “Understanding and reducing weather induced fungal staining of oaten hay windrows” (PRO-016604) to investigate how to cost-effectively manage the fungal staining. Through these projects seven trials, five of which have been conducted by DPIRD in WA, have been conducted to investigate the role of various fungicides and timing of application on saprophyte suppression.

Results

DMI, SDHI and strobilurin fungicides can all reduce saprophytic fungal growth in the window. While late-season fungicide application can reduce saprophytic fungal growth, it had no impact on the overall “greenness” or nutritional quality parameters of oaten hay either at the time of cutting or post weathering. Fungicides have been shown to reliably reduce the saprophyte damage only on the top (bleached portion) of the windrow and have had inconsistent effects on the mould and staining damage within the sub-surface (green portion) of the windrow.

The power of (fungicide) choice

The type of fungicide can significantly impact the level of saprophytic growth on the windrow. All fungicide modes of action registered for disease control in oats were able to reduce saprophyte damage in the windrow, however, the SDHI (benzovindiflupyr + propiconazole) and strobilurin (eg. azoxystrobin, pyraclostrobin) fungicides were more efficient and consistent in reducing saprophyte damage compared to DMI based fungicides.

The strobilurin chemistries tested offered similar levels of saprophyte reduction (Table 1). This means that when selecting a strobilurin chemistry to apply late in the season it is most important to consider what diseases are present in the crop and to select a chemistry registered for their suppression/ control.

Table 1: Saprophytic fungal growth score on weathered windrows measured at Muresk, WA in 2020.

Treatment	4 weeks post cutting#	9 weeks post cutting#
Nil	5.8[a]	8.9[ab]
*Propiconazole (28)**	5.3[a]	9.2[a]
Propiconazole (21)	5.3[a]	9.0[ab]
Propiconazole (7)	5.2[a]	8.3[b]
Pyraclostrobin and epoxiconazole (28)	3.5[b]	7.3[c]
Pyraclostrobin and epoxiconazole (21)	2.9[b]	6.7[c]
Azoxystrobin and cypronazole (21)	2.5[b]	6.7[c]
Azoxystrobin and epoxiconazole® (21)	3.3[b]	7.0[c]
5% LSD	***0.7***	***0.8***
Significance	***P<0.001***	***P<0.001***

* () days prior to cutting
# Rated using a visual 0-10 score where 0 = no saprophytic growth and 10 = 100% of the windrow covered in saprophytic fungal growth Source: DPIRD.

How early is too early?

Strobilurin based products are the fungicide of choice for growers for saprophyte management. The current grower practice is to apply these fungicides at the withholding period (WHP) which is 21 days prior to cutting. Unfortunately applying strobilurins at the exact WHP reduces flexibility for the time of cutting and if the season finishes quicker than expected can lead to the reduction of hay nutritional quality while waiting for the WHP to expire.

The application of strobilurin fungicides up to 35 days prior to cutting offered the same level of protection against saprophyte damage as an application 21 days prior to cutting (Table 2). This offers increased flexibility with cutting times and opportunity to apply fungicide at a more opportune time. Earlier applications at Zadoks growth stage Z31 (first node on the main stem detectable) did not reduce saprophyte damage (Table 2).

How low can we go?

The application of strobilurin fungicide at a lower recommended application rate for oats applied at 28 days prior to cutting significantly reduced saprophyte damage and performed just as well as the highest strobilurin label rate application applied at the same time point (Table 2).

Table 2: Saprophytic fungal growth score on weathered windrows measured at Muresk, WA in 2024.

Treatment	4 weeks post cutting#
Nil	4.4[a]
*Azoxystrobin and cypronazole at Z31^*	4.0[a]
*Azoxystrobin and cypronazole (35)**	2.9[b]
Azoxystrobin and cypronazole full rate (28)	2.4[b]
Azoxystrobin and cypronazole low rate (28)	2.9[b]
Azoxystrobin and cypronazole (21)	2.5[b]
Benzovindiflupyr and propiconazole (14)	2.2[b]
Benzovindiflupyr and propiconazole (10)	2.5[b]
5% LSD	***0.68***
Significance	***P<0.001***

^Zadoks growth stage Z31 (first node detectable)
* () days prior to cutting
# Rated using a visual 0-10 score where 0 = no saprophytic growth and 10 = 100% (poor) of the windrow covered in saprophytic growth Source: DPIRD.

It is crucial that fungicides are only applied when necessary and that they are applied strategically to ensure their efficacy. Fungicides will only reduce saprophyte damage in seasons conducive to saprophyte/ weather damage when there has been rain on the windrow. It is important to ensure fungicide groups are rotated and that chemicals are only applied when there is an associated disease pressure at the time of application.

Following label recommendations for rates and withholding periods is vital to avoid chemical residue in hay which could jeopardise export hay markets.

9 Hay Varieties

Research Aim

Compare yield and quality of old and new oaten hay varieties. The trial will utilise farmer equipment to sow, cut and bale the varieties, and quality will be assessed by Gilmac using commercial methods and procedures.

Methods

The Trial was dry sown as per farmer nutrition (see intro) on 15th April (germinated 6th May). The target plant density was 320 plants/m^2 so seeding rates were adjusted for each variety based on seed weight.

Varieties

Trt	Variety	Sowing rate (kg/ha)
1	Goldie	125
2	Kultarr	125
3	Brusher	125
4	Carrolup	125
5	Archer	110
6	Wallaby	110
7	Bannister	125
8	Koala	110

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9 FINAL REPORT

Evaluating the performance of new Hay Specific and Dual-Purpose varieties in Highbury 2024

Acknowledgments: GILMAC were strong supporters of this trial by providing the funding and also undertaking hay quality analysis. This trial was carried out by ConsultAg (Narrogin) and was included as part of the OATSPO Field day which attracted 260+ attendees. Thanks to the contribution of Ashley Wiese, the grower who hosted the site and assisted in the trial implementation.

Researcher: Garren Knell, Trent Butcher and Gray Yates

Key Findings

- Brusher, Wallaby, Koala and Bannister generated the highest gross returns averaging $1750/Ha ($1850/Ha with top up).
- Wallaby grew the best quality hay returning the highest price per tonne in the trial.
- Goldie needs more field evaluation to determine its effectiveness as a true dual-purpose variety.
- In this early sown trial in a dry season, both quick and long maturing varieties performed well.
- Later planting of longer maturing varieties such as Wallaby and Koala could create management issues if there is not adequate moisture to allow these varieties to finish.

Introduction

The adoption of new hay specific varieties in western areas has been slow, even though they offer improved yield and quality compared to traditional varieties. Recently there has been a significant release of new varieties including the hay specific varieties Kultarr and Wallaby which offers a new short and longer season option and Archer which has tolerance to imidazalone residues and pre-emergent Sentry. Along with these hay specific lines there has also been two new milling lines released which may have potential as dual-purpose. These two varieties are Goldie and Koala, of which Goldie looks to have the widest adaptability for grain production. This trial seeks to evaluate the performance of these new entries against other multi-purpose grain/hay varieties (Bannister and Carrolup) as well as hay specific varieties (Brusher) to determine the agronomic fit and financial returns of these varieties compared to the industry standards.

Trial Aims

Compare yield and quality of old and new oaten hay varieties. The trial will utilise farmer equipment to sow, cut and bale the varieties allowing quality to be assessed from realistic field conditions.

This trial aims to assist growers with variety choice in order to reduce risk and increase returns to the hay grower. The trial includes eight varieties to establish differences in maturity and subsequent cutting and baling times. Yield data and hay quality will be collected to determine the suitability of newer hay varieties compared to those widely grown.

Methods

The trial was located 4.5km to the southeast of Highbury on a soil type that varied from sandy loam to a gravelly sand. This paddock has historically been a high performing paddock. The trial was designed to utilise commercial machinery to most accurately replicate the performance of the varieties under field conditions. The plots were configured to be a 120m in length and 15m in width. The trial was a complete randomised block design with three replicates sown side by side. Eight varieties were included which were: Goldie, Kultarr, Brusher, Carrolup, Archer, Wallaby, Bannister and Koala.

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The trial was sown on the 18th of April to a depth of 2.5-3cm into dry soil. A germinating rain of 28mm on the 2nd of May was sufficient to achieve an even germination. Sowing rates varied for each variety to attempt to achieve 320 plants per square metre for each variety as outlined in table 1.

The farmers commercial fertiliser strategy was used for this trial. This included 2t/ha of lime + 2t/ha of Compost (HR80) which was incorporated. Additionally at seeding 65kg/ha MAP + 50L of liquid compost extract was applied at seeding giving a total of 94kg/ha N, 20kg/ha P and 15kg/ha K. The organic form of nitrogen may not have been fully available during dry periods in 2024.

The trial was sown using a Bourgault bar with hydraulic tynes on 10-inch spacings with split boots. Industry standard herbicides were applied as required to control weeds and fungicides were applied to reduce Septoria and rust infection and to protect the hay against weathering (Azoxystrobin+ Propiconazole on 12th August). Visual observations and plant counts were made in season

Varieties were cut as close to watery ripe as possible, with three mowing dates ranging from 12th September to 19th. Goldie and Archer were cut 2 days later than ideal due to it coinciding with the OATSPO field day. Also, Wallaby and Koala were cut last as they had begun to die from terminal drought before all heads had fully emerged (Table 3 in Appendix shows timings for all varieties). Bale core samples were taken at the time of baling to assess quality and bales were weighed on scales post baling to determine hay yield. Quality was assessed using GILMAC's standards and graded and priced accordingly.

Hay quality is comprised of two main components. The first is the quantitative aspect which is conducted using a Near infra-red analysis (NIR) with a focus on water soluble carbohydrates (WSC), Acid and neutral detergent fibres (ADF & NDF) and dry matter digestibility (DOMD). The second assessment was traditionally a qualitative assessment looking at colour variation and weathering issues.

Results and Discussion

Seasonal Conditions

The conditions prior to the seeding of the trial were extremely dry with very little rainfall recorded. As a result, the crop was dry seeded but received a very gentle starting rain of 28mm which allowed for an even germination across the entire OATSPO site. There was steady rain through most of the growing season though totals fell well short of the long-term average. Spring conditions offered some rain in early September but little after this. The lack of favourable spring conditions meant that the longer season hay varieties (Wallaby and Koala) were penalised and cut slightly early to prevent onset of terminal drought.

Post cutting small rainfall events were recorded in early October between mowing and bailing (7&13mm) that may have contributed to lower hay quality and visual weather damage.

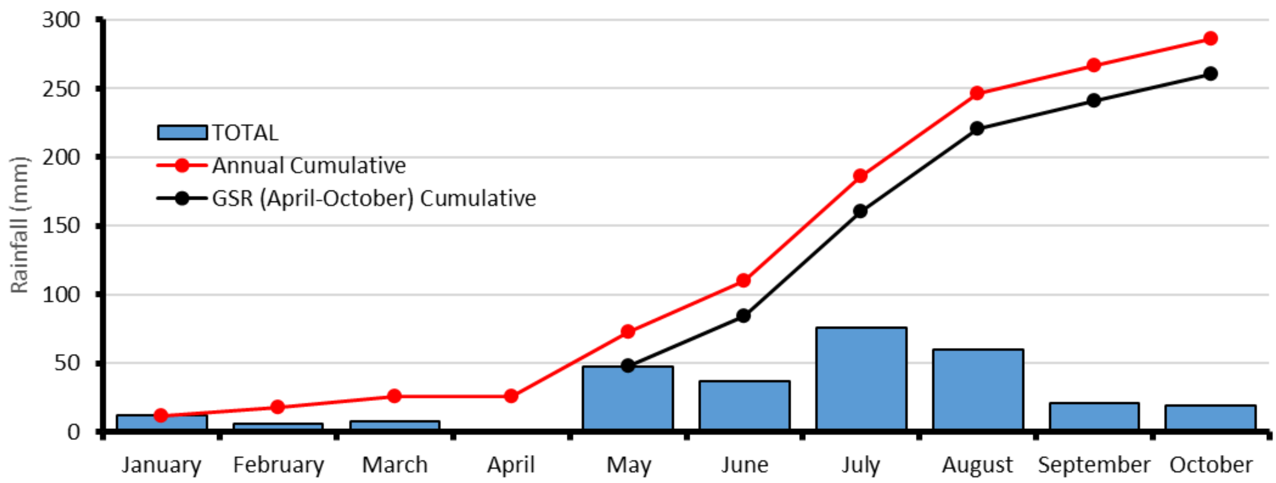

Figure 1: Cumulative 2024 rainfall in Highbury.

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Crop Establishment

The trial was sown dry 14 days prior to the opening rains. As seen in table 1, variety seed rate was varied to reflect grain weight to target 320 plants/m^2. Crop establishment was good given dry sown conditions, however, the crop density of all varieties excluding Archer was slightly lower than the target plant density.

Table 1: Plants per square metre achieved for each variety (target was 320) seed rate was varied to account for seed size.

	Seeding Rate	Established plants per square metre
Goldie	125	288
Kultarr	125	307
Brusher	125	300
Carrolup	125	314
Archer	110	344
Wallaby	110	314
Bannister	125	285
Koala	110	284

Hay Yield

Hay yields at the site in general were very good given the season (>7t/Ha) and didn't vary greatly between the varieties (Figure 2). The early establishment is likely to a be a driver of the higher yields as spring conditions became less important. Interestingly, even in a dry season variety maturity wasn't a predictor of yield, the quick maturing varieties were both the highest (Brusher and Kultar) and lowest (Archer and Goldie) yielding varieties in the trial. The yield of the mid maturing varieties (Bannister and Carrolup) and longer varieties (Koala and Wallaby) reflected the average yield of the trial. Despite the dry season the longer season varieties were able to take advantage of this growing period and as a result all were not significantly different in yield.

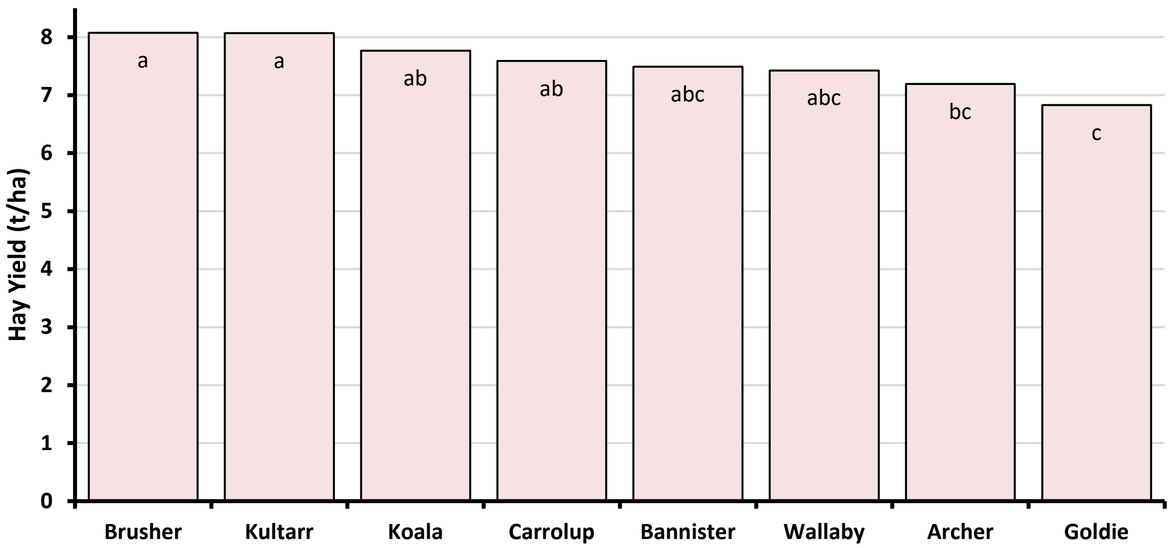

Figure 2: Average hay yield in tonnes per hectare of each variety (letters denote significant difference (P<0.03) CV 5.58).

Hay Quality

The overall quality of the hay in the trial was poor with the reduction in grade primarily being driven by high NDF and ADF (table 2). The hay specialty variety Wallaby grew the best quality hay generating the highest price in the trial. Its overall returns were equal top in the trial (figure 3).

Post cutting small rainfall events were recorded in early October between mowing and bailing (7&13mm) that may have contributed to lower hay quality. Excessive weather damage was recorded in 37.5% of the hay samples taken causing a reduction in visual grade.

Table 2: Average hay quality and price of varieties at baling time (Green=OHQQQ, Orange OH1QQ, Yellow=OHQ, Red=OH1, Grey=OHmin) (letters denote significant difference (P<0.05)).

Treatment	Value based on average grade	DOMD		ADF		NDF		WSC	
Goldie	$200	56.4	bcd	33.0	abc	57.8	ab	19.8	a
Kultarr	$203	55.2	cd	33.9	ab	58.2	ab	19.6	a
Brusher	$213	57.6	abcd	32.0	abc	56.7	abc	20.0	a
Carrolup	$196	53.9	d	34.1	ab	58.7	ab	21.3	a
Archer	$200	53.8	d	34.6	a	59.2	a	20.1	a
Wallaby	$230	60.7	a	30.3	c	54.6	c	22.5	a
Bannister	$220	59.1	abc	31.3	bc	56.2	bc	21.3	a
Koala	$216	59.4	ab	30.8	c	55.8	bc	21.5	a
P value		0.0124		0.0345		0.0506		0.557	
CV		4.1		5.0		3.0		9.2	

***When assessing hay quality, the desired attributed are lower NDF and ADFS and higher WSC.

Interaction of Crop Nutrition and Hay quality

This trial was designed to evaluate varieties under grower practice. At this site the grower used compost to supply nitrogen to the hay crop. The compost was spread pre sowing and lightly incorporated by the canola stubble crunching operation. A large portion of this nitrogen is in an organic form that when seeded with knife points would have been moved to the crop interrow.

With the dry start to the season and below-average winter rainfall, it is likely that much of the nitrogen became available later than usual during spring. This delayed release would have provided a late-season yield boost, but at the cost of hay quality.

Late nitrogen availability tends to reduce water-soluble carbohydrates (WSC) as carbohydrates are diverted toward protein synthesis and structural growth. While crude protein would typically increase under these conditions, it was not measured in this trial. Notably, protein levels have limited influence on hay grading for export markets.

Instead of being stored in the stem for later stages (such as grain fill), WSC is diluted by vegetative overgrowth, especially in stems. This reduction in WSC likely contributed to the lower dry organic matter digestibility (DOMD) observed, although the primary drivers of reduced digestibility were the high ADF and NDF levels.

Late nitrogen also promotes deposition of biomass into thicker, more fibrous stems, which mature more slowly. In contrast, early nitrogen encourages leaf development and tillering, supporting a higher leaf-to-stem ratio and generally resulting in lower ADF/NDF and higher WSC all of which improve hay quality.

The visual nitrogen deficiency early in the season followed by high biomass at cutting supports this interpretation of delayed nitrogen uptake and redistribution. While varietal differences in response are well-documented, in this trial the overriding influence of nitrogen dynamics made it difficult to isolate variety-specific trends. However, the impact may have been more pronounced in shorter-season varieties, which were more advanced and therefore more susceptible to late-season nitrogen effects.

Economics

The economic return from hay is a factor of yield by price minus costs. Higher yielding hay crops usually produce lower quality hay and often the best returns are achieved by maximising quality rather than yield because the cost of baling and freight are high. In this trial the top 5 varieties generated the same gross income (approx. $1700/Ha (Figure 3). Three of these varieties were hay specialty varieties (Brusher, Wallaby, Kultar). The other high performers were Koala and Bannister that are both milling varieties that have a good potential for hay.

In this trial, Carrolup, Archer and Goldie generated the lower returns (approx. $1450/Ha).

Archer and Goldie may have had the hay quality penalised in in this trial because of cutting time. These varieties were ready to be cut on the 10th of September, which coincided with the OATSPO field day. It was decided to delay cutting by 2 days to be able to demonstrate these varieties at the field day.

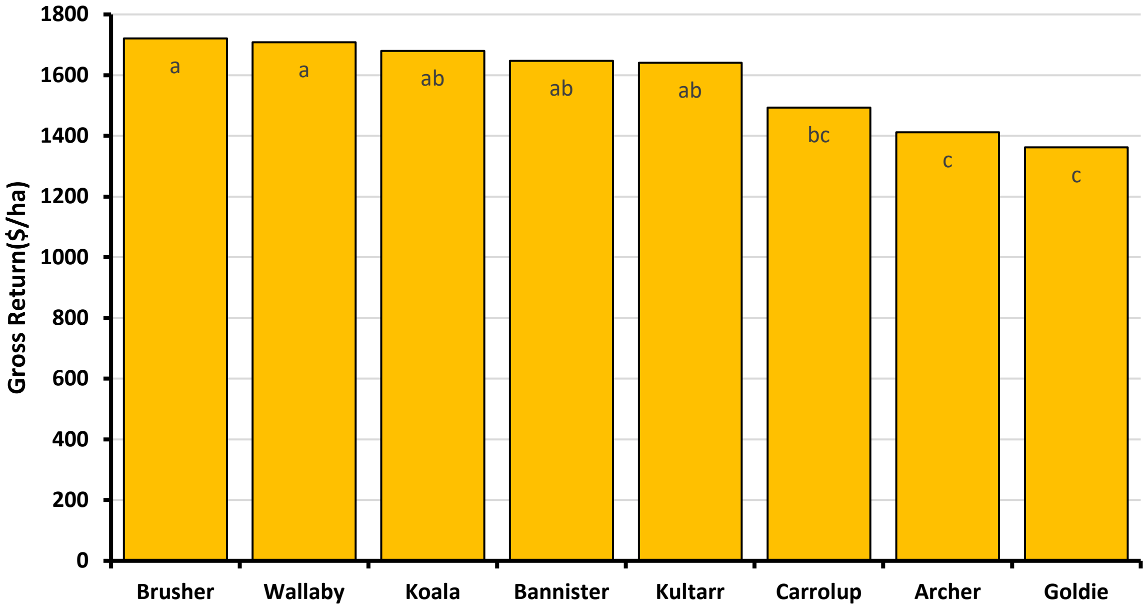

Figure 3: The gross financial returns of varieties as determined by their yield and quality. OHQV hay was priced at $240/t, OHQ at $230/t, OH1V $220/T, OH1 $210/t, OHminv $200/t, Ohmin $190/t and OH4 $180/t. (Letters denote significant difference at P<0.04).

Hay pricing update: in the 2024/25 season GILMAC paid an additional $20/t top up to all export grades after calculations were made in this report. With >7t average yield most varieties would have returned an additional $140/ha. The best performing varieties would have returned up to $1850/ha.

Dual Purpose Varieties

Goldie needs further field evaluation for its potential as a dual-purpose variety. Its good grain quality traits mean that when sown heavier as a potential hay crop, if it is subsequently harvested for grain then the grain is more likely to achieve a milling grade than Bannister or Koala.

Growers continuing with Carrolup as a dual-purpose grain/Hay variety are now missing out on both hay yield (compared to hay specialty varieties) and grain yield compared to Goldie and Bannister.

Variety - Key agronomic traits and observations from this trial.

Wallaby

- Hay specific variety – good grain yield – so easier to get replacement seed.
- Currently not a milling variety.
- Similar hay yield to Brusher – with improved quality – lower fibre level – NDF & ADF and very good colour.
- Its late maturity means that it can be planted early without bringing forward mowing time. Growers will likely need a quicker variety for later break seasons.

Archer

- IMI tolerant hay only variety (Single gene IMI tolerance) so tolerates IMI residues or Sentry applied IBS (for Barley Grass, Brome Grass and wild oat control).
- Good grain yield – so easy to bulk up seed.
- Hay quality is significantly better than Kingbale (alternative IMI variety).
- Improved ADF – similar NDF – higher protein.
- Similar parentage to Yallara.

Goldie

- New high yielding milling oat with quick maturity – it has more biomass than Bannister and looks to have a fit for Dual-Purpose.
- Early indicators are that hay yield and quality is good – similar to Bannister.
- Trial Observation: Goldie was a poorer performing variety in this trial, which maybe a combination of crop nutrition method and cutting time. This trial may not reflect Goldies performance as a dual -purpose variety.

Carrolup

- If you are still growing Carrolup you are likely missing out on yield and quality compared to newer hay specific varieties– eg 1t/Ha and 1 quality grade less than Brusher.
- Carrolup grain has high hectolitre weight – so can deliver quality grain when sown for hay (big trade off in yield).
- Rust and septoria susceptible.
- Sound quality hay – fine stem – quality holds up in windrow.

Koala

- New milling oat – adapted to high rainfall zones – outperforms Goldie in 4t + grain yield environments.
- Longer maturity – so would suit those who wish to sow early and cut later.
- Good grain yield – so easy to replace seed.
- Hay quality looks similar to Bannister.
- May suit dual-purpose in high rainfall zones.

Bannister

- Grain specific variety.
- Ok for Hay – yield and quality.
- Problem with head emergence in dry finish and thicker stem if not sown at high density.
- Good grain yield and quality.
- Ok for part of your hay program – but shouldn't be 100% due to dry finish risk.

Kultarr

- Hay specific oat variety, (Mulgara parent) – quick maturity, tall, high yield - low quality.
- Those familiar with Swan – will like Kultarr.
- Low rainfall zone only.
- Quick maturity - High biomass - Low Quality.

Brusher

- Tried and proven hay specific variety – good yield and quality.
- Poor grain yields due to shedding and lodging.
- Rust and septoria susceptible.
- Good quality hay – fine stem.

10.1 Pre-emergent broadleaf weed control

Research Aim

Compare the efficacy and crop safety of pre-emergent broadleaf herbicides in oats.

Methods

The trial was sprayed and sown into dry soil on 22nd April and germinated on 6th May, after 22mm of rainfall on 2nd/3rd May. A broadleaf weed burden was created by spreading lupins (30kg/ha), clover (20kg/ha) and Roundup Ready canola (2kg/ha) and incorporating the seeds 5-10mm below the soil surface. Pre-emergent herbicide treatments were then applied, and Bannister oats were sown at 90kg/ha.

Treatment List

Trt	Products	Rate
1	Untreated Control	
2	Diuron	275g/ha
3	Diuron	550g/ha
4	Voraxor	200mL/ha
5	Callisto	100mL/ha
6	Callisto	150mL/ha
7	Callisto	200mL/ha
8	Diuron + Callisto	275g/ha + 100mL/ha
9	Logran	10g/ha

Key Findings

- Diuron is weak on volunteer canola, lupins and clover
- Voraxor had good inter-row control of volunteer canola. Not much effect on clover.
- Higher rates of Callisto improved broadleaf weed control. Better furrow control of volunteer canola than Voraxor. Good activity on clover.
- Logran provided strong broadleaf weed control but reduced crop biomass significantly.

Plots were established for demonstration purposes only and were not harvested. Consequently, no data is presented for this site.

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10.2 Post-emergent broadleaf weed control

Research Aim

Compare the efficacy and crop safety of post-emergent broad leaf herbicides in oats.

Methods

The trial was sprayed and sown into dry soil on 22nd April and germinated on 6th May, after 22mm of rainfall on 2nd/3rd May. A broadleaf weed burden was created by spreading lupins (30kg/ha), clover (20kg/ha) and Roundup Ready canola (2kg/ha) and incorporating the seeds 5-10mm below the soil surface. Bannister oats were then sown at 90kg/ha.

Post-emergent treatments were applied on 25th June at the Z25 crop stage and 5 leaf volunteer canola. The trial was sprayed in the late afternoon.

Treatment List

Trt	Product	Rate	Unit/ha
1	Untreated Control		
2	Priority MCPA LVE 570 Update	25 450 0.5	mL mL %
3	Tigrex	1	L
4	Broadside	1	L
5	Triathlon	800	mL
6	Tigrex Bromoxynil	800 600	mL mL
7	Quadrant	800	mL
8	Infinity Ultra Hasten	110 0.5	mL %
9	Infinity Ultra Hasten	140 1	mL %
10	Infinity Ultra MCPA LVE 570 Hasten	140 450 1	mL mL %
11	Precept	2	L
12	Galaxy MCPA LVE 570 Hasten	670 450 1	mL mL %
13	Experimental		
14	Experimental		
15	Experimental		

		Weed Control			Crop Safety
Trt	**Products**	Canola	Capeweed	Lupins	Crop biomass reduction
1	Untreated control	0.0	0.0	0.0	1.3
2	25mL Priority + 450mL MCPA LVE (570) + 0.5% Uptake	8.0	6.0	8.0	1.3
3	1L Tigrex	5.8	5.0	8.0	3.8
4	1L Broadside	7.0	5.5	9.0	1.3
5	800mL Triathlon	7.0	6.3	9.0	2.5
6	800mL Tigrex + 600mL Bromoxynil (200)	6.3	6.7	10.0	6.3
7	800mL Quadrant	7.5	6.5	8.0	5.0
8	110mL Infinity Ultra + 0.5% Hasten	7.0	6.3	5.0	2.5
9	140mL Infinity Ultra + 1% Hasten	6.3	6.8	5.0	0.0
10	140mL Infinity Ultra + 450ml MCPA LVE (570) + 0.5% Hasten	9.0	7.5	6.0	1.3
11	2L Precept	9.0	7.5	6.5	0.0
12	670mL Galaxy + 450ml MCPA LVE (570) + 1% Hasten	9.0	7.5	6.5	1.3
13	Experimental 1	3.8	4.3	2.0	8.8
14	Experimental 2	2.8	1.7	3.5	6.3
15	Experimental 3	1.8	0.5	0.5	7.5

Weed control ratings from 0-10 (0=no control, 10=100% control). Biomass reduction from 0-100 (0=no reduction, 100= crop death)

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10.2 FINAL REPORT

Herbicide Options for Post-emergent Broadleaf Management

Trent Butcher and Gray Yates, ConsultAg Narrogin

Key messages

- All products gave 100% of control of volunteer canola by the end of the season although where were differences in speed of kill and crop effect.
- Quadrant resulted in significantly reduced biomass 29DA-A but this did not result in a grain yield penalty

Background

Most broadleaf sprays are tailored to keep control of wild radish populations. Often in the upper great southern radish is a minor weed compared to the high population densities of other weeds and volunteers. Oats are often sown dry into the program which results in a lack of knockdown and heavy emergence of weeds that come up on the break of the season. These can be difficult to control and in large numbers. The three C's: Canola, clover and capeweed form the highest burdens though volunteer legumes such as lupins can also be problematic. Oats are also typically more sensitive to post-emergent broadleaf products which provides little options prior to the 3 leaf stage and high risk of phytotoxicity. This trial aims to identify the safest and most effective herbicides for controlling the aforementioned weed spectrum.

Aims

- Determine which post-emergent products provide adequate control of canola, clover, capeweed and lupins
- Determine which products offer the highest degree of crop safety without compromising control.

Method

The trial was dry sown using farmer scale machinery, which was a Bourgault air hoe drill bar on 10-inch spacings with a split boot. The paddock was seeded on the 15th of April to Goldie oats at 90kg/ha at a depth of 30mm. Nutrition came from 2t/ha of lime + 2t/ha of Compost (HR80) which was incorporated. Additionally at seeding 65kg/ha MAP + 50L of compost extract was applied at seeding giving a total of 103kg/ha N, 20kg/ha P and 15kg/ha K. The germination event occurred on the 2nd of May with 28mm of rain recorded. The trial was sprayed and sown into dry soil on the 22nd of April and germinated on the 6th of May, after 22mm of rainfall on the 2nd/3rd of May. A broadleaf weed burden was created by spreading lupins (30kg/ha), clover (20kg/ha) and RR canola (2kg/ha) and incorporating the seeds 5-10mm below the soil surface. Bannister oats were then sown at 90kg/ha.

Post-emergent treatments were applied on the 25th of June at the Z25 crop stage and 5 leaf volunteer canola. The trial was sprayed in the late afternoon.

10.2 FINAL REPORT

Table 1: Trial treatments and rates used

	Treatment
1	UTC
2	25ml Priority + 450ml MCPA LVE (570) + 0.5% Uptake
3	1L Tigrex
4	1L Broadside
5	800ml Triathlon
6	800ml Tigrex + 600ml Bromoxynil (200)
7	800ml Quadrant
8	110ml Infinity Ultra + 0.5% Hasten
9	140ml Infinity Ultra + 1% Hasten
10	140ml Infinity Ultra + 450ml MCPA LVE (570) + 0.5% Hasten
11	2L Precept
12	670ml Galaxy + 450ml MCPA LVE (570) + 1% Hasten

Results

Seasonal Conditions

The conditions prior to the seeding of the trial were extremely dry with very little rainfall recorded. As a result, the crop was dry seeded but received a very gentle starting rain of 28mm which allowed for an even germination across the entire OATSPO site. There was steady rain through most of the growing season though totals fell well short of the long-term average. Spring conditions offered some rain in early September, but only small amounts were recorded in early October. The lack of favourable spring conditions is likely to have impacted on the grain filling ability of the oats in this trial.

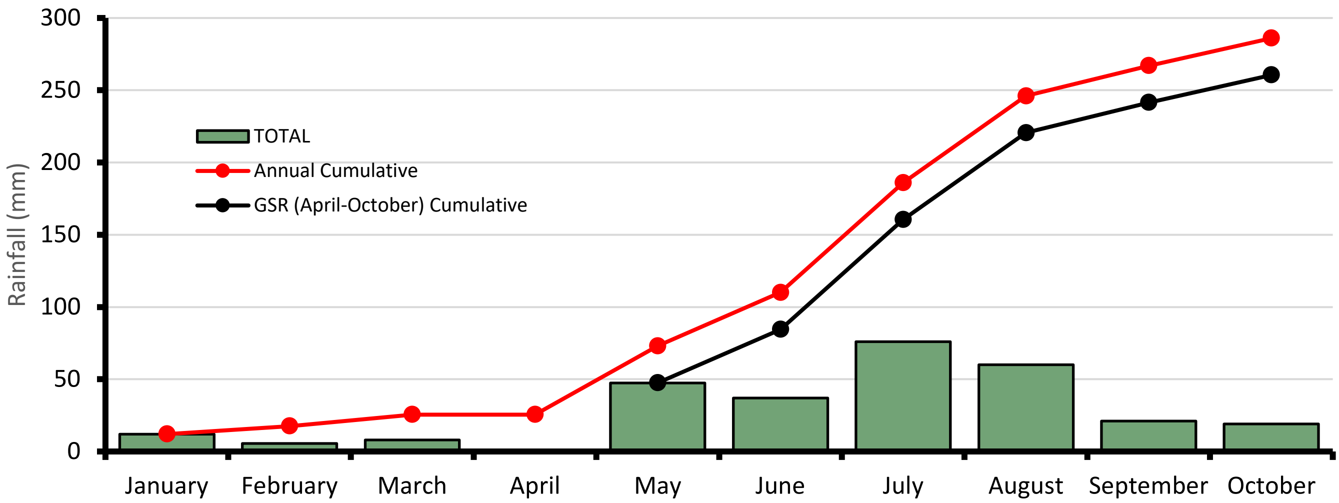

Figure 1: Cumulative 2024 rainfall in Highbury.

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Crop Safety

As crop safety measurements are visually assessed there is often a large amount of variability in ratings between treatments. It is notable that the CV values are quite high for both the crop phytoxicity and biomass reduction assessments. Most herbicide products caused some degree of crop phytotoxicity when assessed 14 days after

application (14DA-A), however, broadly this damage was minimal with the worst treatment Quadrant giving an average of 12.5%. All treatments that were inclusive of diflufenican gave the highest levels of crop effect which was noted as crop bleaching. There was a trend toward increased bleaching when either bromoxynil or pyrasulfotole was mixed with the diflufenican. The lowest levels of crop effect were observed with the MCPA based brews which were exclusive of diflufenican.

Biomass reductions were recorded 29DA-A and noted only a significant reduction in biomass from the use of quadrant at 800ml. All other treatments were no worse than the untreated control with some slight trends toward Priority based treatments and Triathlon being lower.

Table 2: Crop Safety assessments as crop phytotoxicity % (14 days after application (DA-A)) and biomass reduction % (29DA-A)

Treatment		Crop Phytotoxicity (%) 14DA-A		Crop Biomass reduction (%) 29DA-A	
1	UTC	0	d	0	b
2	25ml Priority + 450ml MCPA LVE (570) + 0.5% Uptake	1	cd	6.75	ab
3	1L Tigrex	7.5	abc	4	ab
4	1L Broadside	0.5	d	2.5	ab
5	800ml Triathlon	10.5	a	7.75	ab
6	800ml Tigrex + 600ml Bromoxynil (200)	10.5	a	8	ab
7	800ml Quadrant	12.5	a	10.5	a
8	110ml Infinity Ultra + 0.5% Hasten	9.25	ab	1.25	b
9	140ml Infinity Ultra + 1% Hasten	8.75	ab	0.5	b
10	140ml Infinity Ultra + 450ml MCPA LVE (570) + 0.5% Hasten	11.75	a	6	ab
11	2L Precept	1.75	cd	2.25	ab
12	670ml Galaxy + 450ml MCPA LVE (570) + 1% Hasten	1	cd	3	ab
	CV	**42.9**		**79.0**	
	P-Value	**<0.001**		**0.002**	
	LSD	**6.99**		**9.12**	

Weed Control

Canola

All treatments gave significant levels of control over canola with broadside giving the highest levels of control, closely followed by Quadrant. Treatments inclusive of bromoxynil and MCPA also gave higher level of control. The addition of bromoxynil to the MCPA and diflufenican combinations did overall improve the level of control. There was no difference in performance on the control of canola between Precept and Galaxy, though both of these products were superior to the Infinity treatments in the absence of MCPA. All treatments were able to provide full control of the canola by the end of the season.

Clover

The highest level of clover control was achieved from Broadside; however, this was still only 5 out of a potential 10 for control. Priority + MCPA, Quadrant, infinity ultra + MCPA and galaxy + MCPA LVE were the only treatments to give levels of control which were higher than the untreated control. Though these levels were still quite low

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Capeweed

Treatments inclusive of bromoxynil, MCPA + Pyrasulfotole or the higher rate of infinity gave superior control of capeweed over the untreated control. However, there was no standout treatment amongst this group and broadly control was low with the highest being 5.25 out of a possible 10.

Lupins

All treatments gave significant levels of control of lupins except for standalone infinity treatments. Again, however total levels were quite low with the best treatments Triathlon and Quadrant only reaching a 6.5 out of a possible 10.

Table 3: Weed Control Assessments (rates 1-10) for Canola, Clover, Capeweed and Lupins 29 days after application (29DA-A)

	Treatment	Canola		Clover		Capeweed		Lupins	
1	UTC	0	g	0	f	0	c	0	f
2	25ml Priority + 450ml MCPA LVE (570) + 0.5% Uptake	5	bcde	2.25	bcde	2.5	abc	4.25	abcde
3	1L Tigrex	4.75	cde	1.5	bcdef	2.5	abc	4	abcde
4	1L Broadside	7.75	a	5	a	4.75	a	6	ab
5	800ml Triathlon	7	abc	1.75	bcdef	4	ab	6.5	a
6	800ml Tigrex + 600ml Bromoxynil (200)	5.5	abcd	1.75	bcdef	4	ab	6	abc
7	800ml Quadrant	7.25	ab	2.75	bc	5.25	a	6.5	a
8	110ml Infinity Ultra + 0.5% Hasten	3	ef	1.25	bcdef	2.5	abc	2	def
9	140ml Infinity Ultra + 1% Hasten	2.75	ef	2	bcdef	3.25	ab	2.33	cdef
10	140ml Infinity Ultra + 450ml MCPA LVE (570) + 0.5% Hasten	6.5	abc	2.5	bcd	4.75	a	5.25	abcd
11	2L Precept	6.25	abc	1.5	bcdef	3.75	ab	4.5	abcde
12	670ml Galaxy + 450ml MCPA LVE (570) + 1% Hasten	6.75	abc	3	ab	4	ab	6	ab
	CV	**18.40**		**46.66**		**34.59**		**33.38**	
	P-Value	**<0.001**		**<0.001**		**<0.001**		**<0.001**	
	LSD	**2.258**		**2.112**		**2.882**		**NA**	

Grain yield

There was no significant difference in the grain yield of any treatments. Grain quality was not assessed.

Table 4: Grain Yield (t/ha) of various herbicide treatments.

	Treatment	Yield t/ha
1	UTC	3.41
2	25ml Priority + 450ml MCPA LVE (570) + 0.5% Uptake	3.98
3	1L Tigrex	4.02
4	1L Broadside	3.96
5	800ml Triathlon	3.79
6	800ml Tigrex + 600ml Bromoxynil (200)	3.85
7	800ml Quadrant	3.73
8	110ml Infinity Ultra + 0.5% Hasten	3.80
9	140ml Infinity Ultra + 1% Hasten	3.91
10	140ml Infinity Ultra + 450ml MCPA LVE (570) + 0.5% Hasten	3.77
11	2L Precept	4.08
12	670ml Galaxy + 450ml MCPA LVE (570) + 1% Hasten	3.89
	CV	**9.2**
	P-Value	**0.197**
	LSD	**0.50**

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Conclusion

Early intervention on heavy densities of canola is a critical need for dry sown oats as yields from this trial were lower than surrounding trials which did not have the sown weed burden. Whilst all treatments gave high levels of control by the end of the season, a useful intervention at the 2-3 leaf stage would have significant value. Unfortunately, most treatments that offered high levels of early efficacy on canola were MCPA based and would require 3 leaves before intervention. Infinity ultra has potential for earlier intervention, though it's speed of control of canola at this earlier stage needs additional exploration. Strong pre-emergents in Callisto and Voraxor are likely to see increased popularity if oats are sown dry without a knockdown opportunity. Similarly, the higher level of control on clover and capeweed from Callisto will likely see its wider adoption.

The strong broadleaf products in this trial did offer high levels of control and reveal the breadth of options of oat growers. The very aggressive broadleaf sprays, in particularly Quadrant, should be avoided unless the wild radish is demanding of that level of control. Whilst there was a biomass reduction from Quadrant the final yield was not significantly different. It's important to note that whilst the reduced biomass didn't reduce yield, is likely to have an impact on ryegrass competition. If grass was a confounding factor in this trial, there may have been yield impacts.

Mixes which do not include diflufenican offer the best opportunity to reduce initial crop phytotoxicity. Similarly attempts to avoid mixes with diflufenican and bromoxynil in combination should be avoided where possible as whilst the diflufenican effects were transient, biomass impacts from these treatments appear to persist. Bromoxynil + MCPA and Pyrasulfotole + MCPA mixes in contrast were very soft on the crop and offer a good option for high levels of control with minimal crop effect.

Acknowledgments

This trial was conducted using funds from the Processed Oat Partnership investment into the OATSPO showcase with financial support from Bayer.

10.3 Pre-emergent Grass Control

Research Aim

Compare the efficacy and crop safety of pre-emergent and early post emergent (EPE) herbicide strategies for controlling annual ryegrass in oats.

Methods

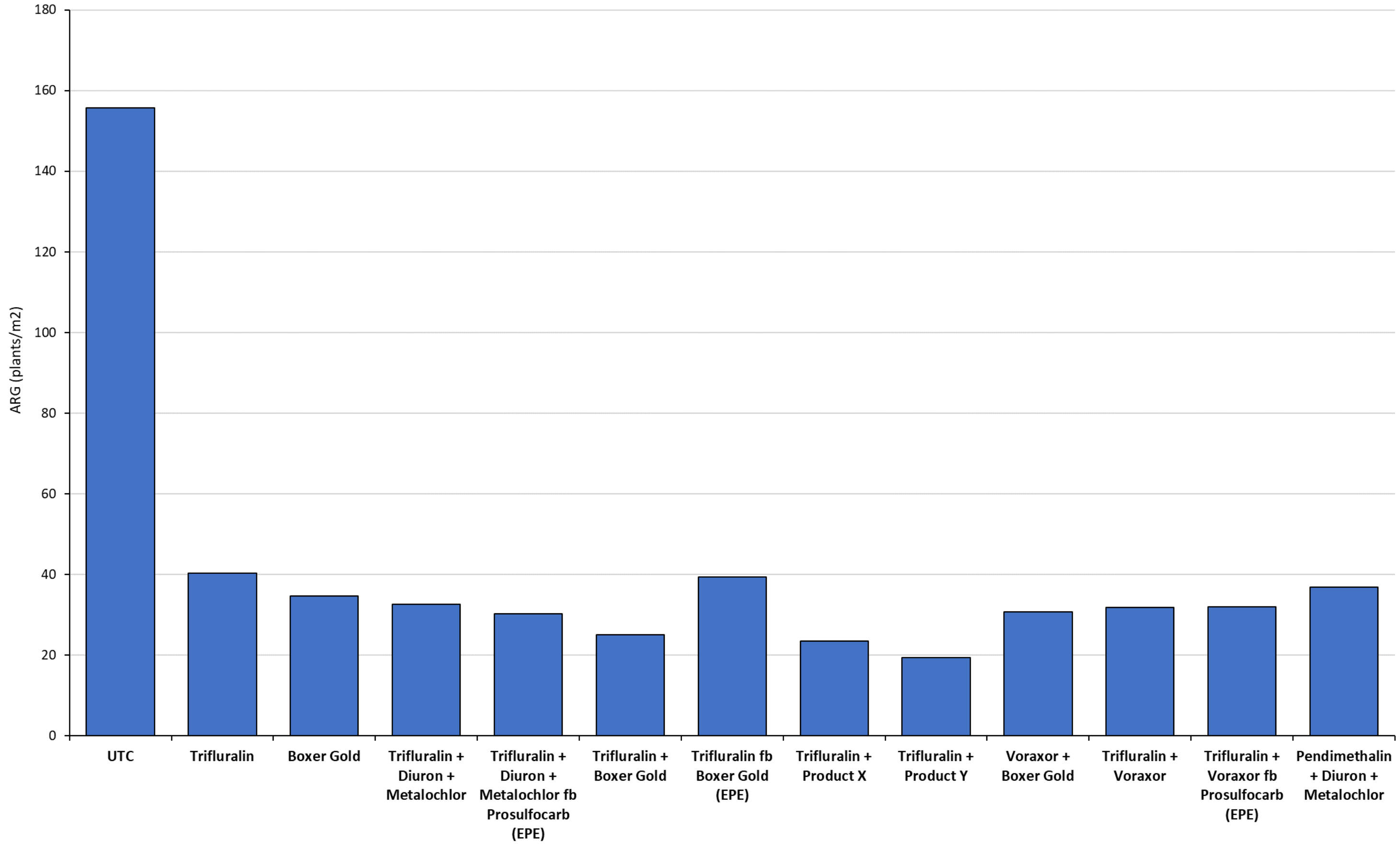
The trial was sprayed and sown into dry soil on 22nd April and germinated on 6th May, after 22mm of rainfall on 2nd/3rd May. Safeguard ryegrass was spread at 5kg/ha and incorporated to 5-10mm below the soil surface before pre-emergent herbicide treatments were applied. Bannister oats were sown immediately after at 90 kg/ha.

Treatment List

Trt	Product	Rate		Timing
1	Untreated Control			
2	Trifluralin	2	L/ha	IBS
3	Boxer Gold	2.5	L/ha	IBS
4	Trifluralin	2	L/ha	IBS
	Diuron	400	g/ha	IBS
	Metolachlor 960S	500	mL/ha	IBS
5	Trifluralin	2	L/ha	IBS
	Diuron	400	g/ha	IBS
	Metolachlor 960S	500	mL/ha	IBS
	Prosulfocarb	3	L/ha	EPE
6	Trifluralin	2	L/ha	IBS
	Boxer Gold	2.5	L/ha	IBS
7	Trifluralin	2	L/ha	IBS
	Boxer Gold	2.5	L/ha	EPE
8	Trifluralin	2	L/ha	IBS
	Product x			IBS
9	Trifluralin	2	L/ha	IBS
	Product Y			IBS
10	Voraxor	200	mL/ha	IBS
	Boxer Gold	2.5	L/ha	IBS
11	Trifluralin	2	L/ha	IBS
	Voraxor	200	mL/ha	IBS
12	Trifluralin	2	L/ha	IBS
	Voraxor	200	mL/ha	IBS
	Prosulfocarb	3	L/ha	EPE
13	Pendimethalin	2.18	L/ha	IBS
	Diuron	400	g/ha	IBS
	Metolachlor 960S	500	mL/ha	IBS

IBS = Immediately before seeding, EPE = Early Post Emergent

Annual Ryegrass Counts 28DAA



Further information

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Herbicide strategies for annual ryegrass control in oats

Project Number: TAR2211-001SAX

Further information

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Summary

There is a suite of new chemistry available for use in oats which can provide additional control of ryegrass over conventional options. This trial compares the currently available as well as experimental options which may provide improved control of ryegrass in the future. The trial was located in Highbury Western Australia and included as part of an oat agronomy showcase, as a result, ryegrass was planted at the site as opposed to an established background. This grass is likely to be more susceptible to chemistry, a theory that is reflected by the results. There were good conditions to maximise the efficacy of chemistry as the opening rainfall was 25.2mm after the treatments were applied to dry soil.

The trial demonstrates vastly improved herbicide options available in oats with strong efficacy results achieved by all treatments.

Background

Annual ryegrass (*Lolium rigidum*) is the most abundant grass weed in Western Australian cropping systems. Oats face challenges in herbicide use due to increased susceptibility to herbicide damage and limited pre-emergent options, reducing the use of available weed control products. The smaller market for oats, in comparison to wheat and barley has constrained herbicide product development and registration in oats.

Until recently, there were limited herbicide options for ryegrass control in oats. The registration of trifluralin and Boxer Gold in oats, as well as new products to market such as Voraxor, has provided improvement in ryegrass control in oats. To maintain crop safety, growers need to ensure that oats are sown relatively deep and that a knife point seeding system is used to provide good seed separation from the pre- emergent herbicide.

The trial was established on the 22nd of April 2024, in Highbury, WA. A consistent ryegrass burden was created on the trial area by spreading 5kg/ha of safeguard ryegrass (*Lolium rigidum* cv Safeguard) and then lightly incorporating the seed just below the soil surface with the farmer's seeder bar. The pre-emergent herbicide treatments were applied immediately prior to dry seeding 90kg/ha of Bannister oats at a depth of 30mm.

The first rainfall post seeding was 25mm over the 2nd and 3rd of May. This was timely rainfall to ensure activation of the pre-emergent herbicides. The crop emerged on the 8th of May.

Early post emergent treatments were applied at the 3.5-leaf crop stage on the 6th of June, with 10mm of rain to incorporate these treatments the next day.

It was decided to use safeguard ryegrass (*Lolium rigidum* cv Safeguard) as a courtesy to the farmer, because introducing natural ryegrass would be much more challenging to control in the following seasons. Safeguard ryegrass is more susceptible to herbicides than natural populations, so it is expected that the trial treatments would have slightly better efficacy than in a normal paddock situation.

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Objectives

1. Compare the efficacy of pre-emergent herbicide strategies for annual ryegrass control in oats.
2. To establish a site at OATSPO to provide a major extension opportunity for growers to evaluate newly registered herbicide options in oats.

Experimental details

Site details

Location	Highbury, W.A.
GPS co-ordinates	-33.0848
Soil description	117.2684
Soil pH	5.6
Crop type	Oats
Previous crop type/year	Canola

Experimental design

Trial design type	Randomised complete block design (RCBD)
Replicates	Four
Plot size (width x length)	2.5m x 12m

Target(s) description

Common name	**Scientific name**
Annual Ryegrass	Lolium rigidum

Product details

Product name(s)	Active ingredient(s) (ai)	Active concentration (g ai/kg or L)	Formulation type
Pendimethalin	Pendimethalin	440	EC
Diuron	Diuron	900	WG
Trifluralin	Trifluralin	480	EC
Boxer Gold	Prosulfocarb + S-Metalochlor	800 + 120	EC
Dual Gold	S-Metalochlor	960	EC
Voraxor	Saflufenacil + Trifludamoxazin	250 + 125	SC

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Treatment list

Treatment		Rate	
		Product (g or mL/ha)	Timing
1	Untreated control	Nil	Nil
2	Trifluralin	2000	IBS
3	Boxer Gold	2500	IBS
4	Trifluralin + Diuron + Metalochlor	2000 + 400 + 500	IBS
5	Trifluralin + Boxer Gold	2000 + 2500	IBS
6	Boxer Gold + Voraxor	2500 + 200	IBS
7	Trifluralin + Voraxor	2000 + 200	IBS
8	Pendimethalin + Diuron + Metalochlor	2180 + 400 + 500	IBS

Application details

IBS treatments

Equipment	Handboom	**Start time**	11am
Nozzle type	Airmix Agrotop	**Finish time**	12am
Nozzle size	015	**Treatments applied**	13
Number of nozzles	5	**Wind speed (km/hr)**	4kmph
Nozzle spacing (cm)	50	**Cloud cover (%)**	0
Height above target (cm)	50	**Relative humidity (%)**	54
Spray quality	course	**Temperature (°C)**	29
Spray volume (L/ha)	100L/ha	**Wet bulb**	-
Pressure (kPa)	2 Bar	**Dew present (Y/N)**	N
Speed(km/hr)	6kmph	**Crop growth stage**	-
Date	22/04/2024	**Target growth stage**	-

Assessment details

Date	Weeks after application X (DAA - X)	Crop growth stage Zadok / BBCH / Description	Assessment Description
6/06/2024	45DAA	Z13	Weed counts, crop phyto
11/11/2024	203DAA	Senescence	Ryegrass biomass
25/11	217DAA	Maturity	Harvest and Grain Quality

Results and Discussion

Early Control

At 45DAA, all treatments had significantly reduced ryegrass numbers compared to the untreated control. There were 158 ryegrass plants m^2 in the untreated control. There was no significant difference between any of the herbicide treatments, all providing effective ryegrass control. The safeguard ryegrass used in the trial was relatively susceptible to all herbicides so the performance of herbicides were stronger than we would expect with endemic annual ryegrass. Trifluralin, applied stand-alone (T1), achieved 74% control which is typically higher than expected in a normal field situation where trifluralin typically achieves ~60-65% control. Boxer Gold provided comparable control (78%) to trifluralin, however, Boxer Gold is often expected to provide 5-10% better control than trifluralin (see results in Figure 1 and Table 1).

The addition of Voraxor to Trifluralin increased control by ~6% (31p/M^2 vs 41p/M^2). Pendimethalin provided equivalent control to trifluralin.

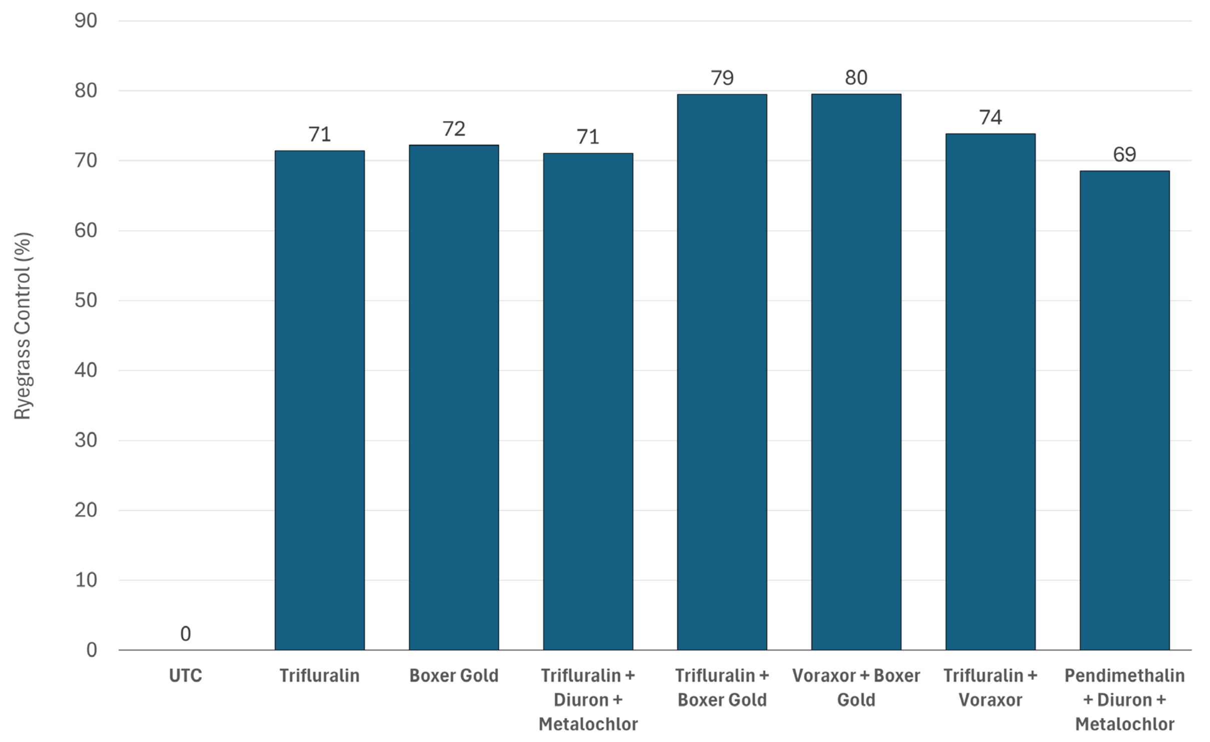

Figure 1: Shows percentage ryegrass control from herbicide treatments. There were no significant differences between the herbicide treatments.

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Table 1: Annual Ryegrass Count 45DAA. letters denote significant difference P>0.05.

	Treatments	Rate (ml,g / ha)	45DAA- ARG Counts (plants/m2)	
1	Untreated Control		158	a
2	Trifluralin	2000	41	b
3	Boxer Gold	2500	35	b
4	Trifluralin + Diuron + Metalochlor	2000 + 400 + 500	33	b
5	Trifluralin + Boxer Gold	2000 + 2500	25	b
6	Boxer Gold + Voraxor	2500 + 200	31	b
7	Trifluralin + Voraxor	2000 + 200	31	b
8	Pendimethalin + Diuron + Metalochlor	2180 + 400 + 500	37	b

Crop Biomass Reduction

All treatments in this trial were assessed as safe to the crop. This was achieved by seeding the crop at 30mm below the surface and no driving at a moderate speed (avoiding soil throw into adjacent furrows).

Table 2: Crop Safety (letters denote significant difference P>0.05).

	Treatments	Rate (ml,g / ha)	Crop Biomass Reduction 45DAA (%)		Crop Biomass Reduction 45DAA (%)	
1	Untreated Control		0.0	a	0	a
2	Trifluralin	2000	2.5	a	0	a
3	Boxer Gold	2500	0.0	a	0	a
4	Trifluralin + Diuron + Metalochlor	2000 + 400 + 500	0.0	a	0	a
5	Trifluralin + Boxer Gold	2000 + 2500	0.0	a	0	a
6	Boxer Gold + Voraxor	2500 + 200	0.0	a	0	a
7	Trifluralin + Voraxor	2000 + 200	0.0	a	0	a
8	Pendimethalin + Diuron + Metalochlor	2180 + 400 + 500	3.8	a	0	a

Final Ryegrass Biomass

Trifluralin reduced ryegrass biomass by ~55% compared to the untreated control. There was no significant difference between trifluralin and Boxer Gold, however there was a numerical trend towards improved control from Boxer Gold. The combination of trifluralin + Boxer Gold (T6) provided significantly more control than stand-alone trifluralin.

Voraxor did not add much in this trial, with very little additional control when used in combination with trifluralin and Boxer Gold. Additional control from Voraxor would be more likely in a tougher ryegrass population.

Table 3: End of Season Ryegrass Biomass (8th of November) (letters denote significant difference P>0.05).

	Treatments	Rate (ml,g / ha)	Ryegrass Biomass (kg/ha)	
1	Untreated Control		1046	a
2	Trifluralin	2000	482	b
3	Boxer Gold	2500	266	bcd
4	Trifluralin + Diuron + Metalochlor	2000 + 400 + 500	277	bcd
5	Trifluralin + Boxer Gold	2000 + 2500	92	d
6	Boxer Gold + Voraxor	2500 + 200	188	cd
7	Trifluralin + Voraxor	2000 + 200	404	bc
8	Pendimethalin + Diuron + Metalochlor	2180 + 400 + 500	497	b

Yield and Grain Quality

There was no significant difference in yield or grain quality from any treatments. Despite heavy ryegrass burden in the untreated control, the safeguard ryegrass was not as vigorous and persistent as natural ryegrass and the yield in the untreated control was unaffected.

Table 4: Grain Yield and Quality (letters denote significant difference P>0.05).

	Treatments	Rate (ml,g / ha)	Yield (t/ha)		Screenings (%)		Hectolitre Weight (kg/HL)	
1	Untreated Control		4.21	a	6.2	a	49.6	a
2	Trifluralin	2000	4.40	a	7.4	a	48.8	a
3	Boxer Gold	2500	4.15	a	8.5	a	47.8	a
4	Trifluralin + Diuron + Metalochlor	2000 + 400 + 500	4.39	a	7.2	a	50.3	a
5	Trifluralin + Boxer Gold	2000 + 2500	4.32	a	8.9	a	48.3	a
6	Boxer Gold + Voraxor	2500 + 200	4.19	a	7.2	a	48.8	a
7	Trifluralin + Voraxor	2000 + 200	4.47	a	6.4	a	49.6	a
8	Pendimethalin + Diuron + Metalochlor	2180 + 400 + 500	4.40	a	8.5	a	49.0	a

Conclusion

Improved annual ryegrass herbicide options are now available in oats, supported by strong efficacy data from this trial.

This trial should be repeated with a native ryegrass population to further validate these results.