GOA Trial Site Report

Wheat: improving confidence in high plant populations as a weed control tool in lower rainfall environments. Coonamble 2022.

Grain Orana Alliance

Trial code:	GAWE06322-2
Season/year:	Winter 2022
Location:	"Newgowrie", Coonamble
Trial partners:	Henry Moxham
Trial establishment date:	23/6/2022

Keywords

GAWE063, wheat, plant populations, competition, varieties, sowing rates.

Key findings

- Higher sowing rates did not cause any yield decrease.
- Higher sowing rates did not result in higher screenings.
- The vegetation index (VI), a measure of crop competition, increased with the increasing plant populations.
- Some varieties, such as Condo, had higher early VI compared to other varieties.

Increasing sowing rates and choosing a variety with early season vigour are recommended in paddocks where weeds are a problem.

Background

Improving weed control by improving crop competitiveness is well documented. This can be achieved through several practices, such as decreasing row spacing and increasing plant populations. A key barrier to adoption of these practices, particularly in marginal, lower rainfall environments and seasons, is the perception of yield instability and grain quality impacts (e.g., screenings). Growers are reluctant to decrease row spacing as trash flow can be impeded with tyne sowing rigs, particularly in minimum tillage

systems. Moving to narrower row spacing usually requires an additional investment in machinery with higher sowing rates also having increase costs.

Recent research such as US00084[1] has demonstrated changes in crop competitiveness through variety, population and crop choice that requires some further regional validation against standard district practices or commonly grown varieties. Practically, sowing rates can be the most easily changed and adopted by growers compared with reducing row spacings.

Higher seeding rates in the number one recommendation of the Crop Competition pillars of the Weed Smart Big 6 [2] and is an easy weed management tool growers can adopt. The trial will focus on the impact on yield and grain quality of increasing crop competitiveness through seed rate and variety.

Aims

To investigate if increasing sowing rate affects yield and grain quality for a range of varieties common to the Grain Orana Alliance (GOA) region. To investigate interactions between population and variety on crop biomass as a measure of crop competition

Methodology

Trial design	
Design	Randomized complete block
Varieties	8 varieties commonly grown in the region
Target populations	30, 70, 110 and 150 plants/m^2
Replications	4
Analysis	ANOVA (ASREML)
Confidence interval	95%
Measurements and assessments	Plant establishment, NDVI, yield, grain quality (protein, screenings)

Site Selection

The site was selected in the western area of the GOA region where the adoption of higher sowing rates as a weed control tool is not as well adopted as in the eastern, higher rainfall areas. Trials were placed in paddocks with a good rotational history to minimise disease risk.

[1] https://www.csu.edu.au/research/gulbali/research/food-beverage-agricultural-innovation/projects/innovative-crop-weed-control-for-northern-region-cropping-systems

[2] https://www.weedsmart.org.au/big-6/

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Table 1: Rainfall at Coonamble for 2022 and the long-term average (LTA).

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2022	78	28	43	78	73	14	20	64	116	130	83	47	774
LTA	57	51	41	31	37	37	33	26	30	39	43	46	471

Treatments

Table 2: Varieties, target plant populations and actual sowing rates used.

		Target population (plants/m^2) and sowing rate (kg/ha)			
Variety	**Growth habit[3]**	**30**	**70**	**110**	**150**
Beckom	Short plant type	11	29	50	77
Condo	Tall plant type	11	29	51	78
Coolah	Tall plant type	13	33	57	88
LRPB Flanker	Tall plant type	11	28	48	74
LRPB Lancer	Short-medium plant height	12	31	54	82
LRPB Mustang	Medium plant type	11	28	49	75
LRPB Spitfire	Medium plant type	12	31	55	84
Vixen	Short-medium plant height	14	37	64	98

Results

Plant populations: District practice targets ~50 plants/m^2 i.e., sowing rate of 25-35 kg/ha in low rainfall environments.

- Establishment was greater than the targeted population (Figure 1), particularly at the higher sowing rates.
- For each variety the established populations were different except for the 2 lower populations of LRPB Mustang.

[3] Adapted from NSW DPI Winter crop variety sowing guide 2022

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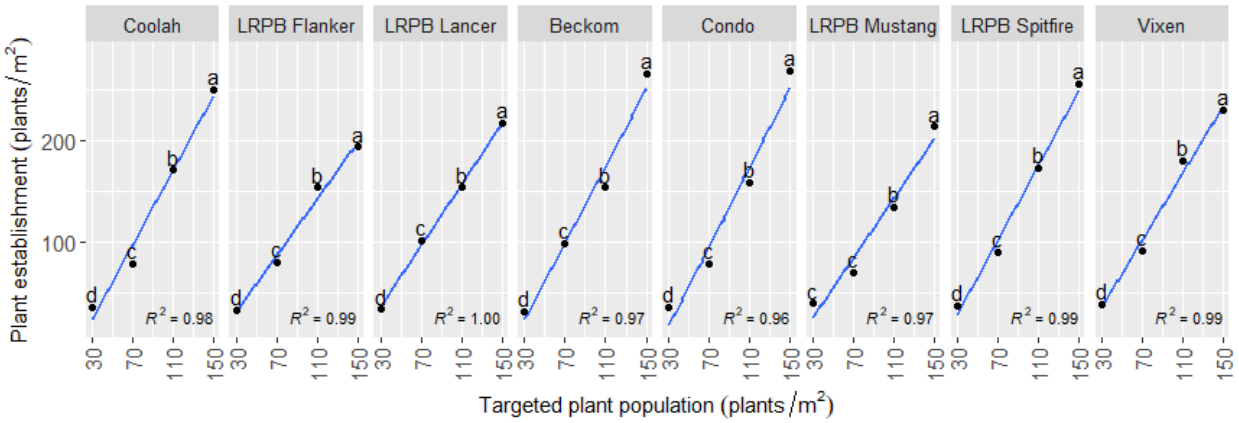

Figure 1: Plant establishment by variety and target plant population. Treatments with the same letter within a variety are not significantly different.

Vegetation index

The VI was measured with a handheld Trimble Ag Greenseeker which records the normalized difference vegetation index (NDVI) ranging from 0.00 to 0.99. Higher numbers indicate a greater density of green material. In this trial it is used as a proxy for crop competition.

- The VI tended to increase with the increasing plant populations (Figure 2).
- The VI for each population within each variety was significantly different, except for the 2 lower populations of LRPB Mustang, reflecting the plant establishment results.
- Condo tended to have a higher VI than other varieties.

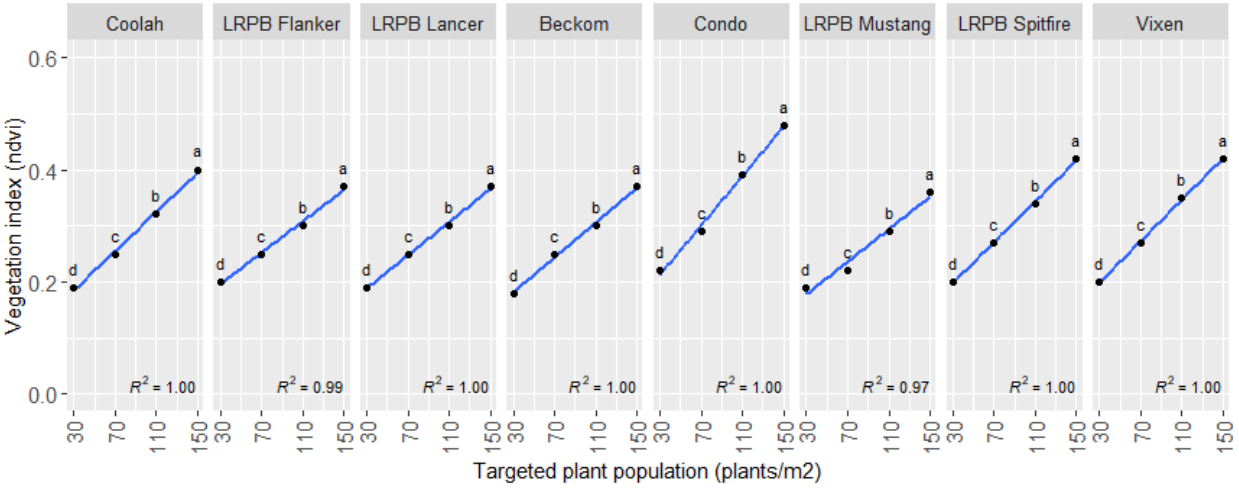

Figure 2: VI on the 10/8/2022 (48 days after sowing) by variety and targeted plant population. Treatments with the same letter within a variety are not significantly different.

Yield

- Yields were very high, with several treatments yielding well over 6 t/ha (the long-term average wheat yield for NSW is 1.93 t/ha[4]).
- For 7 of the 8 varieties, lowest yields were for the target population was 30 plants/m^2 and increased for the higher plant populations, the exception was LRPB Mustang.
- Higher sowing rates did not cause any yield decrease (Figure 3).

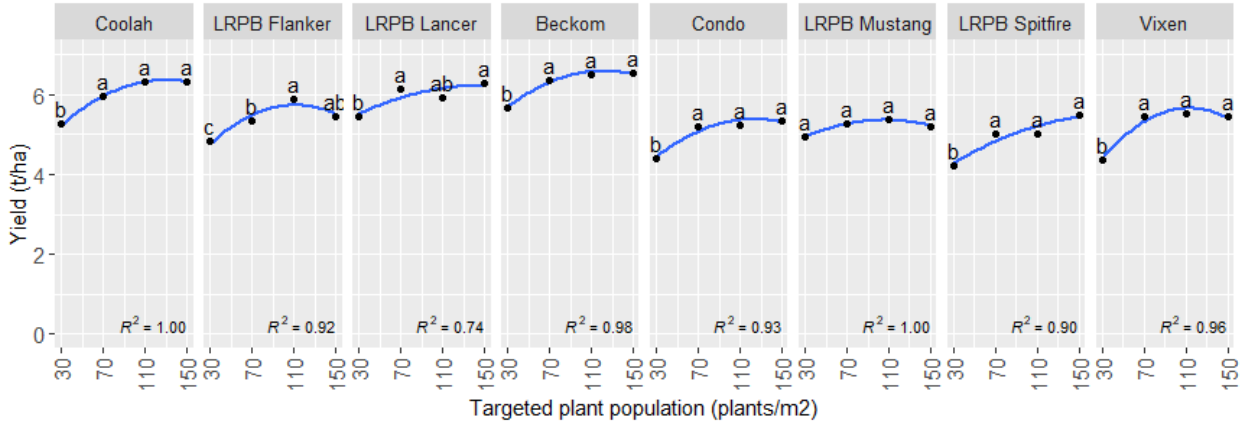

Figure 3: Wheat yield by variety and targeted plant population. Treatments with the same letter within a variety are not significantly different.

Protein

Protein levels declined slightly with increasing populations and increasing yields for 5 of the 8 varieties, this may be due to yield dilution effects (Figure 4). LRPB Mustang had slightly lower protein at higher populations without a yield increase, however the difference was not enough to result in a lower quality grain classification.

[4] Wheatcast™: wheat yield forecasts for Australia – Digiscape Future Science Platform (csiro.au)

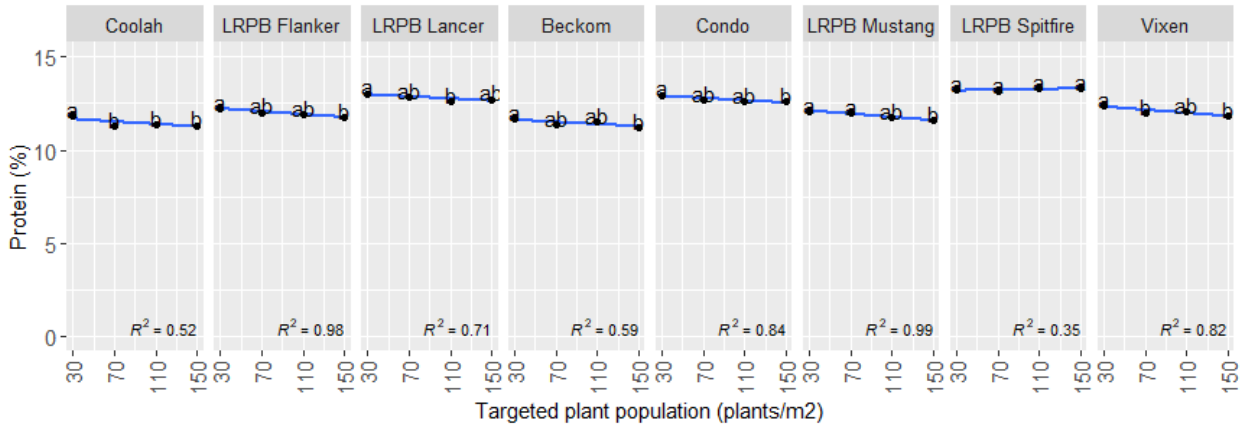

Figure 4: Wheat protein by variety and targeted plant population. Treatments with the same letter within a variety are not significantly different.

Screenings

- For 6 of the 8 varieties population had little or no effect on screenings.
- The screenings for LRPB Spitfire and Vixen decreased with increasing plant populations (Figure 5).
- Five of the 8 varieties were >5% screenings (across all populations) which may see them obtaining a lower quality grain classification.

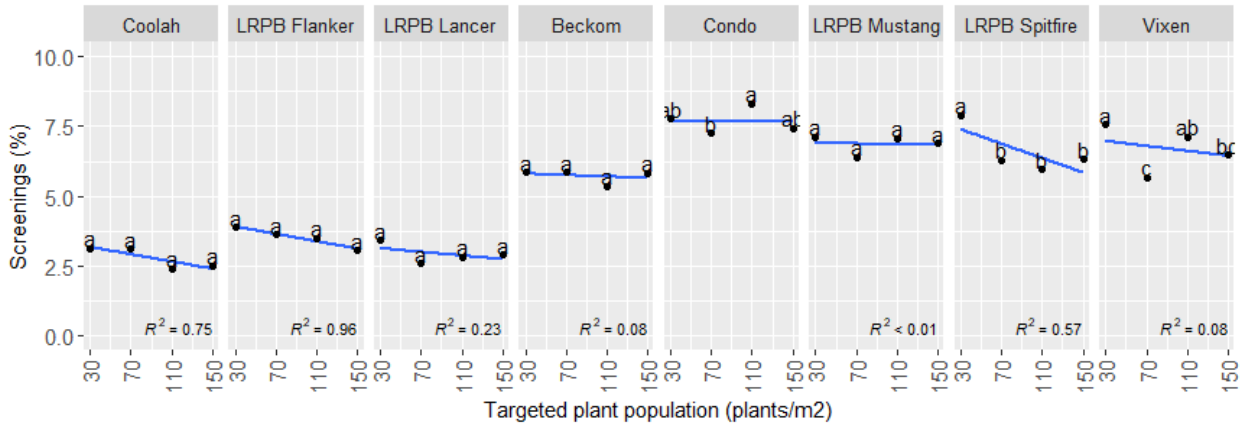

Figure 5: Wheat screenings by variety and targeted plant population. Treatments with the same letter within a variety are not significantly different.

Discussion

2022 was a very wet year. The in-crop rainfall at this site was in the order of 428.8 mm. As a result, the wheat crop in 2022 was high yielding. The average site yield was 5.5 t/ha (Figure 1) and average protein levels were 12% (Figure 2).

There was a yield response to both variety and population, with ~2.7 t/ha difference between the highest (6.5 t/ha) and lowest (3.8 t/ha) yielding treatments.

Plant establishment was higher than expected. It is generally accepted that germination rates[5] are reduced at higher sowing rates, and it was assumed that at a target of 30 plants/m^2 achieved 90% establishment, while at 150 plants/m^2 would have a 66% establishment. Conditions were close to ideal at sowing, as such germination was close to 100% regardless of population.

Early in the season there was a clear indication that increasing populations increased the VI (a measure of crop competition), regardless of variety. For the varieties and the populations tested this was almost a linear relationship. There was also a considerable difference in VI between varieties, for example Condo had 24% higher NDVI reading than LRPB Mustang, where both had a target population of 70 plants/m^2.b

Increasing plant populations, even to the very high levels of over 200 plants/m^2 (well over the target of 150 plants/m^2) did not reduce yields regardless of variety or have any large effects on grain quality. The fact that yields and quality did not decline at the higher sowing rates tends to suggest that experiences or perceptions of yield instability may have occurred where other factors were at play, such as disease (e.g., crown rot). Other contributing factors to yield stability may relate to early vigour and establishment of a more robust root system and/or earlier row closure allowing for a better water use efficiency (less surface evaporation).

These results may give growers the confidence to increase sowing rates with compromising yield or quality in problem weed paddocks. There is also an opportunity for growers to select varieties that display higher levels of early season vigour.

Conclusions

Any increase in sowing rates, regardless of variety, is likely to increase crop competition and improve weed control.

Some varieties are quicker growing and are likely to be better suited to providing earlier in-crop weed competition.

Increasing sowing rates did not negatively impact yields or grain quality (screenings or protein). In fact, evidence in this trial suggests quite the opposite, yields tended to improve, and screenings decreased with higher sowing rates.

Acknowledgements

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[5] https://www.agric.wa.gov.au/barley/factors-affecting-grain-crop-field-establishment, Establishment in wheat: germination and emergence (GS0–GS2) | AHDB,

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Appendix

Results

Table 3: Trial results 2022.

										Vegetation index					
Variety	**Target population**	**Yield**		**Test weight**		**Protein**		**Screenings**		**NDVI**		**NDVI**		**Plant establishment**	
	(plants/m²)	**(t/ha)**		**(kg/hl)**		**(%)**		**(%)**		**(10/8/22)**		**(13/9/22)**		**(plants/m²)**	
Beckom	30	5.67	cdef	77.2	ghi	11.7	klmn	5.85	ghi	0.18	p	0.52	no	32.5	l
	70	6.36	ab	77.0	ghij	11.3	no	5.85	ghi	0.25	lm	0.75	ijk	99.7	j
	110	6.51	a	77.3	ghi	11.5	mno	5.35	i	0.30	hij	0.81	cdefgh	154.0	gh
	150	6.52	a	76.9	hijk	11.2	o	5.84	fhi	0.37	cde	0.81	cdefgh	265.2	a
Condo	30	4.40	jk	76.4	jkl	13.0	abcd	7.77	abc	0.22	no	0.64	l	36.5	l
	70	5.21	fghi	76.5	ijk	12.7	cdef	7.25	bcde	0.29	hijk	0.79	efghi	78.7	j
	110	5.22	fghi	75.7	l	12.6	def	8.32	a	0.39	cd	0.86	abc	159.0	gh
	150	5.35	fgh	76.5	ijk	12.6	efg	7.42	abcd	0.48	a	0.88	ab	269.0	a
Coolah	30	5.25	fghi	77.4	fgh	11.8	jklm	3.13	jklm	0.19	op	0.54	mno	36.5	l
	70	5.95	bcd	78.3	cde	11.3	o	3.10	jklm	0.25	lm	0.73	jk	79.5	j
	110	6.32	ab	78.9	abc	11.4	no	2.40	m	0.32	gh	0.84	abcde	171.0	fg
	150	6.31	ab	78.8	bcd	11.3	no	2.50	lm	0.40	bc	0.86	abc	250.4	abc
LRPB Flanker	30	4.82	ij	78.7	bcd	12.2	ghi	3.88	j	0.20	op	0.56	mn	33.3	l
	70	5.34	fgh	79.1	ab	12.0	hijk	3.62	jk	0.25	l	0.75	ijk	80.2	j
	110	5.87	bcde	79.1	ab	11.9	ijkl	3.48	jkl	0.30	hi	0.83	abcdef	154.0	gh
	150	5.46	defg	79.4	ab	11.8	jklm	3.05	jklm	0.37	de	0.85	abcd	193.8	def
LRPB Lancer	30	5.44	efgh	78.8	bc	13.0	abc	3.42	jklm	0.19	op	0.56	mno	34.5	l
	70	6.13	abc	79.6	a	12.8	bcde	2.58	klm	0.25	lm	0.78	fghij	102.5	ij
	110	5.93	bcde	79.6	a	12.6	def	2.83	jklm	0.30	hij	0.83	bcdefg	154.0	gh
	150	6.29	ab	79.2	ab	12.7	cdef	2.90	jklm	0.37	cde	0.88	a	217.2	cd
LRPB Mustang	30	4.94	hi	76.2	kl	12.1	hij	7.13	bcdef	0.19	p	0.51	o	40.0	kl
	70	5.25	fghi	77.5	fgh	12.0	ijk	6.40	defghi	0.22	mn	0.65	l	70.5	jk
	110	5.37	fgh	77.3	ghi	11.8	jklm	7.08	bcdef	0.29	ijk	0.77	ghij	135.0	hi
	150	5.21	fghi	76.8	hijk	11.6	lmno	6.88	bcdefg	0.36	ef	0.81	cdefgh	213.7	cde
LRPB Spitfire	30	4.21	k	76.8	hijk	13.2	a	7.91	ab	0.20	nop	0.59	lm	38.5	kl
	70	5.02	ghi	78.1	def	13.1	ab	6.28	efghi	0.27	kl	0.76	hijk	90.7	j
	110	5.01	ghi	77.7	efg	13.3	a	5.95	ghi	0.34	fg	0.81	cdefgh	172.7	efg
	150	5.49	defg	77.1	ghij	13.3	a	6.31	efghi	0.42	b	0.88	ab	255.5	ab
Vixen	30	4.37	jk	72.7	no	12.4	fgh	7.55	ab	0.20	nop	0.50	o	39.5	kl
	70	5.44	efgh	73.8	m	12.0	ijk	5.65	hi	0.27	jkl	0.72	k	92.2	j
	110	5.53	def	73.4	mn	12.1	hij	7.13	bcdef	0.35	ef	0.80	defghi	179.8	efg
	150	5.44	efgh	72.5	o	11.8	jklm	6.47	cdefgh	0.42	b	0.84	abcde	230.0	bc
lsd	lsd	0.50		0.7		0.4		1.09		0.03		0.06		34.6	