GOA Trial Site Report

Selecting the right variety for dry sowing – Gilgandra, 2018.

Trial code:	GOMA00318-1
Season/year:	Autumn 2018
Location:	'Ardmona' Gilgandra
Trial partners:	Roger and George Pagan

Keywords

GOMA003, wheat, dry sowing, late sowing, sowing rate, variety, maturity, dry seasons, drought

Key findings

- There was no yield advantage to early sowing (dry sowing), compared to sowing just before rain.
- Protein % increased with the later times of sowing (TOSs).
- Screenings increased with the later TOSs.

Background

The practice of dry sowing of wheat in the Central West (CW) of NSW is not as common as it is in other grain growing regions of Australia, with a varied number of reasons for this lower level of adoption.

1. The timing of the autumn break in the Grain Orana Alliance (GOA) region is less reliable than it is in many areas of Western Australia (WA), where the practice is more widely adopted. By dry sowing, growers lock-in their crop and variety choice when the seed is planted to match their best guess at the time of the seasonal break. This may result in a mismatch of the timing of flowering and grain fill, which has been shown by other Grains Research and Development Corporation (GRDC) funded research to be pivotal in optimising crop performance.
2. Growers wary of successive false breaks on dry sown crops, which could result in failed, or reduced crop establishments.

In 2018 many growers were in the predicament where they only had mid-long season maturity wheat seed on hand and as the season progressed, many of those varieties surpassed their ideal sowing windows. In this situation, growers could have dry sown these varieties prior to rainfall to optimise production. This would enable the crop to emerge more quickly after the rainfall than waiting for paddocks to dry out or weeds to be sprayed before sowing. The benefit or penalty attached to dry sowing when the break is delayed may vary with the crop maturity.

GOA Trial Site Report

This trial was developed in response to the dry conditions and delayed seasonal break of 2018 and looked to address the above points.

Aims

- Compare the performance of a range of wheat varieties with different maturities when sown across a range of sowing timings.
- Quantify any effects on crop establishment and yields when the crop is dry sown.
- Quantify the advantage of dry sowing when planting varieties outside of their ideal sowing window.

Methodology

- Eight varieties across 4 TOSs.
- Split plot design with 3 replications.

The varieties selected reflected a range of commonly used CW NSW varieties of a range of maturities. Sowing timings replicated dry sowing either a long time before or just prior to rainfall and sowing into moisture after a rain event.

The TOSs were:

Time of sowing	Guidance	Actual sowing date
TOS1	Dry sown, no imminent forecast of rain.	6/06/2018
TOS2	Dry sown, 1-2 days ahead of forecast rainfall of enough for crop establishment (>10 mm).	26/06/2018
TOS3	Sown into moisture as soon as possible after enough rainfall for crop establishment.	3/07/2018
TOS4	Sown into moisture 7-10 days post rainfall.	12/07/2018

The targeted plant population was set at 150 plants/m^2. Sowing rates were adjusted according to the seed size and germination % of each variety, an establishment factor of 80% used.

The varieties chosen to represent a range of maturities:

- Kittyhawk (winter wheat)

1. Sunmax[A] (long season- slow spring wheat)
2. LRPB Lancer[A] (mid- late maturity, spring wheat)
3. LRPB Flanker[A] (mid- late maturity but with plasticity in sowing date)
4. Beckom[A] (mid maturity- spring wheat)
5. Suntop[A] (mid maturity- spring wheat)
6. LRPB Spitfire[A] (early-mid maturity, spring wheat)

7. Dart[A] (quick- spring wheat).

Table 1: Trial site details.

Trial establishment date	Autumn 2018		
Crop and variety	Wheat various varieties	**Seeding rate**	Targeted
TOS	Various	**Harvest date**	9/11/18 and 5/12/18
Seedling equipment	Knife point, press wheel	**Row spacing**	27.5 cm
Sowing fertiliser (kg/ha)	MAP 100	**Soil type**	Brown dermosol
Previous crop (and yield)	Canola 0.9 t/ha	**Pre-sowing stubble management**	Standing stubble
Soil residual nutrition (at sowing, 0-15 cm)	Colwell P ~ 15 ppm, Sulphur ~ 4.7 ppm	**Nitrogen**	0-15cm ~ 36 kg/ha, 10-90cm

Data was analysed using ASREML (Butler, Cullis, Gilmour, & Gogel, 2009) for R. T. Unless otherwise stated the statistical difference is tested using 95% level of confidence, represented as $P<0.05$.

Discussion

Sowing.

Many paddocks in the district were dry sown much earlier than the 6 June, when TOS1 was sown. The TOS1 seed sat in the ground for 20 days, with 2 false breaks of 3.5 and 4 mm. This lighter rain is generally considered enough to initiate germination, but not enough for a full establishment. TOS2 was sown ahead of forecast rain with 13.5 mm falling within 48 hours (of sowing). TOS3 was sown 5 days after rain, while TOS4 was sown 12 days after rain, with no rain falling in the interim. The next decent rain (23 mm) did not fall till the 25/08/2018 almost 2 months after TOS1 (

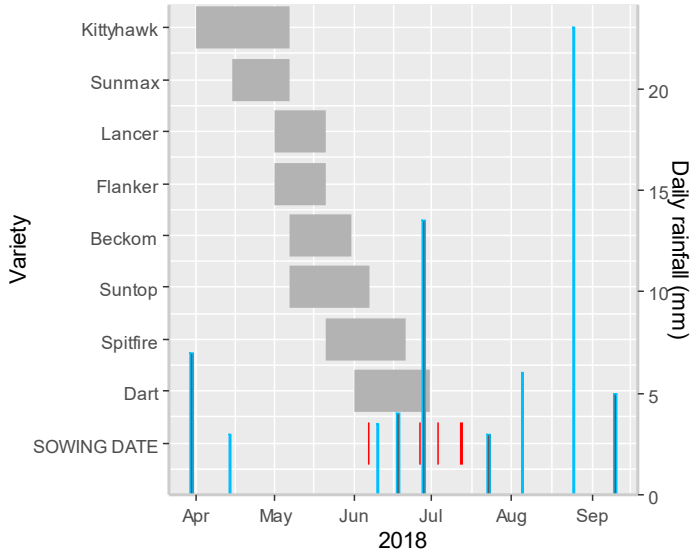


Figure 1).

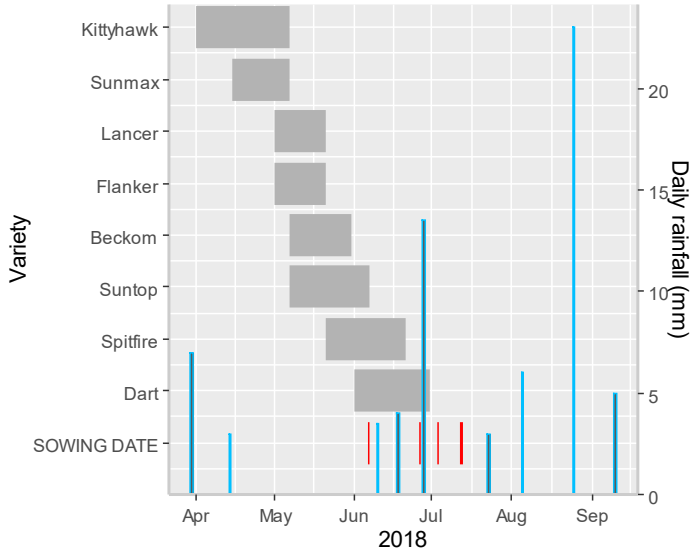


Figure 1. Suggested variety sowing windows NSW DPI Winter Crop Sowing Guide 2018 (Matthews & McCaffery, 2019), actual TOS's (red) and rainfall (mm) (blue), Gilgandra 2018.

Plant establishment.

There were differences in plant establishment within TOSs and within varieties, with an interaction between both.

- For TOSs (regardless of variety), TOS2 achieved the highest plant population with 154 plants/m^2, very close to the target population of 150 plants/m^2.
- For TOS4 the plant establishment was 73 plants/m^2, almost half of TOS2 (**Figure** 2).
- TheTOS1 had close to 115 plants/m^2 while TOS3 had 93 plants/m^2.
- Establishment assessments were conducted on the 19/9/18 for TOS3 and TOS4.

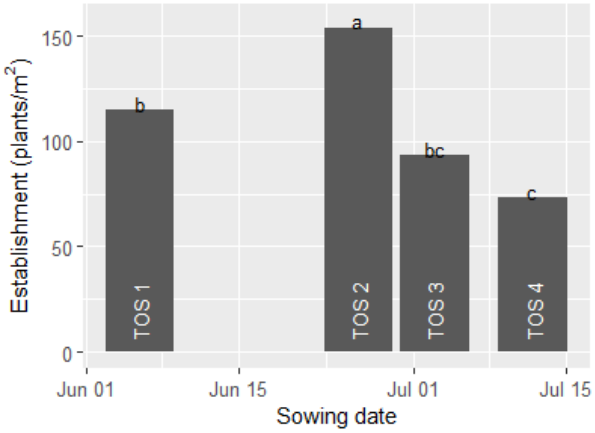


Figure 2. Establishment for the 4 TOS's. Values with the same letter are not significantly different.

There were also differences between varieties (see annex). Beckom[A] had the highest establishment (not considering TOS) with a population of 125 plants/m^2. At the other end Dart[A] had the lowest population with 82 plants/m^2.

Yields

- There was a range of yields across the TOS's
- Generally, TOS1 and TOS2 out yielded TOS 3 and TOS4.
- The highest yielding timing, TOS2 yielded 1.84 t/ha, 36% more than TOS4 (1.18 t/ha).

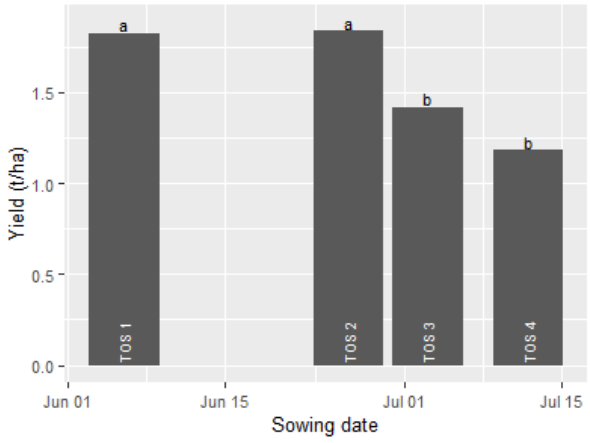


Figure 3. Yield (t/ha) for the 4 TOS's. Values with the same letter are not significantly different.

Grain quality

- Overall, the protein % were high.
- TOS1 had the lowest protein % at 15.3%, compared to TOS4 which tested at 17.1%.
- Screenings increased with the later TOSs.
- Screenings for TOS1 and TOS2 were both below the 5% threshold for a change in bin grade at 2.9% and 3.4% respectively.
- Both TOS 3 and TOS4 had screening levels >5% @ 6.3% and 9.0% respectively.

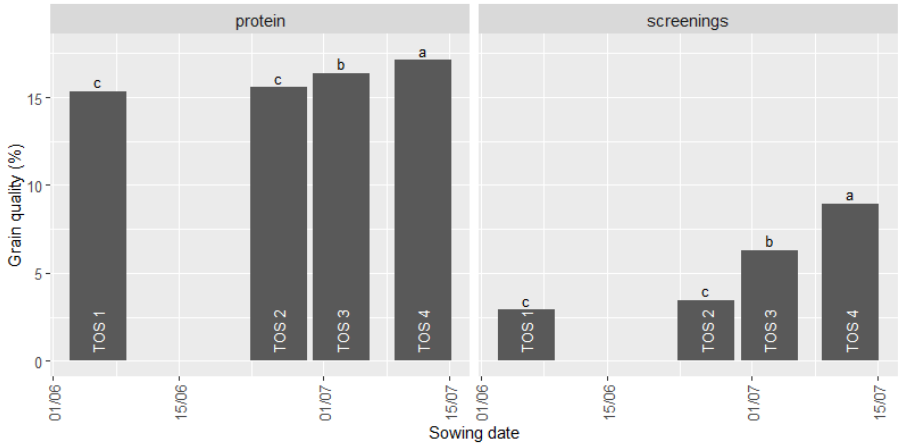


Figure 4. Grain quality (%) for the 4 times of sowing. Values with the same letter are not significantly different

Discussion

Establishment

For TOS1, small amounts of rain were received shortly after sowing (~7 mm), while TOS2 had ~13 mm 2 days after sowing. This effectively meant that the varieties sown dry (TOS1) had 2 small showers of rain (false breaks) before germinating rain fell on the 28/6/18. This affected establishment, with half the varieties having significantly lower establishment at TOS1 than TOS2. Overall, sowing just before the rain (TOS2) was the most reliable establishment option across all varieties, regardless of the varietal maturities and sowing window differences. Arguably soil moisture and rainfall have a much larger influence over establishment than sowing window (seed size may also contribute). There was limited rainfall after TOS2, which effectively meant that TOS3 and particularly TOS4 were sown into drying soils, and it is likely that the full germination of these timings was not achieved before the rainfall event more than a month later (25/8/2018).

Yields

- There was no yield advantage to early sowing (dry sowing) compared to sowing just before rain.

- Yields for the first 2 TOSs were better than for the later 2. There are several studies showing that later sowing reduces the yield potential, but this doesn't necessarily hold true for dry sowing.
- Varieties such as Kittyhawk, Sunmax[A], LRPB Lancer[A] and LRPB Flanker[A] were able to compensate for the lower establishment at TOS1 resulting in similar yields to when sown at TOS2.
- Dart[A] could not compensate.
- Varieties such as Beckom[A], Suntop[A] and LRPB Spitfire[A] sown at TOS1 had the same establishment than the same varieties sown at TOS2, with no yield differences. This may indicate that yields were maximised at this population for these varieties.
- It is possible that there was some yield upside by increasing the seeding rate (at TOS1) for the varieties that were able to compensate for lower plant population, however this was not tested.

Grain quality

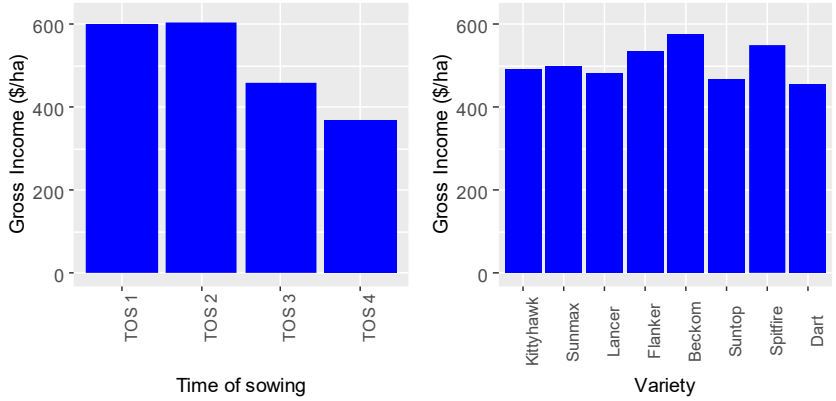
Protein % increased with the later TOSs, which is likely to be explained by yield dilution (as yield increases, the percentage of protein in the grain often decreases — even though the total protein exported per hectare may stay the same or even increase). The later TOSs had high screenings, that would have resulted in a grade penalty. Normally it might be expected that higher yielding crops are more prone to high screenings, but that was not the case in this trial. It is likely that the later sown varieties matured later and ran out of moisture during grain fill. The earlier sown varieties made better use of the small amounts of rain that fell before the later TOSs were sown and this rainfall may have been lost to evaporation. The earlier TOSs may have had a greater opportunity to establish more robust root networks, allowing them to extract more moisture. It is possible that the combination of these factors all contributed to higher yields and lower screenings.

Economics

There were economic differences between TOS's. The first 2 TOSs were very close in terms of gross income and were more than $140/ha better options than either of the later TOSs. Some varieties had higher gross income than others, overall Beckon[A] had the highest gross income of ~$570/ha and Dart[A] the lowest at ~$450/ha.

Figure 5. Gross income ($/ha)[1] for the 4 times of sowing and 8 varieties.

[1] Grain prices delivered Nevertire March 2019, using GrainCorp Wheat Standards 2019 to determine grades.



Conclusion

- Dry sowing and exposing seeds to false breaks can reduce the plant establishment for some varieties and for some varieties this can also lead to a yield reduction.
- If the season break is already late, delaying sowing until after an establishing rain event can also have a significant negative impact on yield and screenings.
- Sowing as close as possible prior to a germinating rainfall event proved to be the best option when the season break is unusually late, regardless of variety.
- Sowing time had a greater influence on yield than variety. Arguably in a very late sowing scenario the frost risk was very low for all varieties, but heat stress should have been more acute for the longer season varieties, though this did not eventuate.

Acknowledgements

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Annex 1. Trial results and analysis

Variety	Time of sowing	Plant establishment (plants/m2)			Vegetation index (NDVI)			Yield (t/ha)			Screenings (%)			Protein (%)			Test weight (kg/hl)		
		p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]
Beckom																			
	1	136	abcde	ab	0.26	cdef	a	2.20	a	a	2.3	kmn	b	14.1	m	b	81.2	bcdefgh	a
	2	156	ab	a	0.26	defg	a	1.94	abcde	ab	2.9	ijklmn	b	15.0	ijkl	a	80.5	cdefghi	a
	3	117	cdefgij	bc	0.21	ijk	b	1.58	cefghijkln	bc	2.9	jklmn	b	15.0	jkl	a	82.2	abcdef	a
	4	90	iklmo	c	0.18	klmn	b	1.31	ijklmnopq	c	6.1	efg	a	15.5	ghijk	a	81.0	bcdefghi	a
Dart																			
	1	98	jklmn	b	0.22	ghij	a	1.49	efghijklmnop	b	4.3	ghij	b	14.7	klm	b	78.5	ghi	a
	2	135	bcdef	a	0.25	efgh	a	2.03	abc	a	3.3	hijklmn	b	14.9	klm	b	81.6	abcdefg	a
	3	55	op	c	0.17	nop	b	1.03	oq	bc	9.8	bc	a	17.0	cd	a	80.5	cdefghi	a
	4	42	p	c	0.17	mp	b	0.99	q	c	10.0	bc	a	16.9	cd	a	79.8	defghi	a
Flanker																			
	1	92	jklmn	bc	0.24	fghi	b	1.63	bcdefghijklm	ab	2.2	lmn	b	14.8	klm	b	82.5	abcdef	a
	2	147	bc	a	0.28	abcd	a	1.99	abc	a	3.0	ijklmn	b	15.0	jkl	b	79.3	fghi	a
	3	101	efghijklm	b	0.20	ijklm	bc	1.68	bcdefghik	ab	3.8	hijkl	b	15.3	hijk	b	82.0	abcdefg	a
	4	63	np	c	0.17	mp	c	1.24	klmnopq	b	8.4	cd	a	16.3	defg	a	80.3	cdefghi	a
Kittyhawk																			
	1	100	fhijklm	b	0.29	abc	a	1.92	abcd	a	1.7	mn	c	15.5	ghijk	c	82.2	abcdef	a
	2	155	abc	a	0.26	bdefg	a	1.74	bcdefghi	ab	3.2	hijklmn	c	15.9	fghi	bc	79.6	bcdefghi	ab
	3	102	efghijklm	b	0.21	ijk	b	1.36	hijklmnopq	bc	6.9	de	b	16.6	def	b	79.9	defghi	ab
	4	74	klno	b	0.17	klmn	b	1.13	nopq	c	12.5	a	a	17.5	bc	a	78.1	hi	b
Lancer																			
	1	99	fhijklmn	b	0.29	abc	a	1.72	bcdefghi	a	1.5	n	b	16.5	def	bc	84.7	a	a
	2	158	ab	a	0.26	cdef	a	1.60	defghijklm	a	2.4	lmn	b	16.0	efgh	c	79.8	defghi	b
	3	93	ghiklmn	b	0.20	ijkl	b	1.46	fghijklmnp	ab	4.7	fghi	a	16.9	cd	b	82.3	abcdef	ab
	4	69	lno	b	0.17	klmn	b	1.08	opq	b	6.4	ef	a	17.9	ab	a	81.4	bcdefg	b
Spitfire																			
	1	123	bcdefghi	ab	0.30	ab	a	1.87	abcdef	a	3.5	hijkl	b	16.5	def	b	83.4	abc	a

GOA Trial Proposal

Variety	Time of sowing	Plant establishment (plants/m2)			Vegetation index (NDVI)			Yield (t/ha)			Screenings (%)			Protein (%)			Test weight (kg/hl)		
		p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]	p.v.[1]	s1[2]	s2[3]
	2	156	ab	a	0.26	cdef	b	1.69	bcdefghij	ab	3.6	hijklm	b	16.3	defg	b	82.5	abcdef	a
	3	109	defghijk	b	0.22	hij	c	1.78	abcdefg	ab	3.8	hijkl	b	16.8	cde	b	84.1	ab	a
	4	94	ghikm	b	0.17	lmo	d	1.38	ghijklmnop	b	6.6	def	a	18.1	ab	a	82.7	abcde	a
Sunmax																			
	1	129	bcdeg	b	0.30	a	a	1.97	abcd	a	3.7	hijkl	b	16.3	defg	b	79.5	efghi	a
	2	172	a	a	0.28	abcde	a	2.04	ab	a	4.9	fgh	b	16.3	defg	b	78.0	i	a
	3	90	hklmn	c	0.20	jklmn	b	1.20	mopq	b	10.5	b	a	18.3	ab	a	77.8	i	a
	4	85	jklmno	c	0.18	klmn	b	1.23	lmnopq	b	11.2	ab	a	18.4	a	a	78.0	i	a
Suntop																			
	1	139	abcd	a	0.27	cde	a	1.81	bcdefgh	a	3.9	hijkl	c	14.3	lm	c	82.8	abcd	a
	2	153	abc	a	0.25	efgh	a	1.68	bcdefghijk	ab	4.2	hijk	c	15.1	ijkl	bc	81.4	bcdefg	ab
	3	80	lmn	b	0.18	klmn	b	1.25	jlmnopq	bc	7.8	de	b	15.8	fghij	ab	82.2	abcdef	ab
	4	68	lno	b	0.17	klmn	b	1.10	opq	c	10.5	b	a	16.2	defg	a	79.4	fghi	b
lsd																			
	lsd	34			0.03			0.44			1.9			0.9			3.3		

[1] predicted value

[2] values with the same letter for each variable are not significantly different

[3] values with the same letter for each variable within each variety only are not significantly different