

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

Trial code:	GOMA00318-3
Season/year:	Autumn 2018
Location:	'Mimosa' Alectown
Trial partners:	Craig Ward and Peter Yelland

Keywords

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

Key findings

- There were no differences in yields between time of sowings (TOSs). Yields ranged from 0.79 to 0.96 t/ha.
- There were differences in plant establishment within TOSs and within varieties, with an interaction between both.
- Screenings increased with the later sowing timings.
- TOS2, when averaged across all varieties, had the highest gross income.

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.

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 contrasting maturities when sown across a range of sowing timings.
- Quantify any impacts on crop establishment and resultant yields when crop is dry sown.
- Quantify the advantage of dry seeding when sowing varieties outside of their ideal sowing window.

Methodology

- Eight varieties, 4 time of sowings (TOS).
- Split plot design, 3 replications.

The varieties selected reflected a range of commonly used varieties with a range of maturities in the Central West of NSW and the sowing timings were to replicate dry sowing either a long way before or just before rain and sowing into moisture after a rain event as follows.

The TOSs were:

TOS1. (7/6/18): Dry sown, no forecast of rain imminent

TOS2. (27/6/18): Dry sown, 1-2 days ahead of forecast rainfall of enough for crop establishment

TOS3. (3/7/18): Sown into moisture as soon as possible after enough rainfall for crop establishment

TOS4. (12/7/18): Sown into moisture 7-10 days rainfall.

The targeted plant population was set at 150 plants/m². Seed rates were adjusted according to the seed size and tested germination of each variety. An establishment factor of 80% was used.

1. Kittyhawk (winter wheat)
2. Sunmax^A (long season- slow spring wheat)
3. Lancer^A (mid- late maturity, spring wheat)
4. Flanker^A (mid- late maturity but with plasticity in sowing date)
5. Beckom^A (mid maturity- spring wheat)
6. Suntop^A (mid maturity- spring wheat)
7. Spitfire^A (early-mid maturity, spring wheat)
8. Dart^A (quick- spring wheat)

Table 1. Trial site details

Establishment date	Autumn 2018		
Crop and variety	Wheat-various	Seeding rate	Targeted
Sowing date	Various	Harvest date	3/12/18

Seedling equipment	Knife point press wheel	Row spacing	27.5 cm
Crop nutrition (kg/ha)	MAP 100	Soil type	Red chromosol
Previous crop	Lupins	Pre-sowing stubble management	Standing stubble
Soil residual nutrition (at sowing, 0-15 cm)	Colwell P ~ 43 ppm, Sulphur ~ 6 ppm	Nitrogen	0-10cm ~ 81 kg/ha, 10-90cm ~ 74 kg/ha

Data was analysed using ASREML (Butler, Cullis, Gilmour, & Gogel, 2009) for R. The Least Significant Difference (LSD) method was used to determine if there were differences between the treatments. A statistically significant difference is one in which we can be confident that the differences observed are real and not a result of chance. Unless otherwise stated the statistical difference is tested using 95% level of confidence, represented as $P < 0.05$.

Table 2: Alectown 2018 rainfall and the long-term average (LTA).

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
2018	19	5	4	10	17	25	1	19	21	36	81	22	260
LTA	60	54	54	47	46	41	49	49	47	54	55	51	607

Results

Sowing.

While there were many paddocks dry sown earlier in the district, TOS1 was sown on the 6 June, 7.3 mm fell 4 days later, with a further 5 mm later that week (Table 2).

TOS2 was sown on the 26/6 and 11 mm fell the day after while TOS3 and TOS 4 were sown on the 3 and 12/July respectively. The next rainfall event wasn't until the beginning of August (**Figure 1**).

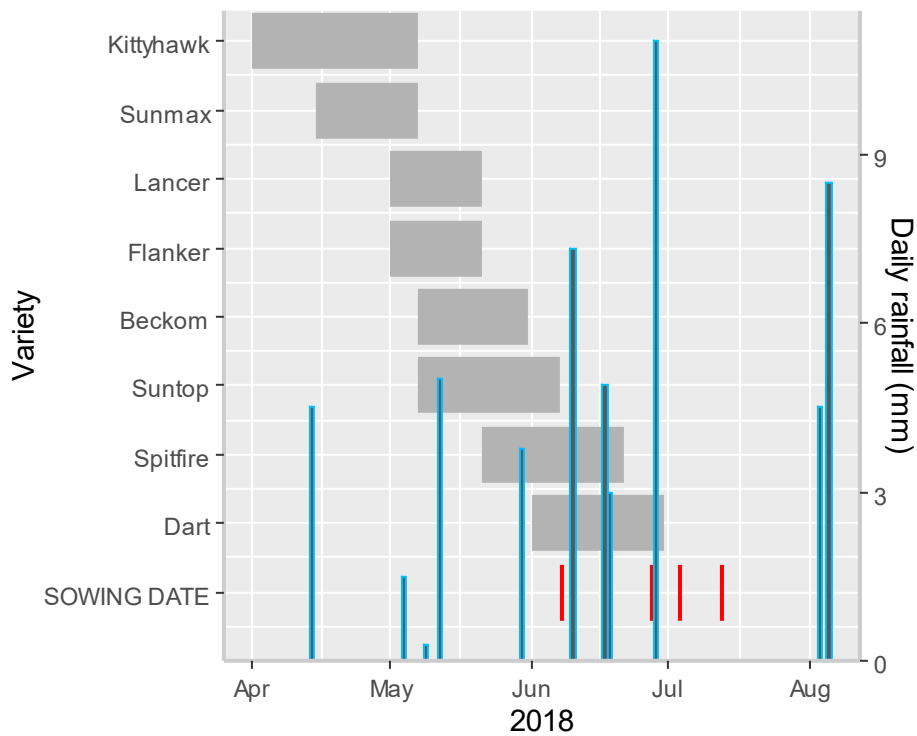


Figure 1. Suggested variety sowing windows NSW DPI Winter Crop Sowing Guide, 2019 (Matthews & McCaffery, 2019), actual sowing dates (red) and rainfall¹ (mm) (blue).

Plant establishment.

There were differences in plant establishment within TOSs and within varieties, with an interaction between both. For TOS, regardless of variety, TOS3 achieved the highest and closest to the target plant population of 150 plants/m² with 125 plants/m² established. For TOS1, TOS2 and TOS4 the plant establishment was 95, 88 and 90 plants/m² respectively, (Figure 2).

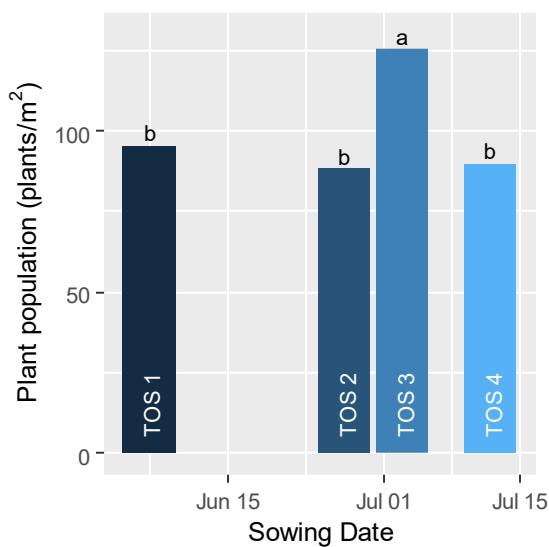


Figure 2. Establishment for the 4 TOSs. Values with the same letter are not significantly different.

¹ Rainfall data from on farm records.

There were also differences between varieties for plant establishment (see Annex 1). Beckom^A had the highest establishment (not considering TOS) with a population of 126 plants/m². At the lower end Dart^A had a population of 78 plants/m².

Yields.

There were no differences in yields between TOSs. Yields ranged from 0.79 to 0.96 t/ha (**Figure 3**). Beckom^A had the highest yield (regardless of TOS) while Dart^A had the lowest overall yield, there was 0.4t/ha difference between these varieties.

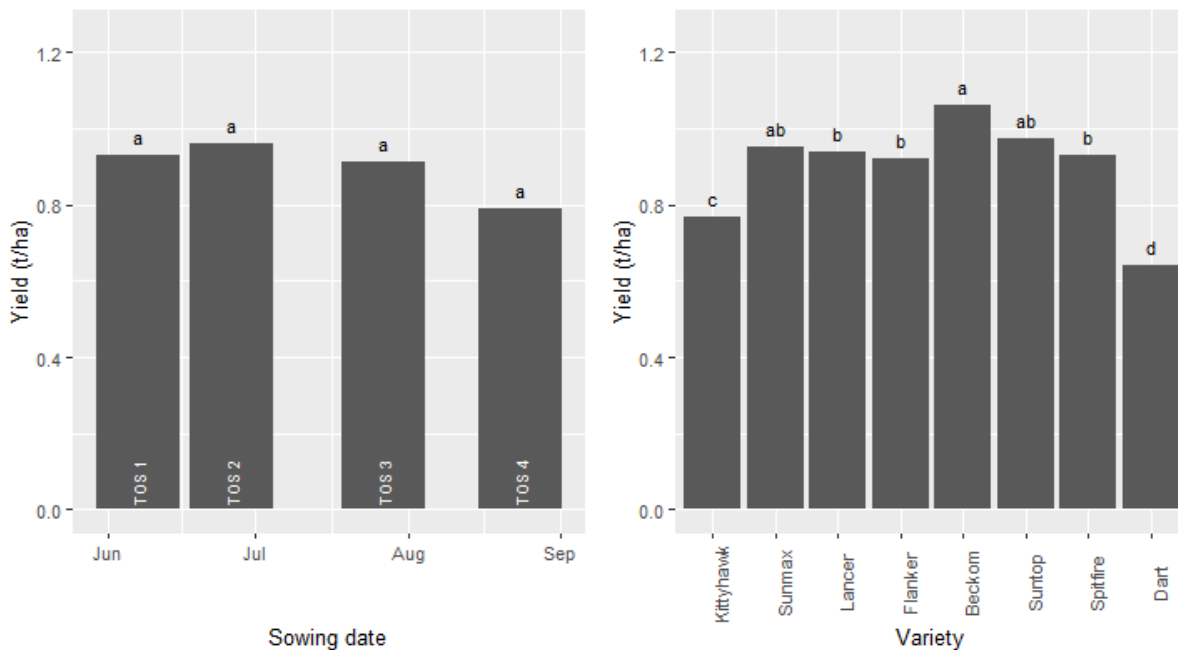


Figure 3. Yield for the 4 TOSs and each variety. Values with the same letter within a variable are not significantly different.

There were some varietal differences in yield (**Figure 4: Y**).

- The lowest yield was Dart^A (0.4 t/ha) while the highest yield was Beckom^A with 1.3 t/ha, both at TOS1.
- Kittyhawk^A, Flanker^A and Beckom^A had lower yields at the last TOS compared with TOS1.
- Sunmax^A, Lancer^A and Suntop^A had no yield differences across the range of sowing timings.
- Spitfire^A and Dart^A had lower yields at TOS1 than TOS3 and TOS2 respectively.

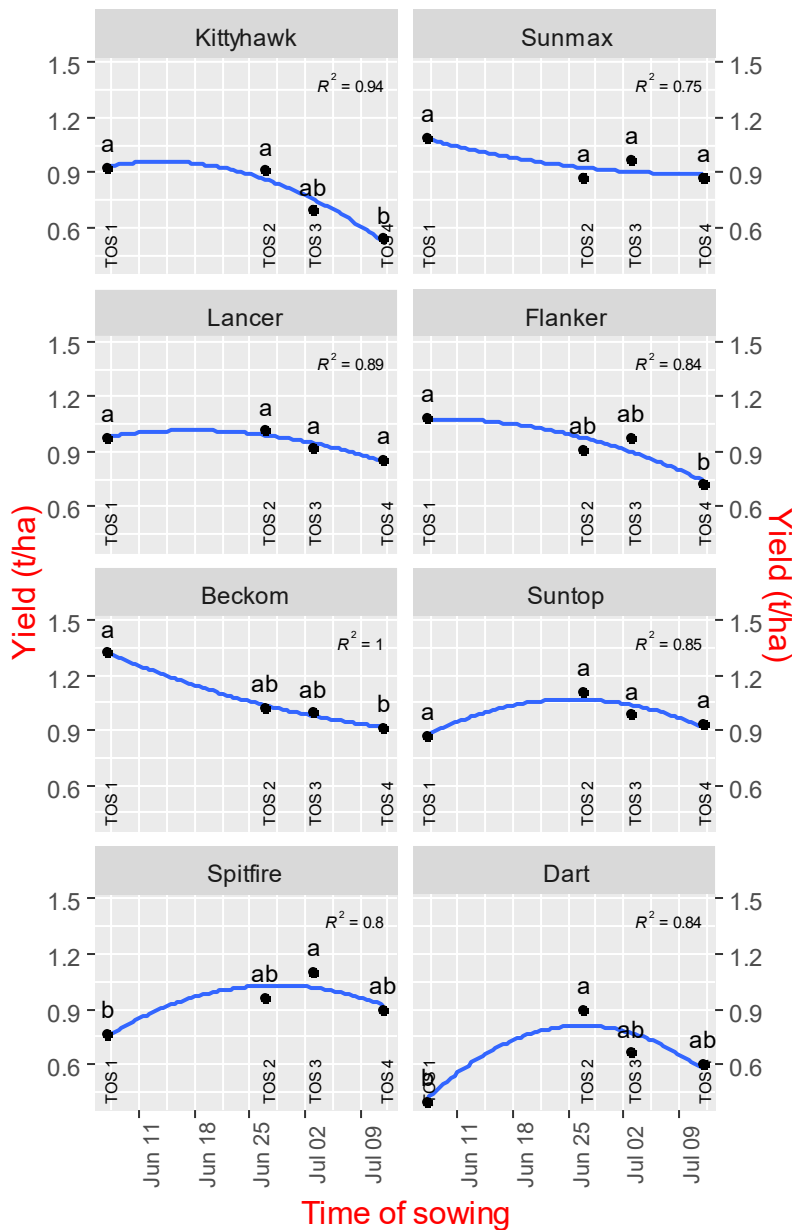


Figure 4: Yield for the 8 varieties and 4 TOSs. Values with the same letter are not significantly different.

Grain quality

Overall protein was high, TOS1 with the lowest protein levels tested at 14.4%, compared to TOS3 which tested at 14.8%. Screenings increased with the later sowing timings. TOS1 was below the 5% threshold for a change in bin grade at 4.5%. TOS2, TOS3 and TOS4 tested 6.5% with 9.2% and 7.2% respectively.

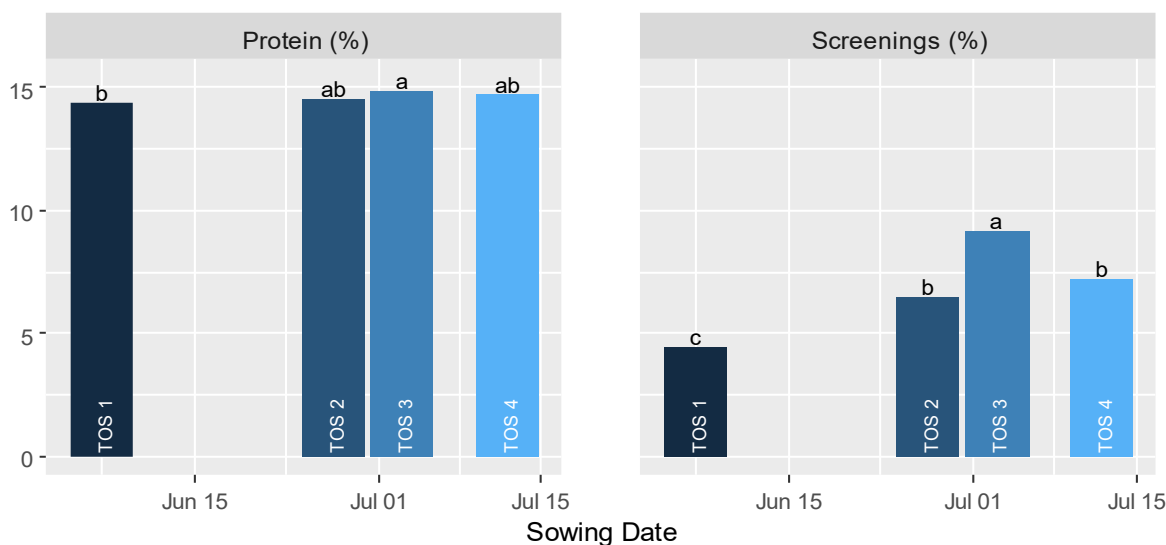


Figure 4. Grain quality for the 4 TOSs. Values with the same letter are not significantly different.

Discussion

Establishment

This trial was impacted by well below average rainfall (260 mm versus the long-term average of 607 mm) (Table 2). This provided a good test for establishing crops under low rainfall conditions, however also limited yields. Rain in October and November may have been beneficial for the varieties that were less mature when it arrived (such as the later sown Dart).

The TOS1 sowing was followed up by small amounts of rain soon after (~11 mm) which was enough to initiate a germination and was helped by a further 11 mm that fell just after TOS2. This effectively meant that the varieties sown dry (TOS1) were not exposed to an extended dry period nor were they subject to false breaks. TOS2 was sown into marginal moisture and the 11 mm just after sowing was enough for crop establishment. TOS3 and TOS4 were sown into drying conditions, with the next rainfall in the first week in August, about a month later. TOS3 had the highest establishment, which is unexpected, and hard to explain.

Yields

The hypothesis that germination may be affected by having seeds sitting in dry soil for an extended period was not tested at this site due to the pattern of rainfall. However, there was some scope for looking varietal performance differences from sowing outside of recommended windows. Sunmax^A and Lancer^A, sown well outside their windows, and Suntop^A, sown at the very end of its window, did not show significant yield variations between the 4 TOSs. Kittyhawk^A, Flanker^A or Beekom^A yields tended to taper off the later they were planted outside of their optimal window. At TOS1 Spitfire^A and Dart^A were well inside the recommended sowing window, however had better yields at later sowing times. This may suggest that the sowing windows are guides and that there will always be seasonal variations.

There was more to be gained by selecting the appropriate variety than there was to alter the sowing time. There are several studies showing that later sowing reduces the yield potential, however this may not hold true when there is rain towards the end of the growing season. Varieties such as

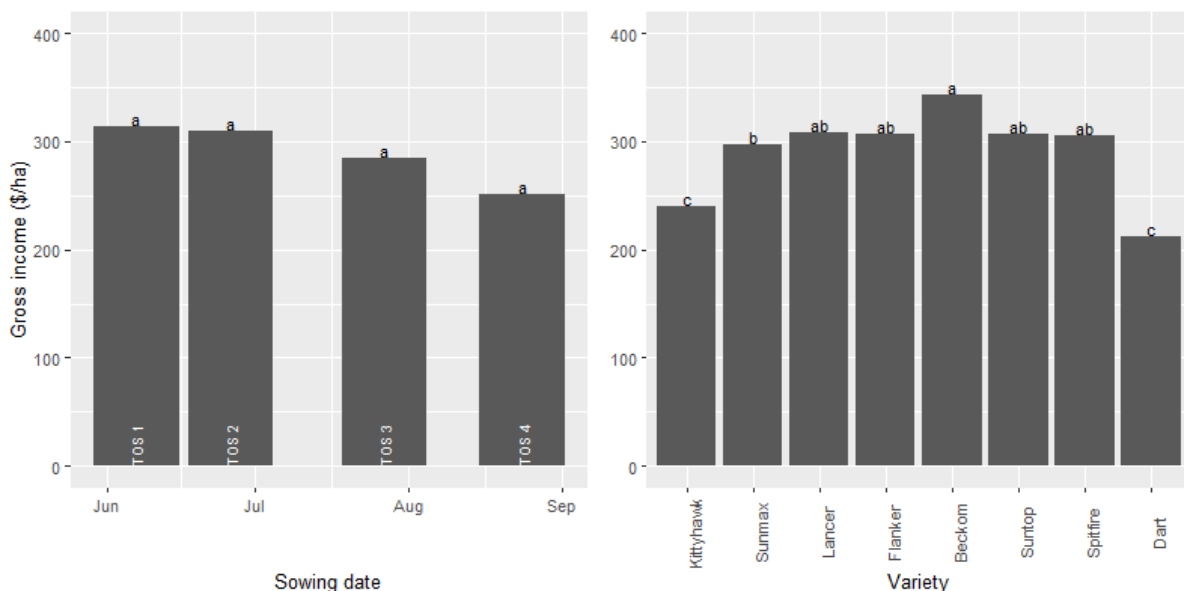
Kittyhawk^A, Sunmax^A, Lancer^A and Flanker^A were all able to compensate for the lower establishment at TOS1 and have similar yields at TOS2. Dart^A on the other hand could not compensate and may have been ripe when rain did fall in October. Varieties such as Beckom^A, Suntop^A and Spitfire^A sown at TOS1 had the same establishment at TOS2, with the same yields. .

Grain quality

Protein levels increased slightly with the later TOSs, which is likely to be explained by yield dilution (where lower yields tend to have higher protein levels). The later TOSs had high screenings, that would have resulted in a grade penalty. It is the norm that higher yielding crops are more prone to screenings blow outs, but that was not the case here. It is likely that later TOSs matured later and ran out of moisture during grain fill. The earlier TOSs were able to make better use of the small amounts of rain that fell prior to sowing, some of which may have been lost to evaporation for the later TOSs. The earlier TOSs had a greater opportunity time for establishing a more robust root network, 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 yield and grain quality differences added up to considerable differences in gross incomes. Overall, TOS2, when averaged across all varieties, had the highest gross income of \$315/ha, nearly \$60/ha better than TOS4. There were big variations between the varieties, averaged across all TOSs. Overall Beckom^A had the highest gross income of ~\$350/ha and Dart^A the lowest at ~\$202/ha. When looking at the relationship between TOS and variety, the gross income clearly reflected the yield results, with little influence from the grain quality parameters.



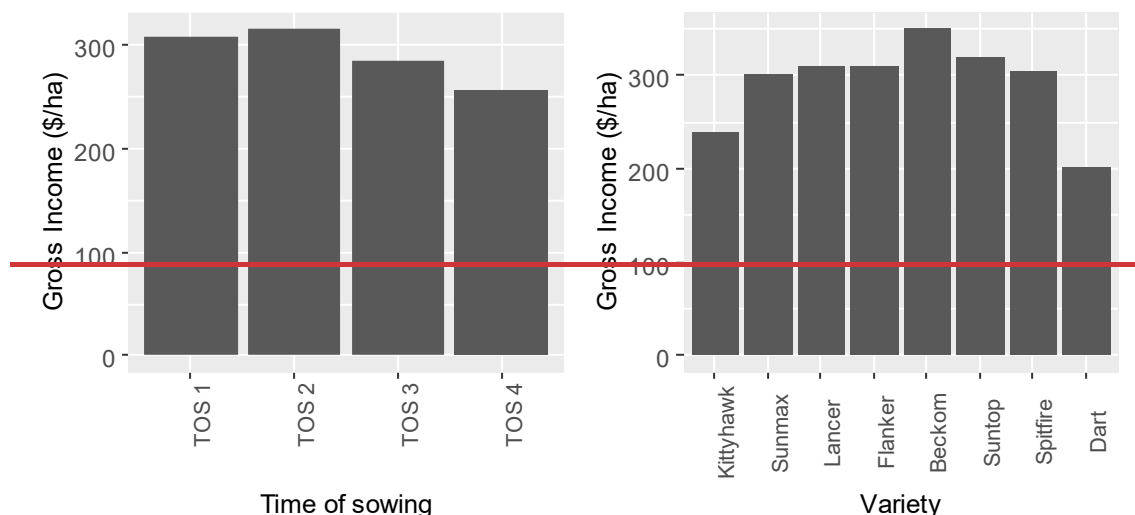


Figure 5. Gross income (\$/ha)² for the 4 times of sowing and 8 varieties.

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 timing had a greater influence on yield than variety. Arguably in a very late sowing scenario the frost was very low for all varieties, however heat stress should have been more acute for the longer duration varieties, though this did not appear to eventuate.

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² Grain prices delivered Nevertire March 2019, using GrainCorp Wheat Standards 2019 to determine grades.

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Appendix

Annex 1. Trial results and analysis

Variety	Time of sowing	Plant establishment			Vegetation index			Yield			Screenings			Protein			Test weight		
		(plants/m2)			(NDVI)			(t/ha)			(%)			(%)			(kg/ha)		
		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	112	cdefg	b	0.29	b	a	1.32	a	a	2.9	l	b	14.0	ijk	a	80.2	abcde	a
	2	99	efghi	b	0.25	defgh	b	1.02	abcdef	ab	4.7	ijkl	b	13.5	jkl	a	79.6	defghijk	ab
	3	176	a	a	0.24	efghi	bc	1.00	abcdef	ab	8.6	cdefg	a	13.8	jkl	a	79.4	defghijk	ab
	4	117	cde	b	0.21	ikl	c	0.91	bcdefgh	b	8.2	cdefgh	a	14.0	ijk	a	78.8	hijklm	b
Dart	1	95	efghij	a	0.22	ghijk	a	0.40	k	b	6.1	fghijk	b	15.1	efg	ab	79.0	fghijkl	a
	2	72	jkl	ab	0.23	fghijk	a	0.89	defghi	a	9.0	cdef	ab	14.7	ghi	b	79.1	efghijkl	a
	3	83	hijkl	ab	0.21	jkl	ab	0.66	hijk	ab	11.4	bc	a	15.4	defg	ab	78.7	gijklm	a
	4	63	l	b	0.18	l	b	0.61	ijk	ab	7.1	efghi	b	15.5	cdef	a	79.2	efghijkl	a
Flanker	1	91	ghijk	b	0.32	a	a	1.08	abd	a	3.3	kl	a	12.8	m	c	79.4	defghijk	a
	2	82	hijkl	b	0.25	cdefgh	b	0.91	bcdefgh	ab	5.3	hijkl	a	13.4	klm	bc	78.8	hijkl	a
	3	129	bcd	a	0.23	efghij	b	0.98	abcdef	ab	5.6	ghijkl	a	14.2	hij	a	78.8	ijklm	a
	4	67	kl	b	0.19	l	c	0.72	fijk	b	5.6	ghijkl	a	13.7	jkl	ab	79.6	cdefghijk	a
Kittyhawk	1	84	hijkl	ab	0.27	bcde	ab	0.93	bcdefgh	a	4.7	ijkl	c	13.1	lm	b	79.7	cdefghi	a
	2	77	ijkl	b	0.27	bc	a	0.91	bcdefgh	a	8.7	cdefg	b	13.9	jk	a	78.2	lm	b
	3	105	defgh	a	0.24	defgh	b	0.69	ghijk	ab	12.9	ab	a	14.2	hij	a	76.9	no	c
	4	92	fghij	ab	0.20	jkl	c	0.54	jk	b	10.4	bcd	ab	13.8	jkl	ab	78.6	klm	b
Lancer	1	94	efghij	a	0.27	bcd	a	0.98	bcdfg	a	3.4	kl	a	14.8	fgh	b	79.1	efghijkl	b
	2	99	efghi	a	0.25	bcdefgh	ab	1.01	abcdef	a	3.8	jkl	a	15.8	cde	a	79.6	defghijk	ab
	3	111	cdefg	a	0.22	hijkl	bc	0.92	bcdef	a	4.3	ijkl	a	15.8	bcd	a	79.9	bcdefn	ab
	4	103	defgh	a	0.20	jkl	c	0.85	bcdefgh	a	4.7	ijkl	a	15.7	cde	a	80.4	abcd	a

GOA Trial Site Report

Variety	Time of sowing	Plant establishment			Vegetation index			Yield			Screenings			Protein			Test weight		
		(plants/m ²)			(NDVI)			(t/ha)			(%)			(%)			(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
Spitfire	1	103	defgh	ab	0.28	abcd	a	0.76	ehij	b	2.9	l	b	17.1	a	a	80.8	ab	a
	2	82	hijkl	b	0.28	bc	a	0.96	abcdefgh	ab	3.7	jkl	ab	16.6	ab	ab	80.7	abc	a
	3	115	cdef	a	0.25	bcdefg	a	1.10	abcd	a	6.4	ghijkl	a	16.2	bc	b	81.2	a	a
	4	92	fghij	ab	0.20	kl	b	0.89	bcdefgh	ab	4.3	ijkl	ab	16.6	ab	ab	81.4	a	a
Sunmax	1	89	ghijk	b	0.26	bcde	a	1.09	abd	a	6.2	fghijk	c	14.1	hij	b	78.6	jklm	a
	2	99	efghi	b	0.25	bcdefg	a	0.87	defghi	a	8.1	defgh	bc	15.1	efg	a	77.8	mn	a
	3	152	ab	a	0.26	bcdefg	a	0.97	abcdef	a	15.1	a	a	15.4	def	a	76.2	o	b
	4	80	hijkl	b	0.20	kl	b	0.87	bcdefgh	a	9.8	bcde	b	15.1	defg	a	78.7	ijklm	a
Suntop	1	94	efghij	b	0.26	bcdef	a	0.87	cefgi	a	6.3	fghijk	a	14.1	hij	a	79.4	defghijk	a
	2	95	efghij	b	0.26	bcde	a	1.11	abc	a	8.6	cdefg	a	13.5	jklm	a	79.6	defghijk	a
	3	131	bc	a	0.24	defghi	a	0.99	abcdef	a	8.9	cdef	a	13.9	jk	a	79.7	bcdefghij	a
	4	104	defgh	b	0.20	kl	b	0.93	bcdegh	a	7.9	cdefghij	a	13.7	jkl	a	80.0	bcdefg	a
lsd	lsd	25			0.03		0.29			3.2			0.7			1.1			

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