GOA Trial Site Report

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

Trial code:	GOMA00318-2
Season/year:	Autumn 2018
Location:	'Carinya' Narromine
Trial partners:	Scott Vincent and Ryan Pratton.

Keywords

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

Key findings

- 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.
- Sowing as close as possible prior to a germinating rainfall event proved to be the best option for achieving a plant stand.
- In a dry sowing situation, increasing seeding rates may compensate for reduced establishment (if rain is delayed). Selecting varieties medium to shorter maturing varieties may mitigate the risk of reduced yields in the case of delayed season break.

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 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 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 differing 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

TOS1. Dry sown, no imminent forecast of rain
TOS2. Dry sown, 1-2 days ahead of forecast rainfall of enough for crop establishment.
TOS3. Sown into moisture as soon as possible after enough rainfall for crop establishment.
TOS4. Sown into moisture 7-10 days rainfall.

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 for a range of maturities:

1. Kittyhawk (winter wheat)
2. Sunmax[A] (long season- slow spring wheat)
3. LRPB Lancer[A] (mid- late maturity, spring wheat)
4. LRPB 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. LRPB Spitfire[A] (early-mid maturity, spring wheat)
8. Dart[A] (quick- spring wheat)

Table 1: site details

Establishment date	Autumn 2018		
Crop and variety	Wheat - various	**Seeding rate**	Targeted

Sowing date	Various	**Harvest date**	10/12/18
Seedling equipment	Knife point press wheel	**Row spacing**	27.5 cm
Crop nutrition (kg/ha)	MAP 100	**Soil type**	Red dermosol
Previous crop and yield	Canola (failed)	**Pre-sowing stubble management**	Cultivated
Soil residual nutrition (at sowing, 0-15 cm)	Colwell P ~ 41 ppm, Sulphur ~ 9 ppm	**Nitrogen**	0-15cm ~ 44 kg/ha, 10-90cm ~ 78 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 1: Narromine rainfall for 2018 and long-term average (LTA)[1].

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2018	24	4	3	7	11	13	0	27	6	48	75	37	**255**
LTA	59	52	49	42	42	44	42	38	39	48	48	48	**551**

Discussion

Sowing dates:

TOS	Date	Notes
TOS1	7/6/2018	~5 mm fell on 8/6/2018
TOS2	26/6/2018	~7 mm fell post sowing
TOS3	27/7/2018	Sowing delayed till the end of July due to low seedbed moisture after rainfall. <10 mm fell post sowing
TOS4	24/8/2018	Sowing delayed till the end of August due to low seedbed moisture after rainfall. 16 mm fell post sowing

Many paddocks in the district were dry sown much earlier than this trial. For TOS1 in early June the seed sat in the ground for 20 days, with a false break of about 5 mm falling the day after sowing (lighter rain, generally enough to initiate germination but not enough for a full establishment).

[1] Queensland Government. (2021). SILO Gridded Climate Data. Retrieved 2025 from https://www.longpaddock.qld.gov.au/silo/

TOS2 was sown ahead of forecast rain toward the end of June, however the forecast did not eventuate though a smaller amount of ~7 mm falling within 48 hours.

As there was insufficient rain to sow into moisture TOS3 was delayed until the next forecast rain, which was predicted for the end of July. The rain received was less than expected (<10 mm). The soil moisture was still not good enough for sowing and TOS4 was delayed till the next forecast which arrived towards the end of August and was followed up by a fall of around 16 mm which was sufficient to achieve germination (

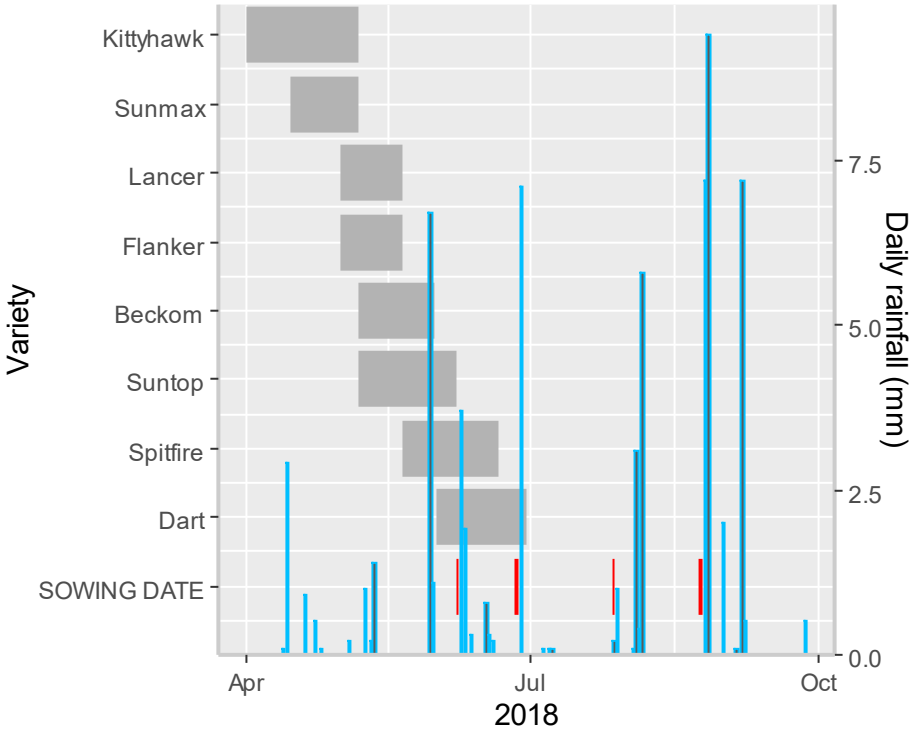

Figure 1).

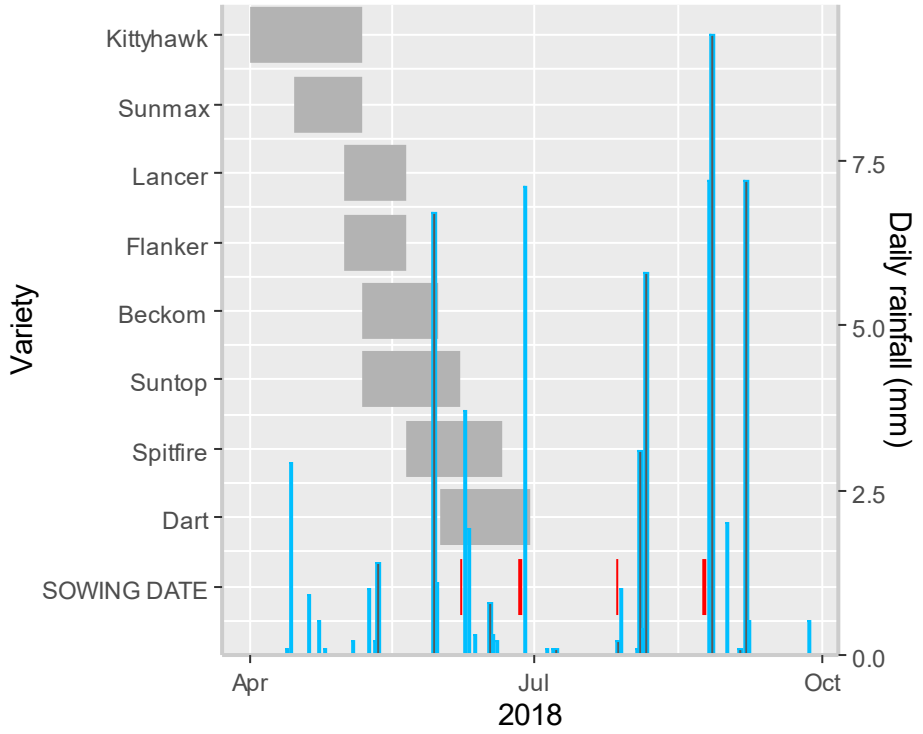

Figure 1. Suggested variety sowing windows (grey boxes) (Matthews & McCaffery, 2019), actual sowing dates (red) and rainfall[2] (mm) (blue), Narromine 2018.

Plant establishment.

- There were differences in plant establishment within TOSs and within varieties, with an interaction between both.
- TOS4 achieved the highest plant population with 160 plants/m^2, very close to the target population of 150 plants/m^{2,} regardless of the variety.
- For TOS1 the plant establishment was 103 plants/m^{2,} about 30% less than TOS4 (Figure 2).
- Beckom^A had the highest establishment, regardless of the TOS, with a population of 125 plants/m^2.
- Dart^A had the lowest population with 82 plants/m^2.

[2] Rainfall data from Narromine Airport (SILO site: 51115), approximately 17 km south west of the trial site.

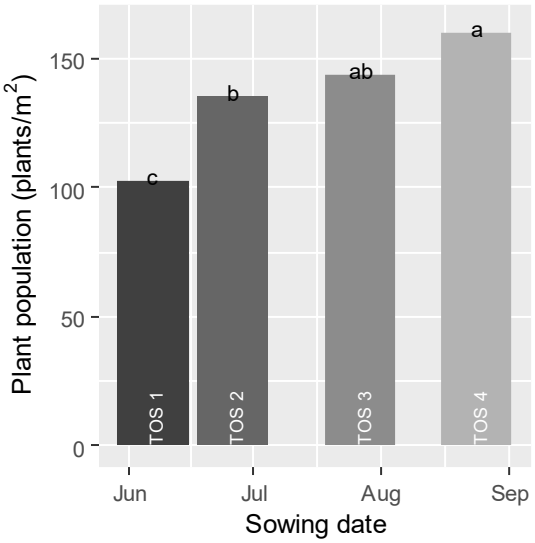

Figure 2. Establishment (plants/m^2) for 4 TOSs (regardless of variety). Values with the same letter are not significantly different.

Yields.

- There was a range of yields across the TOSs. Generally, TOS1 and TOS2 was out yielded by TOS3 and TOS4.
- The highest yielding timing, TOS3, yielded 1.80 t/ha, 24% more than TOS1 (1.34 t/ha).

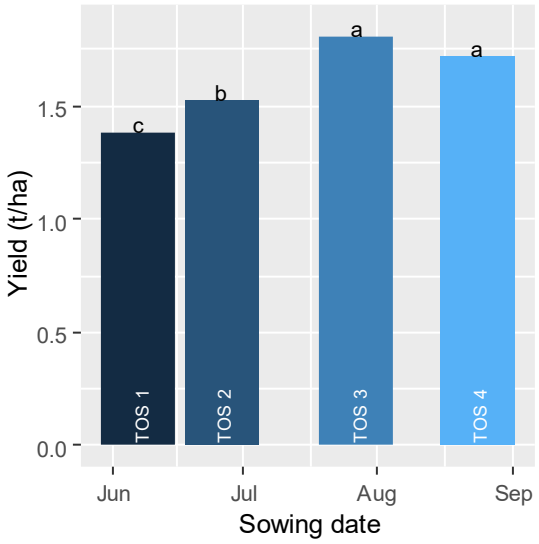

Figure 3. Yield (t/ha) for the 4 TOSs. Values with the same letter are not significantly different.

- Lancer[A], Flanker[A], Beckom[A], Spitfire[A] and Dart[A] all had higher yields at the later sowing dates.
- For Flanker[A] the difference between TOS1 and TOS4 was >0.5 t/ha.
- Sunmax[A] had higher yields at TOS3 than TOS1and TOS4.
- Suntop[A] had a flat response to wowing date with no difference in yields.
- Kittyhawk[A] was very green at harvest, and the performance of the late TOS is not known.

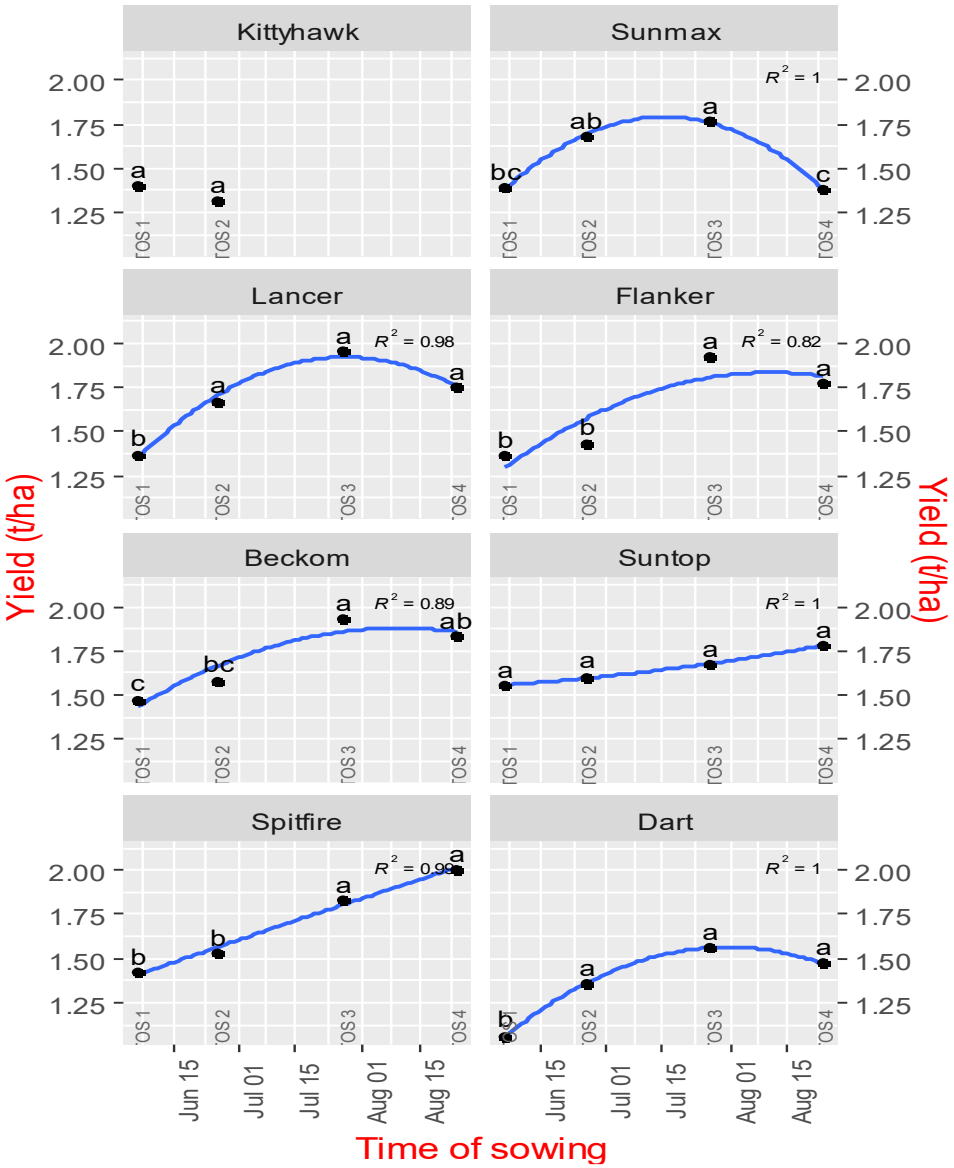

Figure 4. Yields by variety with blue fitted lines.

Grain quality.

Overall, grain protein was high.

- TOS1 had the lowest protein levels at 15.7%, compared to TOS4 at 16.5%.
- Screenings decreased with the later TOSs (Figure 4).
- Screenings for TOS1, TOS2 and TOS 3 were all above the 10% threshold for a downgrade to HPS1 or FED1 bin grade.
- TOS4 at 9.5% would make AUH2 grade, potentially attracting a better price.

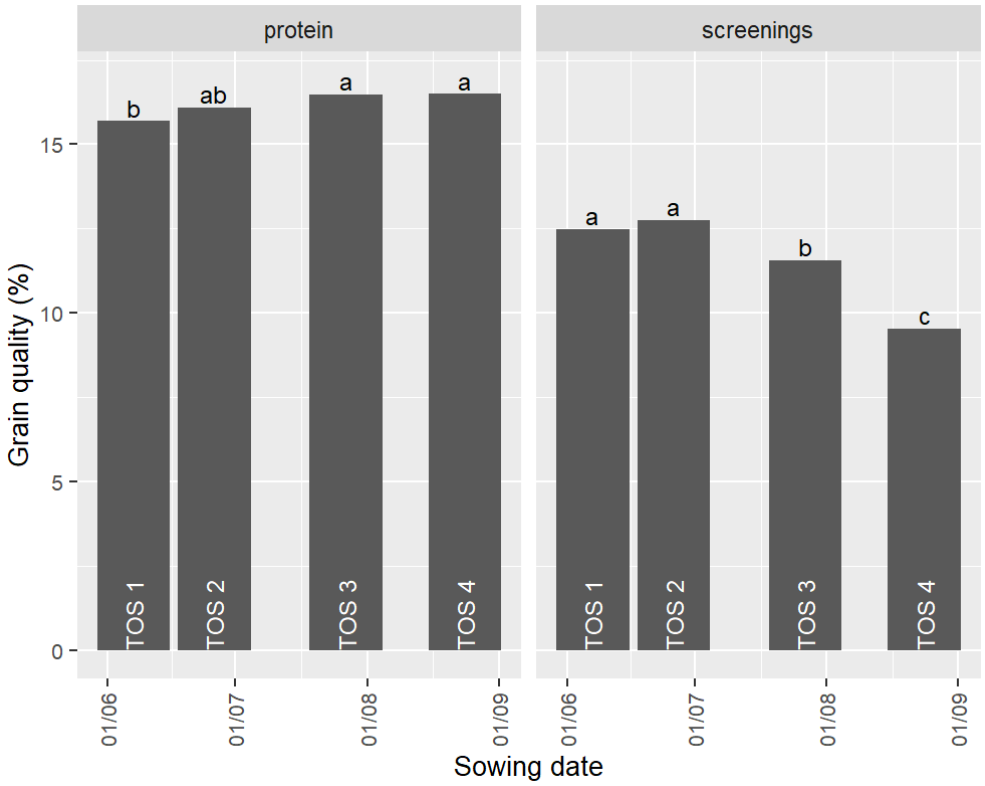

Figure 5. Grain quality and time of sowing. Values with the same letter are not significantly different.

Discussion

Establishment

There was 78 days between the first and last TOS at this site, this would have to be seen as an extreme scenario, but not uncommon in dry seasons.

During this period there were several small rainfall events, enough for a partial germination as seedlings were observed in each of the subsequent sowing timings. The final establishment was not assessed until after TOS4 (3 months after TOS1), partially because the site was close to being abandoned due to the extremely dry conditions.

The wheat was established on very low rainfall, as shown for the first 3 TOS, however the best establishment was achieved when seed was planted closest to the best germinating rainfall event. All varieties (except for Kittyhawk[A]), had a reduced population at TOS1 when compared to TOS4. The trend in establishment tended to be reflected in yields, with all varieties having the lowest yields at TOS1 than at least one of the later sowing timings (except for Suntop[A] and Kittyhawk[A]). While lower plant population may have contributed to lower yields, it may be just as plausible that the early sowing caused crops to mature earlier, hence missing the opportunity to capitalise on the rainfall that fell in October and November.

Sowing just before the rain (TOS4) achieved the best establishment across all varieties (except Kittyhawk[A]), regardless of the varietal maturities and sowing window differences. Given that the best establishment was achieved at the latest sowing timing (well over a month late for even the quickest varieties), it is easy to argue that soil moisture and rainfall have a much larger influence over establishment than sowing window.

Yields

There was no yield advantage to sowing early (dry sowing) compared to sowing just before rain (there was no moisture sown treatment in this trial), in fact there was a yield penalty for most varieties (the exception being Suntop[A]). No variety had a statistically better yield than at TOS3, though it appears that several of the longer season varieties may have started tapering off by TOS4 (i.e. Sunmax[A] and Lancer[A]). Suntop[A] showed no yield response to the varying TOSs despite a large difference in plant establishment (Suntop [A] at TOS1 had roughly half the population of TOS4).

Despite the dry winter and late break, the decent rain in October and November (~170 mm), resulted in reasonable overall yields, with a site average of 1.6 t/ha.

Numerous studies have shown that later sowing reduces yield potential, but this trial challenges that. Only Suntop[A] was able to compensate for the lower establishment at TOS1 to have a similar yield to the later sowing timings. Dart[A], on the other hand could not compensate, and this might possibly be because the early sown Dart[A] was maturing and not able to fully benefit from the October/November rain.

It may be possible that yield stability may be improved in dry sowing scenarios by increasing the sowing rates, particularly for varieties that are not able to compensate for lower plant population, however this was not tested.

Grain quality

Protein levels were overall very high (average ~16%) and would not have limited grade. Screenings were also high (over 10% site average)) and would have resulted in all treatments getting a quality downgrade to a lower bin grade.

Protein levels tended to increase with later timings, while screenings tended to decrease. For all varieties (except Spitfire[A]) screenings tended to decrease with later sowing timings. Normally it might be expected that higher yields might be associated with increased screenings, but that was not the case here. It difficult to explain why this is the case, one possibility is that the early sown varieties may have a higher incidence of disease. Another possibility is that the early sown varieties matured before the rain in October, that may have helped fill the later sown varieties.

Economics

There were economic differences between TOSs. The last 2 TOSs were similar for gross income, but >$100/ha better than either of TOS1 or TOS2. Some varieties had higher gross income than others, overall Lancer[A] had the highest gross income of about $532/ha and Dart[A] and Kittyhawk[A] the lowest with about $380/ha. The slowest and fastest varieties

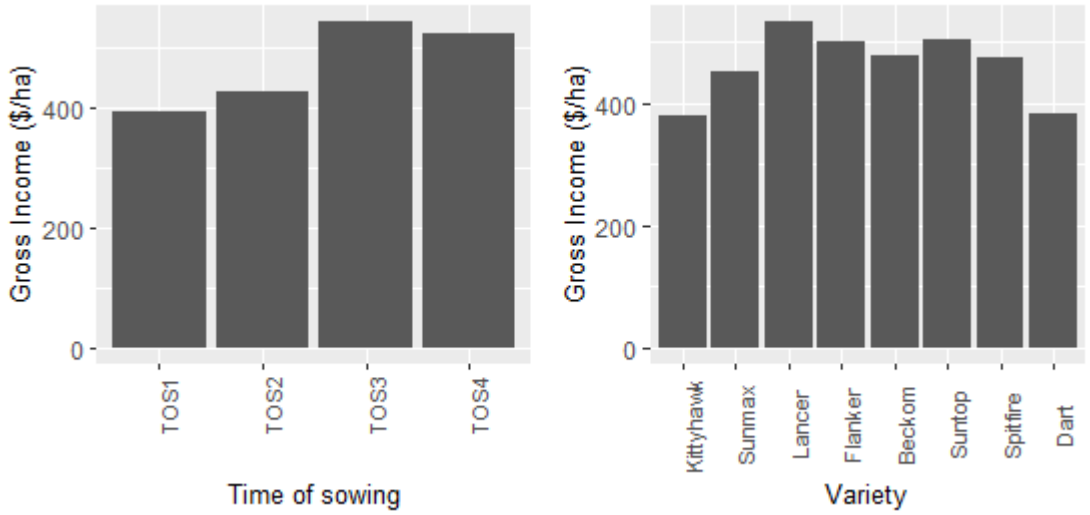

Figure 6. Gross income ($/ha) for TOS (regardless of variety) and variety (regardless of TOS).

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.
- Sowing as close as possible prior to a germinating rainfall event proved to be the best option for achieving an acceptable plant stand.
- In a dry sowing situation, increasing seeding rates may compensate for reduced establishment (if rain is delayed).
- Selecting varieties with wider sowing adaptability may reduce the risk of reduced yields in the case of delayed season break, of the varieties tested here, Lancer[A], Flanker[A], Beckom[A], and Suntop[A] generally have broader adaptability.

Acknowledgements

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Annex 1. Trial results and analysis

Variety	Time of sowing	Plant establishment (plants/m2)			Yield (t/ha)			Screenings (%)			Protein (%)			Test weight (kg/hl)		
		p.v.	s1	s2	p.v.	s1	s2	p.v.	s1	s2	p.v.	s1	s2	p.v.	s1	s2
Beckom																
	1	119	hijk	b	1.47	efghi	c	11.9	efg	ab	15.3	op	a	83.9	efghi	a
	2	153	cdefg	a	1.58	cdefghi	bc	13.1	cde	a	15.7	klmnop	a	83.5	efghi	a
	3	169	bcd	a	1.93	ab	a	12.6	cdef	a	16.0	hijklmno	a	85.3	bcdefg	a
	4	171	bc	a	1.83	abc	ab	10.2	gh	b	15.8	jklmno	a	86.1	bcdefg	a
Dart																
	1	65	m	b	1.06	j	b	14.6	abc	ab	16.3	defghijkl	a	85.6	bcdefg	a
	2	115	ijkl	a	1.36	i	a	16.3	a	a	16.2	fghijkl	a	81.8	hi	b
	3	116	hijkl	a	1.56	cdefghi	a	14.1	bcd	b	16.3	eghijkl	a	84.8	cdefgh	ab
	4	141	defghi	a	1.47	fghi	a	14.0	bcd	b	16.7	defghi	a	84.5	defghi	ab
Flanker																
	1	93	l	c	1.36	i	b	13.1	cde	a	15.3	mnop	a	87.5	abcd	a
	2	116	hijkl	bc	1.43	ghi	b	12.4	def	a	16.1	ghijklm	a	84.9	cdefgh	a
	3	128	ghijk	ab	1.92	ab	a	8.2	ijk	b	15.9	ijklmno	a	87.8	abcd	a
	4	152	cdefg	a	1.77	abcd	a	6.5	kl	b	15.7	klmnop	a	86.9	abcde	a
Kittyhawk																
	1	114	hijkl	a	1.40	ghi	a	11.9	efg	a	15.0	p	a	86.6	abcdef	a
	2	142	cdefgh	a	1.32	ij	a	10.0	ghi	a	15.3	nop	a	82.7	ghi	b
	3	129	fghijk	a												
	4	137	efghi	a												
Lancer																
	1	93	l	b	1.37	i	b	9.3	hij	a	16.4	defghijk	a	87.9	abc	a
	2	131	fghij	a	1.67	bcdefgh	a	10.0	ghi	a	16.5	defghij	a	85.7	bcdefg	a
	3	154	cdef	a	1.95	ab	a	9.4	hij	a	16.9	abcdf	a	86.0	bcdefg	a
	4	157	cdef	a	1.75	abcdef	a	6.9	kl	b	16.8	bcdefgh	a	85.5	bcdefg	a
Spitfire																
	1	106	jkl	b	1.42	ghi	b	15.3	ab	a	16.7	bcdefghi	b	86.3	bcdef	a
	2	133	fghij	ab	1.53	defghi	b	15.7	ab	a	17.0	abcde	ab	85.1	bcdefgh	a
	3	140	efghi	a	1.83	abc	a	16.7	a	a	17.5	ab	ab	88.4	ab	a
	4	138	efghi	a	2.00	a	a	15.5	ab	a	17.5	a	a	86.3	bcdef	a
Sunmax																
	1	130	fghij	b	1.39	ghi	bc	12.9	cde	a	16.2	fghijkl	b	85.0	bcdefgh	b
	2	149	cdefg	b	1.68	bcdefg	ab	12.7	cdef	a	16.6	cdefghij	ab	81.3	i	c
	3	151	cdefg	b	1.77	abcde	a	10.4	gh	b	16.7	cdefg	ab	85.9	bcdefg	b
	4	184	ab	a	1.38	hi	c	5.9	l	c	17.4	abc	a	89.8	a	a
Suntop																
	1	101	kl	c	1.55	cdefghi	a	10.8	fgh	ab	14.4	q	b	85.8	bcdefg	ab
	2	142	cdefgh	b	1.60	cdefghi	a	11.8	efg	a	15.3	nop	a	83.4	fghi	b
	3	165	bcde	b	1.67	bcdefgh	a	9.6	hij	bc	16.1	ghijklmn	a	87.7	abcd	a
	4	205	a	a	1.78	abcd	a	7.9	jk	c	15.6	lmnop	a	84.5	defghi	ab
lsd																