

Optimising cultivar x time of sowing in wheat and barley

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Key Findings

- Despite damage from August frosts, the highest wheat yield in this trial came from Trojan sown mid-April.
- Trojan (mid-maturing) complements Mace (fast-maturing) in a cropping program and allows growers to sow earlier and achieve higher yields (16%) than they could with Mace alone sown in its optimal window.
- Barley yield is less sensitive to time of sowing and in this trial highest yields came from faster maturing cultivars sown in early-mid May.

Why do the trial?

The majority of our current wheat varieties need to be sown in the first half of May to flower during the optimal period for grain yield. Recent research in southern NSW has shown they have well adapted winter and slow maturing spring cultivars that when sown in mid-late April will out-yield fast maturing cultivars sown in May. However, the same cannot be said for SA where no cultivar x ToS options have been shown to out-yield Mace sown in its optimal window.

Currently options for growers in SA who wish to sow early are not well known. The aim of this trial was to investigate time of sowing for individual wheat cultivars with different maturities. The majority of research to-date has focused on wheat varieties so in addition to wheat, four barley varieties with varying maturities were included.

How was it done?

Plot size	1.75 m x 10.0 m	Fertiliser	DAP (18:20) + 2% Zn @ 80 kg/ha @ seeding
Seeding date	ToS 1 – 14 th April ToS 2 – 8 th May ToS 3 – 2 nd June		Urea @ 120 kg/ha split application across @ GS30 and GS32 for each ToS

The trial was a split block design with three replicates, five wheat and four barley cultivars (Tables 1 and 2). Fungicides were applied as necessary to keep the crop canopy free of disease (ie. stripe rust, net blotch). All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen for wheat and a 2.2 mm screen and retention with a 2.5 mm screen for barley.

Table 1. Wheat cultivars and their maturity used in this trial.

Variety	Maturity	Comments
EGA_Wedgetail	Mid-maturing winter (strong vernalisation moderate photoperiod)	The early sowing and dual purpose standard in NSW and an excellent grain-only option. May be too slow in most of SA, only has APW quality and can be quite intolerant of problems associated with alkaline soils (CCN, boron, aluminium)
Rosella	Fast-maturing winter (strong vernalisation weak photoperiod)	Slightly faster than Wedgetail and seems to have better adaption to alkaline soils. However, it now only has GP quality.
Trojan	Mid-fast maturing spring (moderate vernalisation, moderate photoperiod)	Has demonstrated good adaption to SA and has an unusual photoperiod gene which may allow it to be sown in late April and flower at the optimal period
Mace	Fast-maturing spring (weak vernalisation, weak photoperiod)	No introduction necessary! SA main-season benchmark and in the trial as a control from a mid-late May sowing.
RAC1843	Very fast maturing spring (no vernalisation, no photoperiod)	A pre-release line that has imidazolinone tolerance (Clearfield®) bred into an Axe background.

Table 2. Barley cultivars and their maturity used in this trial.

Variety	Maturity	Comments
Oxford	Late maturing (no vernalisation, strong photoperiod)	Feed variety, suited to earlier sowing in medium to high rainfall areas where leaf rust is prevalent.
Navigator	Late maturing (no vernalisation, strong photoperiod)	Malt variety similar maturity to Gairdner, suited to early sowing in higher rainfall zones. Best sown before the middle of May in SA to flower in optimal period.
Compass	Early to mid-season maturing (no vernalisation, weak photoperiod)	Newly developed line from University of Adelaide currently undergoing malt accreditation, Superior adaptation and new yield benchmark for SA main season barley. Slightly earlier and less sensitive to photoperiod than Commander but similar flowering times with later sowing such as mid-June.
Fathom	Early to mid season maturing (no vernalisation, moderate photoperiod)	Well adapted dedicated feed variety that performs well in unfavourable conditions. It will mature slightly later than Compass from early sowing but similar to Hindmarsh with delayed sowing.

Results and discussion

Wheat

Trojan sown on 14th April and 8th May were the highest and second highest yielding wheat treatments (Table 3), out-yielding Mace sown on 8th May by 1.0 and 0.6 t/ha, respectively. A similar result was achieved in experiments at Minnipa, Cummins, Pt Germein and Tarlee (Figure 1). Slow maturing cultivars bred in other states (e.g. EGA Wedgetail and Rosella) showed poor adaptation to SA and this was also reflected at other sites. Protein (Table 4) tended to relate to yield dilution effects (higher yield=lower protein), the only point of interest being that Trojan had the same protein content as Mace at the last two times of sowing despite yielding significantly more. Screenings (Table 5) were generally stable or increased slightly with delayed sowing, with the exception of RAC1843 where the first time of sowing was severely frosted and most yield came from secondary tillers which grew after the frost. Test weight (Table 6) declined with time of sowing in Wedgetail and Rosella, was stable in Mace and Trojan and was very high at the first time of sowing in RAC1843 again due to frost damage.

Table 3. Mean yield for wheat cultivars at different times of sowing at Hart in 2014.

Yield (t/ha) Cultivar	Time of sowing		
	14-Apr	8-May	2-Jun
Wedgetail	4.5	4.0	3.0
Rosella	4.3	3.7	2.8
Trojan	5.7	5.3	3.7
Mace	3.9	4.7	3.3
RAC1843	0.8	3.6	3.5
P-value	<0.001		
LSD (P=0.005)	0.3		

Table 5. Mean screenings for wheat cultivars at different times of sowing at Hart in 2014.

Screenings (%) Cultivar	Time of sowing		
	14-Apr	8-May	2-Jun
Wedgetail	1.4	2.0	1.6
Rosella	2.2	3.7	4.1
Trojan	1.2	2.1	1.9
Mace	1.1	1.9	2.1
RAC1843	7.2	1.4	1.9
P-value	<0.001		
LSD (P=0.005)	1.1		

Table 4. Mean protein for wheat cultivars at different times of sowing at Hart in 2014.

Protein (%) Cultivar	Time of sowing		
	14-Apr	8-May	2-Jun
Wedgetail	11.0	12.0	12.6
Rosella	10.7	12.1	12.4
Trojan	9.9	10.1	10.5
Mace	12.8	9.8	9.8
RAC1843	17.4	13.4	10.5
P-value	<0.001		
LSD (P=0.005)	1.0		

Table 6. Mean test weight for wheat cultivars at different times of sowing at Hart in 2014.

Test Weight (kg/hL) Cultivar	Time of sowing		
	14-Apr	8-May	2-Jun
Wedgetail	79.0	78.7	74.5
Rosella	80.7	79.4	76.6
Trojan	84.9	84.2	84.0
Mace	78.9	80.1	79.8
RAC1843	47.9	82.9	82.7
P-value	<0.001		
LSD (P=0.005)	2.5		

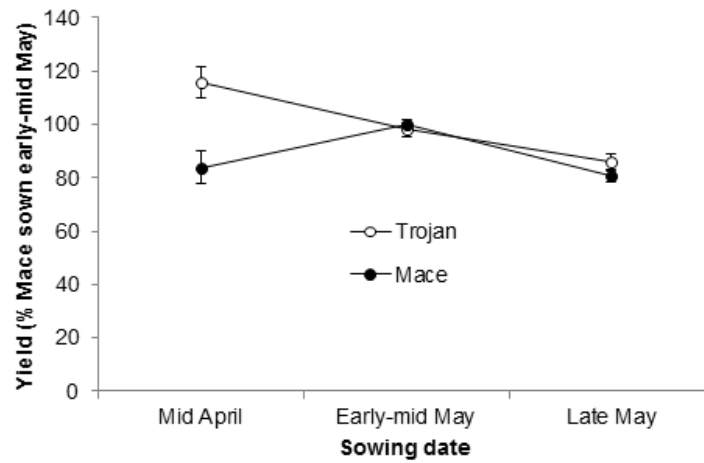


Figure 1. Mean yield performance (Minnipa, Cummins, Port Germein, Hart, Tarlee) of Trojan and Mace at different times of sowing relative to Mace sown in its optimal window of early-mid May. Error bars are standard error of means.



Photo: RAC1843 (left) and Mace (right). Photo taken 14th July 2014 at Hart.

Barley

Highest yields for all cultivars other than Oxford came from the 8 May sowing date (Table 7). Yield of Oxford decline with sowing date, but at the first time of sowing equalled the yields of faster cultivars sown 8 May. Protein related to yield dilution effects (Table 8), retention (Table 9) decreased and screenings (Table 10) increased with later sowing (disastrously so in the case of Oxford), and test weight (Table 11) decreased with later sowing.

Table 7. Mean yield for barley cultivars at different times of sowing at Hart in 2014.

Yield (t/ha)	Time of sowing		
	14-Apr	8-May	2-Jun
Cultivar			
Oxford	5.4	5.2	3.6
Navigator	5.0	5.4	4.3
Compass	4.8	5.5	4.6
Fathom	4.8	5.6	4.8
P-value	<0.001		
LSD (P=0.005)	0.5		

Table 8. Mean protein for barley cultivars at different times of sowing at Hart in 2014.

Protein (%)	Time of sowing		
	14-Apr	8-May	2-Jun
Cultivar			
Oxford	11.3	12.0	13.0
Navigator	11.6	11.4	12.5
Compass	11.4	11.4	11.2
Fathom	13.3	12.4	12.3
P-value	0.006		
LSD (P=0.005)	0.9		

Table 9. Mean retention for barley cultivars at different times of sowing at Hart in 2014.

Retention (%)	Time of sowing		
	14-Apr	8-May	2-Jun
Cultivar			
Oxford	84.8	59.2	34.1
Navigator	89.6	81.1	76.6
Compass	93.5	91.8	91.2
Fathom	94.9	89.7	92.4
P-value	<0.001		
LSD (P=0.005)	7.1		

Table 10. Mean screenings for barley cultivars at different times of sowing at Hart in 2014.

Screenings (%)	Time of sowing		
	14-Apr	8-May	2-Jun
Cultivar			
Oxford	2.4	7.5	18.7
Navigator	1.7	3.9	3.6
Compass	1.6	2.2	2.1
Fathom	1.7	2.5	2
P-value	<0.001		
LSD (P=0.005)	1.8		

Table 11. Mean test weight for barley cultivars at different times of sowing at Hart in 2014.

Test Weight (kg/hL)	Time of sowing		
	14-Apr	8-May	2-Jun
Cultivar			
Oxford	73.3	69.6	66.7
Navigator	69.8	67.2	66.1
Compass	71.3	69.9	67.3
Fathom	69.1	69.1	69.2
P-value	<0.001		
LSD (P=0.005)	1.4		

Implications

Based on the 2014 trial data, growers in SA could improve whole-farm yields by including Trojan in their cropping program to complement Mace (Figure 1). Trojan has an unusual photoperiod sensitivity allele inherited from a European parent which is rare in Australian cultivars. This allele seems to delay flowering from an April sowing relative to Mace quite successfully (Table 12).

Despite performing strongly from a mid-April sowing in these trials, it is not recommended that Trojan be planted this early in the majority of SA locations as it incurs excessive frost risk. As a rough rule of thumb, it is best suited to being planted 7-10 days earlier than Mace. As an example of how it may fit in a program, if 10 May is the optimal sowing time for Mace in a given environment, then the optimal sowing time for Trojan is 1 May. If a grower has a 20 day wheat sowing program and wants to grow half Trojan and half Mace, to maximise whole farm yield they should start with Trojan on 25 April, switch to Mace on 5 May and aim to finish on 15 May.

Barley is less sensitive to sowing time than wheat, and other trials have shown that highest yields tend to come from faster maturing cultivars such as Compass, Fathom, Latrobe and Hindmarsh when sown in mid May. This trial has demonstrated that if growers wish to sow very early (i.e. mid-April) that there are cultivars available (e.g. Oxford) that will be more successful when sown at this time.

Table 12. Flowering dates for Trojan and Mace from different times of sowing at Minnipa in 2014.

Flowering date - Minnipa	Time of sowing		
	Cultivar	11-Apr	13-May
Trojan	6-Aug	10-Sep	17-Sep
Mace	8-Jul	6-Sep	13-Sep

Acknowledgements

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Photo: Compass (left) and RAC1843 (right). Photo taken 14th July 2014 at Hart.