Early sown winter wheats – Hart

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Key Findings

- The highest yielding spring varieties trialed were Cutlass and Trojan sown on the 3rd of May at 4.5 t/ha and 4.3 t/ha, respectively.
- The highest yielding winter varieties trialed were V09150-01 and Kittyhawk sown on the 18th of April at 4.2 t/ha, which was not significantly different to the top yielding spring lines.
- LPB14-0392 sown on the 18th of April topped the trial at Hart yielding 4.7 t/ha. This variety is neither a spring or winter plant type, but described as facultative (shorter but distinct vernalisation requirement which flowers earlier compared to true winter types).

Why do the trial?

In SA the time at which wheat flowers is very important in determining overall yield. Crops that flower too early have increased risk of frost damage, while crops which flower too late have increased risk of high temperatures and water stress which can restrict grain formation and grain-filling. As the size of farming enterprises are increasing, getting a wheat crop established so that it flowers during the optimal flowering period for peak yield can be difficult. However, an opportunity exists in South Australia to take advantage of stored moisture over the summer and rain events in March and April to start sowing crops earlier than what is currently practiced.

Over the last few decades wheat breeding efforts have focused on mid-fast maturing varieties that need to be sown in the first half of May to flower during the optimal period (late September for Hart) for grain yield. Sowing earlier than what is currently practiced requires winter varieties that are slower to mature, and recent studies with near isogenic lines have indicated that a 15% yield gain could be achieved through well adapted winter varieties. This would equate to a 0.6 t/ha increase in yield in an average 4 t/ha season at Hart, however, currently available winter varieties (e.g. Wedgetail and Rosella) bred for NSW are not suited to SA conditions.

How was it done?

Plot size	1.75 m x 10.0 m	**Fertiliser**	DAP (18:20) + 2% Zn @ 75 kg/ha
Seeding date	ToS 1 – 14th March		UAN (42:0) @ 60 L/ha on 3rd July
	ToS 2 – 31st March		UAN (42:0) @ 60 L/ha on 2nd Aug
	ToS 3 – 18th April		
	ToS 4 – 3rd May		

The trial was a split block design with four replicates of nine varieties (Table 1) at four times of sowing (ToS). Fungicides and herbicides were applied as necessary to keep the crop canopy free of disease (i.e. stripe rust) and weeds. All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Table 1. Different categories of wheat varieties based on their development habits (and speed) selected for the trial at Hart.

Spring	Facultative	Winter
Cutlass (slow) Scepter (fast) Trojan (fast-medium)	LPB14-0392 (intermediate winter – fast spring)	ADV08.0008 (slow) ADV11.9419 (slow) Kittyhawk (medium) Longsword (fast) V09150-01 (medium)

Results and discussion

After receiving above average rainfall over the summer months of 2016/2017 (50 mm above long-term average) opening rains for the 2017 growing season were minimal during the March ToS, with only 8 mm falling for the month. A significant rainfall event did not arrive until the 20th of April where 48 mm fell at the site. To ensure plant emergence would occur, the first three ToS (14th March, 31st March and 18th April) were irrigated with the equivalent of 10 mm of rainfall post-sowing. The last ToS did not require irrigation for emergence.

Emergence & Establishment

Plant establishment differed between ToS with increased plant densities at later ToS (Table 2). This was probably due to higher soil temperatures and faster evaporation during the earlier ToS. The only treatment to reach the targeted plant density was ToS 4 with 164 plants/m², when adequate soil water was available and evaporation was not as severe due to cooler air temperatures. Plant density also differed between varieties with the slower maturing winter types such as ADV08.0008 and ADV11.9419, and the facultative type LPB14-0392 emerging poorly at the first two ToS.

Table 2. Average plant densities across all four ToS at Hart (target 150 plants/m^2).

Time of Sowing	Average plants/m²	Average air temperature (°C) two weeks post sowing
1	110	24.6
2	127	16.8
3	141	16.7
4	164	13.2
LSD (P≤0.05)	**9.1**	

Grain Yield

The highest yielding treatment was LPB14-0392 (facultative wheat type) sown on 18th April at 4.7 t/ha (Table 3). V09150-01 and Kittyhawk performed well for the winter varieties sown on 18th April yielding 4.2 t/ha. Cutlass and Trojan sown on 3rd May performed best for the spring varieties yielding 4.5 t/ha and 4.3 t/ha, respectively.

Generally, the higher yielding varieties flowered just before the optimal flowering period at Hart (21 September to 2 October) (Figure 1). This isn't surprising due to the warmer and drier conditions during the growing season when compared to 2016, favouring varieties that are able to fill grain quickly before becoming too water stressed.

As expected, planting spring varieties during March and April increased sterility (up to 38%, data not shown) due to flowering too early during the colder months of June and July, negatively affecting yield. Interestingly, the winter variety Longsword flowered around the optimal flowering period when sown on 18th April and 3rd May but showed increased levels of sterility (35% when sown on 18th April) even though no frost events were recorded around that time (Figure 1). Early sown Kittyhawk also yielded poorly even though flowering around the optimal flowering period due to increased levels of disease present, causing plants to become stunted and yellow.

Grain Quality

Protein content differed between variety and ToS across the trial (Table 3). The highest protein treatment was Longsword sown 31st March with 15.2%. Longsword and LPB14-0392 sown on the 14th March also had protein content above the 13% receival standard for H1 classification. However, treatments with higher protein content were also generally lower yielding due to the 'dilution effect', where the available nitrogen in the higher yielding varieties is distributed amongst a greater number of grains or within larger grains, therefore diluting the protein concentration in each grain.

Test weight also differed between variety and ToS. None of the varieties from ToS 1 reached the required 76 kg/hL test weight for maximum grade, while the number of varieties to reach 76 kg/hL increased with later ToS. Overall Kittyhawk had the highest average test weight with 75.3 kg/hL, followed by Cutlass and Longsword with 73.8 kg/hL and 73.7 kg/hL, respectively.

Screening levels for all treatments were well below the maximum level of 5% for maximum grade.

Table 3. Grain yield and quality for all wheat varieties at different times of sowing at Hart in 2017 (LSD P≤0.05 is for the interaction between variety and time of sowing). Treatments shaded grey are not significantly different from the highest yielding treatment.

	Yield (t/ha)				**Protein %**			
	14th March	**31st March**	**18th April**	**3rd May**	**14th March**	**31st March**	**18th April**	**3rd May**
ADV08.0008	3.1	3.6	4.0	3.4	11.6	11.2	11.8	11.1
ADV11.9419	3.2	3.6	3.5	3.2	9.7	9.9	10.4	9.7
Cutlass	2.1	2.7	3.3	4.5	12.6	12.7	11.4	9.1
Kittyhawk	2.2	3.9	4.2	3.6	11.9	10.7	10.6	10.1
LPB14-0392	1.8	3.9	4.7	3.9	14.6	11.0	10.3	10.3
Longsword	2.0	2.4	3.0	3.5	14.6	15.2	13.6	11.6
Scepter	1.4	2.1	2.6	4.1	11.8	11.9	12.4	9.5
Trojan	1.3	1.9	3.1	4.3	12.3	12.6	12.8	9.4
V09150-01	2.8	3.9	4.2	4.1	12.0	10.9	11.1	9.6
LSD (P≤0.05)	**0.4**				**1.1**			
	Test weight (kg/hL)				**Screenings %**			
	14th March	**31st March**	**18th April**	**3rd May**	**14th March**	**31st March**	**18th April**	**3rd May**
ADV08.0008	71.2	72.7	73.1	70.6	0.5	0.6	0.7	0.9
ADV11.9419	68.8	70.7	71.1	70.0	1.7	1.5	1.4	1.5
Cutlass	68.3	74.5	76.3	76.2	0.5	0.1	0.1	0.1
Kittyhawk	74.8	76.1	76.1	74.2	0.5	0.4	0.6	1.1
LPB14-0392	68.5	75.5	75.9	72.9	0.7	0.5	0.7	1.3
Longsword	71.2	73.6	74.7	75.2	0.3	0.1	0.1	0.2
Scepter	69.8	70.8	73.7	76.7	1.8	0.3	0.2	0.3
Trojan	65.7	69.0	75.2	76.3	0.3	0.2	0.1	0.2
V09150-01	70.0	72.3	72.7	70.4	0.3	0.2	0.2	0.4
LSD (P≤0.05)	**1.9**				**0.4**			

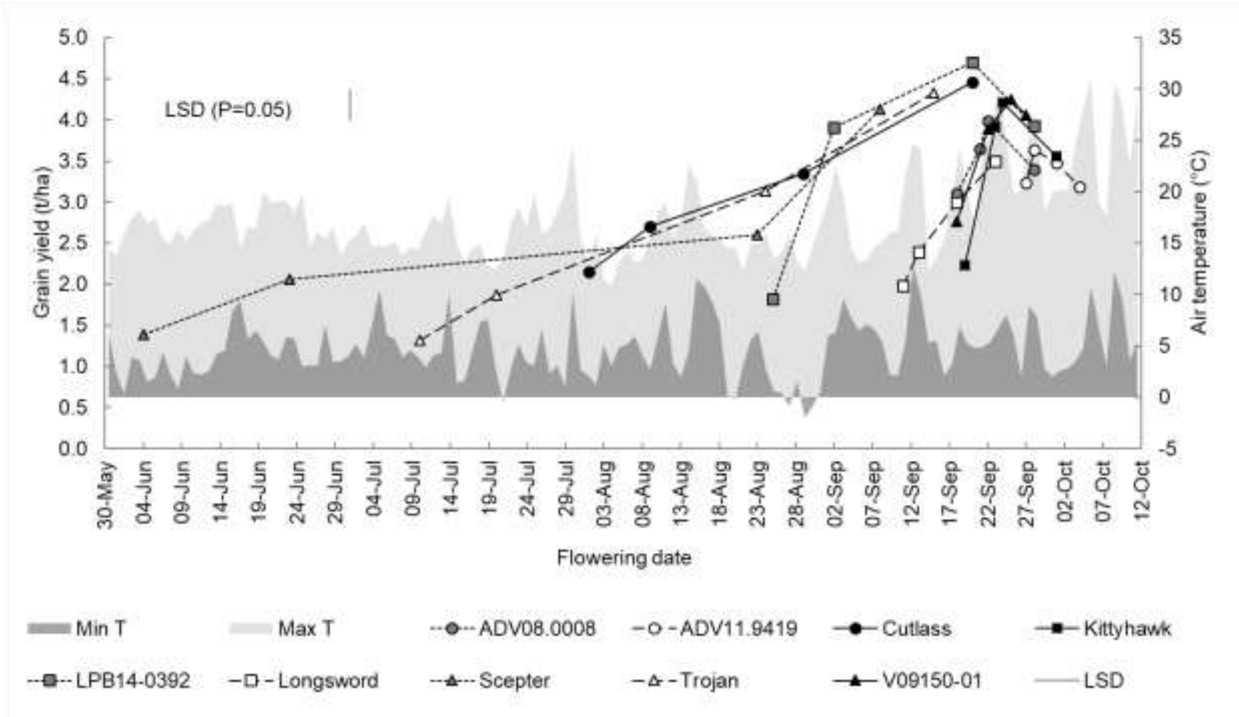

Figure 1. Average yield and flowering date for all varieties and times of sowing with maximum and minimum temperatures at Hart in 2017.

Summary / implications

In 2017, 331 mm of rain fell at the site compared to the long-term average of 406 mm. The lack of opening rainfall made it difficult for early sown (pre-Anzac Day) crops to emerge in this trial, but once established they were able to access good subsoil moisture from summer rainfall.

The use of different ToS and varieties with differing maturities resulted in a wide range of flowering dates, yields and overall crop performance were observed in this trial. The spring varieties' yields peaked when sown 3rd May, compared to the winter varieties which generally yielded highest when sown 18th April. Due to their vernalisation requirements, the winter varieties appear to have greater stability with their time of flowering and also yield regardless of being sown two or more weeks apart. This is a positive result from the first year of trials indicating newer winter varieties may be suitable to an early sowing program where they will flower during the optimal flowering period for peak yield. With the development of winter varieties such as V09150-01 and Longsword there is the potential to include these varieties in a sowing program to take advantage of early season rainfall events, in order to increase whole farm yield and avoid yield penalties from sowing spring varieties too early or too late.

The relative poor performance of Longsword was due to increased sterility at this site in 2017, despite flowering in the optimum window. This result requires further investigation and suggests in some scenarios Longsword may be more prone to higher levels of sterility.

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