

Optimising cultivar and time of sowing in wheat

Rochelle Wheaton, Hart Field-Site Group

Key Findings

- The highest yielding treatment was Trojan sown on the 26th May at 5.96 t/ha.
- RAC2341 has shown good adaption to SA conditions as a Winter variety and its potential release could provide growers with an earlier sowing option.

Why do the trial?

The majority of current wheat varieties need to be sown in the first half of May to flower during the optimal period (mid-September for Hart) for grain yield. Recent work has validated that currently available Winter varieties (e.g. EGA Wedgetail and Rosella) bred for NSW, are not suited to SA conditions. This can be attributed to the fact that once these varieties meet their vernalisation requirement they still require a long period until they reach flowering (outside optimal flowering window).

Over the last two seasons (2014 and 2015) this trial work has been conducted over similar seasonal conditions in terms of dry and warm finishes. The trial was repeated in 2016 to see if results from cool and wet Spring conditions could be achieved. Cultivar selection was also modified to include RAC2341 which has shown potential as a long season wheat adapted to SA.

Another limitation in the current trial methodology is seeding rate (100 plants/m²). It follows the traditional theory of 'sow early, sow light'. This seeding rate is well below the target seeding rates used in early May (180 plant/m²). A seeding rate factor was added to the trial to identify the optimal time of sowing and seeding rate for each cultivar.

How was it done?

Plot size	1.75 m x 10.0 m	Fertiliser	DAP (18:20) + 2% Zn @ 100 kg/ha @ seeding
Seeding date	ToS 1 – 21 st April		Urea (46:0) @ 120 kg/ha split application at GS30 and GS32 based on Mace at each ToS
	ToS 2 – 10 th May		
	ToS 3 – 26 th May		

The trial was a randomised block design with three replicates, two target plant densities (100 and 200 plants/m²) and three varieties (Table 1). Fungicides were applied as necessary to keep the crop canopy free of disease (i.e. stripe rust). Crop growth stages were recorded between the 20th June and the 24th October to identify the flowering time for each treatment. All plots were assessed for grain yield, protein, test weight and screenings with a 2.0 mm screen.

Table 1. Wheat cultivar and maturity for varieties trialled at Hart, 2016.

Variety	Maturity	Comments
Mace	Early to mid-maturing Spring	High yielding AH quality variety SA main season benchmark for mid-late May sowing
Trojan	Mid to late maturing Spring	High yield potential in medium to high rainfall areas with early sowing situations
RAC2341	Fast maturing Winter	Fast to develop once its vernalisation requirement has been met

Results and discussion

The 2016 growing season started with minimal opening rains with only 11 mm of rainfall in April. To ensure even establishment of the earliest time of sowing treatments (21st April) irrigation was required. These plots were irrigated with the equivalent of 10 mm of rainfall (one day prior to sowing). The remaining time of sowing treatments did not require irrigation for establishment.

Hart is not generally considered a frost prone area however, minor frost damage was evident in some treatments (variety and ToS dependent). Minimum air temperature data collected from the site's weather station (Table 2) indicated mild frost events ($\leq 1^{\circ}\text{C}$) may have occurred through August to October. This should be taken into account when interpreting results.

Table 2. Minimum air temperatures of 1°C or less recorded by the Hart weather station.

Date	2-Aug	25-Aug	26-Aug	27-Sep	23-Oct	31-Oct
Temperature ($^{\circ}\text{C}$)	0.2	0.9	-0.4	0.7	0.1	0.7

Plant and tiller number

Plant establishment counts were carried out when plants had reached the 1-2 leaf stage to calculate plant densities. Actual plant densities were 103 plants/m² on average for the 100 plants/m² and 176 plants/m² for the 200 plants/m² treatment. Plant density did not differ significantly between varieties at any of the times of sowing. As RAC2341 is classified as a Winter type, it was expected that this variety would produce more tillers/m² than the Spring varieties. The tillering ability of RAC2341 was evident as it produced a higher amount of tillers/m². On average, for all times of sowing and seeding rates, RAC2341 produced 703 tillers/m² (Table 3). Spring varieties, Trojan and Mace averaged 443 and 449 tillers/m², respectively.

Table 3. Average plant and tiller numbers across both seeding rates and time of sowing for each variety used in this experiment.

Variety	Plants/m ²	Tillers/m ²
Mace	134	449
Trojan	141	443
RAC 2431	143	703
LSD (P \leq 0.01)	ns	55.7

Grain yield

The highest yielding treatment was Trojan sown in late-May at 5.96 t/ha (Table 4). Mace and RAC2341 also yielded highest when sown on the 26th May (ToS 3) at 5.37 and 5.10 t/ha, respectively. This is in contrast to 2014 and 2015 where varieties sown in mid-April and early May were favoured by the warm and dry finish. Interestingly, none of the highest yielding treatments in 2016 flowered during the optimal flowering time to maximise grain yield at Hart (considered to be mid-September). The wet and cool Spring provided favourable conditions for later sown crops to grain fill without heat stress which was evident in previous seasons.

Varieties sown on the 21st April (ToS 1) and 10th May (ToS 2) were generally 1.0 t/ha lower yielding compared to ToS 3. This can be attributed to greater exposure to mild frost temperatures and rain/hail damage which may have contributed to minor yield loss. For example, Mace sown on the 21st April (ToS 1) was at mid-flowering during mild frost events in August (Figure 1) and yielded 1.4 t/ha less than at ToS 3.

Grain yield did not differ significantly between seeding rates for any of the wheat varieties or times of sowing investigated. This shows that there was no yield penalty for sowing early at a lighter rate at Hart. However, this trial was managed to prevent weed and other pressures influencing grain yield. The results from this trial indicate that seeding rate could be lowered for earlier times of sowing provided that adequate early weed control could be achieved.

Grain quality

Protein varied across both ToS and variety with only two treatments consisting of a protein level above 10%. These treatments were RAC2341 sown on the 21st April (ToS 1) and Mace sown on the 10th May (ToS 2) with 10.3% and 10.1%, respectively. These two treatments were also the lowest yielding for each variety indicating a likely “dilution effect”. None of the commercially available varieties were able to achieve the minimum protein level required for Hard 1 or APW classification.

Test weight also differed between ToS and variety. All treatments were above 76 kg/hL the minimum required for maximum grade with an overall average of 81.8 kg/hL. Screening levels for all treatments were also well below the maximum level for of 5% for maximum grade.

Table 4. Grain yield and quality for all wheat varieties trialled at Hart, 2016 (LSD, $P \leq 0.01$ is for the interaction between variety and time of sowing).

	Yield (t/ha)			Protein (%)		
	21 st April	10 th May	26 th May	21 st April	10 th May	26 th May
Mace	4.03	3.98	5.37	9.6	10.1	9.1
Trojan	4.82	5.01	5.96	9.4	8.8	8.3
RAC 2341	4.03	4.89	5.10	10.3	9.3	9.5
LSD ($P \leq 0.01$)		0.29			0.6	
	Test weight (kg/hL)			Screenings (%)		
	21 st April	10 th May	26 th May	21 st April	10 th May	26 th May
Mace	79.1	80.8	81.9	0.4	0.4	0.9
Trojan	80.9	83.0	83.9	0.4	0.3	0.8
RAC 2341	81.0	82.6	82.9	0.2	0.4	0.2
LSD ($P \leq 0.01$)		0.6			0.1	

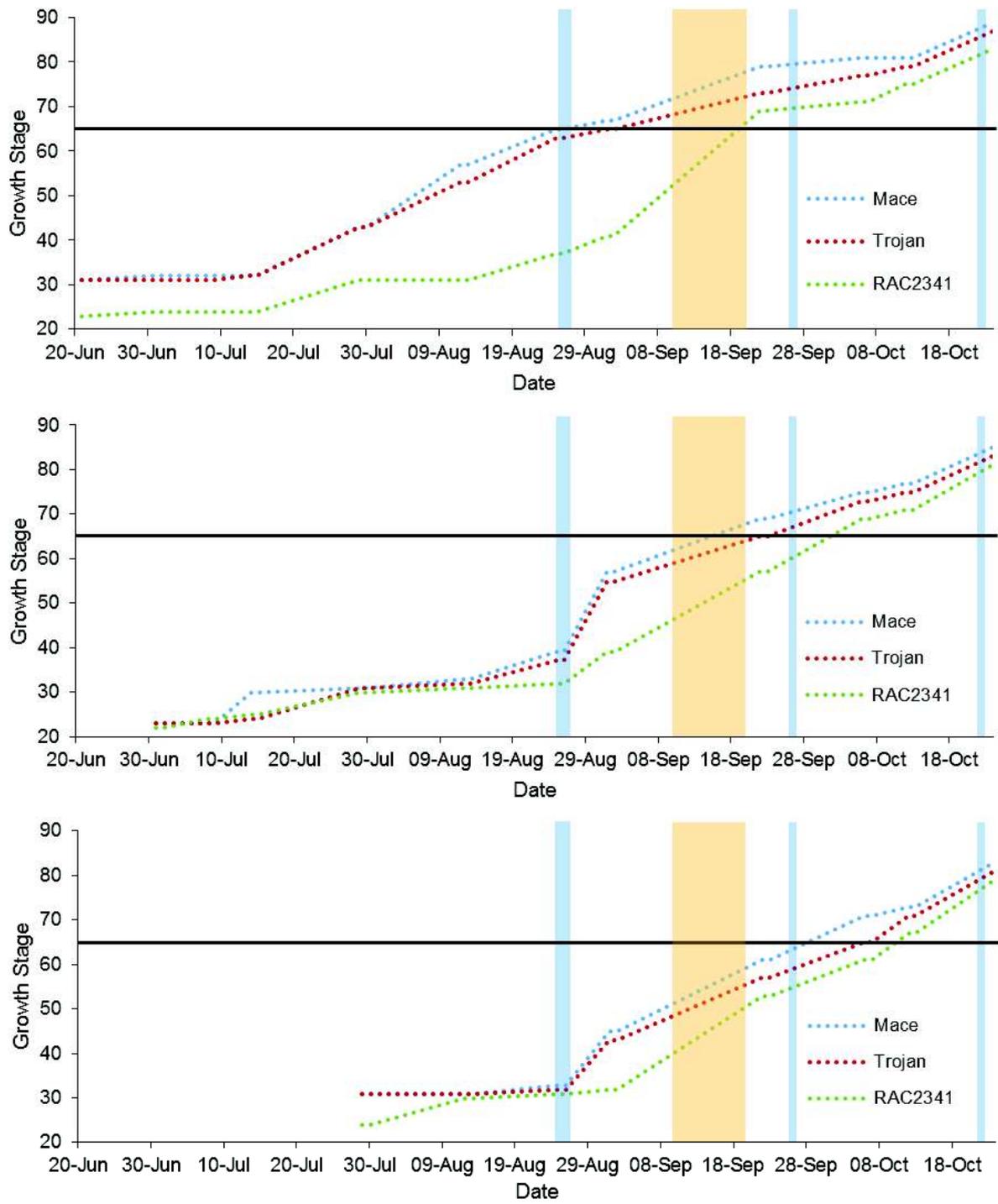


Figure 1. Growth stage assessment for all varieties and times of sowing 20th April (top), 10th May (middle) and 26th May (bottom) between 20th June and 24th October at Hart, 2016. The black horizontal line represents mid-flowering (GS65) and the transparent yellow rectangle displays the optimal flowering window around the 15th September. The blue transparent rectangles indicate when minor frost events may have occurred.

Summary / implications

The 2016 season favoured later sowing due to favourable Spring conditions and above average rainfall in September. Overall Hart experienced above average rainfall for the 2016 growing season minimising stress from low water availability. Heat stress during flowering and grain fill was minimal due to the cooler Spring conditions. This is in contrast to 2014 and 2015 where the site experienced warm and dry finishes to the growing season. These seasons also consisted of below average rainfall which favoured varieties sown in mid-April and early May. Highest yielding treatments during these seasons were those that were able to flower at the optimal time.

Breeding new lines like RAC2341 will provide growers with better options for early sowing opportunities. However, continued evaluation of such lines will be required to better determine their fit in SA environments.



Left: Hart's regional intern Rochelle Wheaton taking plant establishment counts in this trial.

Below: looking over the wheat time of sowing trial at Hart.

