Barley germplasm and fungicide interaction

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Key points

- Severe frost events on 28 and 29 August 2018, combined with dry conditions during spring (GSR of 166mm with 32mm of the total falling during mid – late October), caused trial variability and significantly impacted yield results.
- Applying a foliar fungicide gave variable yield responses, depending on cultivar in the absence of significant disease levels.
- La Trobe was significantly higher yielding than other barley cultivars tested, with retention and screenings among the best in the trial.
- Maltster and RGT Planet gave slightly inferior yields under the extreme environmental conditions experienced during 2018, but had statistically similar grain retention and screenings to La Trobe and superior test weights.
- Winter barley cultivars that developed later during spring were more severely affected by the dry conditions than the earlier-developing spring barley cultivars.

Method

A barley trial was established during late April 2018 at the Riverine Research Centre (RRC), Burramine, Victoria, with funding assistance from Elders Limited.

The trial assessed the performance of nine individual barley cultivars sown on 27 April and focused on winter vs spring barley types and their interaction with fungicides. Each cultivar was subjected to either a full fungicide program of Prosaro at first node (GS31) and Amistar Xtra at first awns visible (GS49) or no fungicide at all. The late sowing date aimed to mitigate the dry start and make best use of early May rainfall for emergence.

The trial had a split plot design, with fungicide being the main plot, replicated four times. Overall management applications were made as per the seasonal conditions to maximise yield potential.

The yield results were presented as express results during December 2018 for Elders and Riverine Plains Inc members.

Sown: 27 April 2018 (emerged 5 – 7 May)
Harvested: 19 November 2018
Rotation position: First cereal after canola
Rainfall:
GSR: 166mm (April – October)
Soil mineral nitrogen: (Sampled 10 April 2017, from buffer areas of trial site.)
0–10cm: 22.4kg N/ha
10–20cm: 5.2kg N/ha
20–30cm: 3.9kg N/ha
30–60cm: 9.4kg N/ha
Total (0–60cm): 40.8kg N/ha
Treatment list: see Table 1

TABLE 1 Treatment list

Cultivar/Line	Type	No fungicide	Full fungicide (product and timing)	
			GS31	GS49
Alestar	Spring	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
Maltstar	Spring	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
Cassiopée	Winter	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
Salamandre	Winter	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
Maltesse	Winter	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
RGT Planet	Winter	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
RGT Conquest	Winter	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
La Trobe	Spring	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
Rosalind	Spring	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha
Alestar	Spring	-	Prosaro 150mL/ha	Amistar Xtra 200mL/ha

Results

i) Establishment and crop structure

The trial site averaged an establishment of 102 plants/m^2, with RGT Planet having the highest emergence counts (137 plants/m^2) and RGT Conquest the lowest emergence (76 plants/m^2) at the three-leaf stage (GS13) (Table 2).

When tillers were counted on 6 August, individual cultivar development ranged from early stem elongation (GS30) to third-node stage (GS33). The European winter cultivar Maltesse had low plant establishment numbers but high tiller numbers (10.5 tillers/plant), producing at least 168 tillers/m^2 more than any other cultivar in the trial, which was significantly more than the other winter barley cultivars Cassiopee and Salamandre. Of the spring cultivars, RGT Conquest had low plant numbers, but compensated by producing 8.6 tillers/plant.

ii) Phenology

Phenology data was assessed throughout the season. Of the winter wheat types Maltese was the slowest to develop, reaching first node (GS31) the latest (3 September) and then flowering (GS65) on 9 October (Table 3). However, Maltese spent the second shortest time (36 days) in the phase from first node (GS31) through to flowering (Figure 1). The spring cultivars, La Trobe and Rosalind, were the earliest to reach first node (GS31) on 16 July and Rosalind was the first to reach flowering on 20 August. Alestar had the longest period of time from first node to flowering (56 days), while Salamandre had the shortest period (29 days).

iii) Normalised difference vegetation index (NDVI)

Crop reflectance measurements taken with the Greenseeker™ and recorded as NDVI measurements, showed significant differences in the crop canopy due to growth habit (Figure 2). The quickest-maturing cultivars, Rosalind and La Trobe, consistently recorded lower NDVI measurements than the longer-season cultivars, with their lower NDVI figures corresponding to a more erect growth habit and less ground cover. Planet had significantly higher NDVI measurements compared with any other cultivar early in the season. Longer-season cultivars presented higher NDVI readings for longer, emphasising a more prostrate growth habit and higher tiller numbers.

TABLE 2 Plant counts 31 May 2018, three leaf stage (GS13), tiller counts and tillers per plants 6 August, late tillering – third node (GS30–33) for barley varieties sown 27 April at Burramine, Victoria

Cultivar/Line	Plants/m^2	Tillers/m^2	Tillers/plant
Alestar	98.1^{bc}	542.2^{e}	6.7^{c}
Maltstar	98.6^{bc}	555.6^{e}	5.7^{cd}
Cassiopée	108.6^{b}	724.4^{b}	7.2^{bc}
Salamandre	95.8^{bc}	675.6^{bcd}	7.2^{bc}
Maltesse	91.1^{c}	892.2^{a}	10.5^{a}
RGT Planet	137.2^{a}	688.9^{bc}	4.9^{d}
RGT Conquest	72.5^{d}	631.1^{cd}	8.6^{b}
La Trobe	106.4^{bc}	642.2^{cd}	6.0^{cd}
Rosalind	108.9^{b}	624.4^{d}	5.8^{cd}
Mean	**101.9**	**664.1**	**7.0**
LSD	16.0	64.1	1.7

Note: When tiller counts were taken on 6 August, individual cultivars ranged from GS29–GS33.
Figures followed by different letters are regarded as statistically significant.

TABLE 3 Dates when barley cultivars reached first node (GS31) and flowering (GS65) for a trial sown 27 April 2018 at Burramine, Victoria

Cultivar/Line	Type	GS31 (2018)	GS65 (2018)
Alestar	Spring	23 July	17 September
Maltstar	Spring	6 August	17 September
Cassiopée	Winter	20 August	25 September
Salamandre	Winter	27 August	25 September
Maltesse	Winter	3 September	9 October
RGT Planet	Winter	23 July	10 September
RGT Conquest	Winter	23 July	10 September
La Trobe	Spring	16 July	27 August
Rosalind	Spring	16 July	20 August

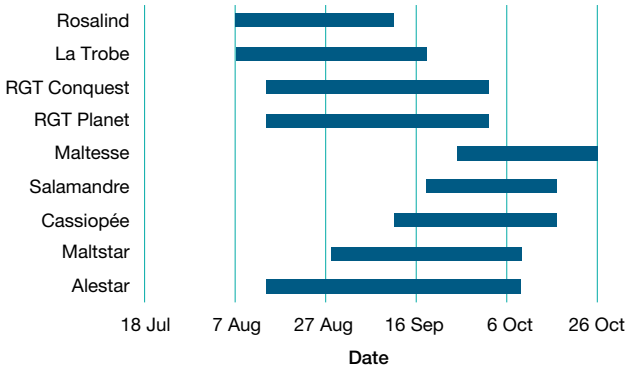

FIGURE 1 Duration of the development period between first node (GS31) and flowering (GS65) for individual cultivars sown 27 April 2018 at Burramine, Victoria

iv) Grain yield and quality

The trial was harvested on 4 December 2018 with an average yield of 1.06t/ha. Drought conditions and frost incidence had a marked impact on grain yield and quality. European winter cultivars that developed later in the season suffered significant yield penalties.

In what was a low-yielding season across the board, the best-performing winter cultivar, Salamandre, yielded significantly less (0.87t/ha) than the lowest-yielding spring type Alestar (1.03t/ha). The faster-maturing spring type,

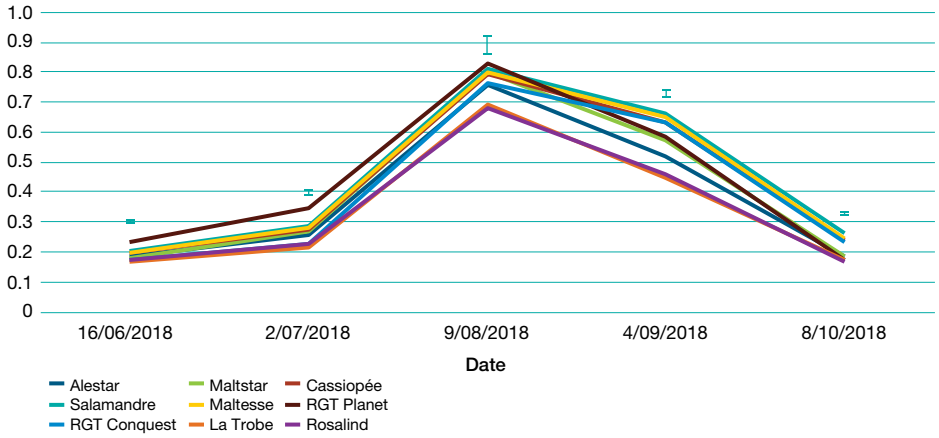

FIGURE 2 NDVI readings on 16 June, 2 July, 9 August, 4 September and 8 October 2018 for barley cultivars sown 27 April 2018 at Burramine, Yarrawonga

La Trobe, proved to yield significantly higher (1.66t/ha) than other cultivars in the trial.

In the absence of significant disease, foliar fungicide applications gave variable yield responses. The yield of several cultivars was significantly less where fungicide was applied, which would not be expected in a season with sustained disease pressure (Table 4).

Winter barley cultivar, Cassiopée, and spring type, RGA Conquest, both had significantly higher grain protein (by at least 1 per cent) than other cultivars in the trial (Table 5), while the grain protein levels of Maltstar (14.3 per cent) were significantly less than other cultivars. Test weights varied, with the winter types generally being lower than the spring type barley cultivars. Although La Trobe yielded significantly higher, RGT Planet and Maltstar proved to have significantly better test weights. The frost-affected winter cultivars Cassiopée, Salamandre and Maltesse all had significantly higher screenings and lower retention than the other trial cultivars.

Conclusions

In a difficult growing season, applying fungicide gave variable responses in the absence of any significant disease stress. Winter cultivars flowered later than spring cultivars sown on the same date and also had a shorter period from the start of stem elongation to flowering. The winter barley cultivars that developed later in the season

TABLE 4 Mean grain yield and percentage, 19 November 2018 for barley sown 27 April 2018 at Burramine, Victoria

Management Level				
	No fungicide	Full fungicide	Mean yield	(Percentage of site mean)
Cultivar/Line	Yield (t/ha)	Yield (t/ha)	(t/ha)	(%)
Alestar	1.01^{ef}	1.05^{def}	1.03^{d}	97
Maltstar	1.42^{bc}	1.23^{cd}	1.33^{b}	125
Cassiopée	0.94^{fg}	0.56^{h}	0.75^{e}	70
Salamandre	0.93^{fg}	0.81^{g}	0.87^{e}	82
Maltesse	0.35^{i}	0.38^{hi}	0.36^{f}	34
RGT Planet	1.17^{de}	1.24^{cd}	1.20^{bc}	113
RGT Conquest	1.23^{cd}	1.11^{def}	1.17^{cd}	110
La Trobe	1.78^{a}	1.54^{b}	1.66^{a}	156
Rosalind	1.23^{cd}	1.18^{de}	1.21^{bc}	113
Mean	**1.12**	**1.01**		
LSD cultivar p = 0.05	0.14			
LSD management p = 0.05	0.07			
LSD cultivar x management p = 0.05	0.20			

Figures followed by different letters are regarded as statistically significant.

TABLE 5 Grain protein, retention, screenings and test weight for barley sown 27 April 2018 at Burramine, Victoria

Cultivar/Line	Grain yield and quality			
	Protein (%)	Test weight (kg/hL)	Retention (%)	Screenings (%)
Alestar	15.8^{bc}	62.6^{bc}	71.8^{abc}	5.0^{cd}
Maltstar	14.3^{e}	65.0^{ab}	71.2^{bc}	3.8^{cde}
Cassiopée (winter barley)	17.2^{a}	61.1^{cd}	40.2^{d}	9.4^{ab}
Salamandre (winter barley)	15.0^{d}	60.0^{d}	37.7^{d}	10.9^{a}
Maltesse (winter barley)	16.0^{b}	54.6^{e}	63.8^{c}	7.9^{b}
RGT Planet	15.2^{cd}	63.8^{b}	77.3^{ab}	4.0^{cde}
RGT Conquest	17.4^{a}	66.4^{a}	79.9^{a}	2.7^{de}
La Trobe	15.5^{bcd}	60.8^{cd}	75.2^{ab}	2.3^{e}
Rosalind	15.6^{bcd}	56.5^{e}	72.4^{abc}	5.3^{c}
Mean	**15.8**	**61.2**	**65.5**	**5.7**
LSD	0.6	2.5	8.7	2.5

Figures followed by different letters are regarded as statistically significant.

were more severely affected by the dry conditions than the cultivars that developed earlier. In a low-yielding season, the winter cultivars yielded between 0.35t/ha and 0.94t/ha, while spring barley cultivars fared better (as they developed earliest and managed to escape frost damage). La Trobe and Maltstar were the best performing cultivars, yielding 1.66t/ha and 1.33t/ha respectively.

While seasonal effects have to be considered when assessing these results, there are clear trends showing the slower-developing winter barley cultivars are not as effective as the spring types in dryer areas or in a dry season.

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