Effect of sowing date on the phenology and grain yield of sixteen barley varieties – Condobolin 2017

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Key findings

- Frost and terminal drought were key determining factors on barley grain yield and development at Condobolin in 2017.
- Selecting sowing date and varietal phenology maximised grain yield by timing flowering for the first week of September at Condobolin.
- Grain plumpness, as indicated by screenings and retention, can be adversely affected by late sowing dates in the absence of spring rainfall.

Introduction

Phasic development varies widely between barley varieties, affecting flowering times and subsequent grain yield. This field experiment assessed the performance of 16 commercially available barley varieties sown on three dates at the Condobolin Agricultural Research and Advisory Station in 2017. The effects from sowing date on flowering date and yield for each variety is reported.

Site details

Location	Condobolin Agricultural Research and Advisory Station
Soil type	Red–brown chromosol
Previous crop	Eight months fallow following lucerne pasture
Fallow rainfall	323 mm (16 November–17 April)
In-crop rainfall	99 mm (17 May–17 October)
Soil nitrogen	43 kg/ha (0–60 cm, January 2017)
Starter fertiliser	70 kg/ha MAP (mono-ammonium phosphate) (11% nitrogen [N], 22.7% phosphorus [P], 2% sulfur [S]) at sowing
In crop management	380 g Achieve® herbicide on 20 June for grass weed control 1000 mL Precept® on 26 June for broadleaf weed control

Treatments

Varieties	AGTB0015, Banks$^{\Phi}$, Biere$^{\Phi}$, Bottler$^{\Phi}$, Commander$^{\Phi}$, Compass$^{\Phi}$, Fathom$^{\Phi}$, Hindmarsh$^{\Phi}$, IGB1512, La Trobe$^{\Phi}$, RGT Planet$^{\Phi}$, Rosalind$^{\Phi}$, Spartacus CL$^{\Phi}$, Urambie$^{\Phi}$, Westminster$^{\Phi}$, WI4952
Sowing date (SD)	SD1: 24 April SD2: 12 May SD3: 25 May

Results

Grain yield and phenology

There were 84 frosts throughout the growing period at Condobolin, with 26 nights recording temperatures of below –2 °C. Frost and low rainfall were the major limitations to crop yield.

There were significant effects observed between varieties ($P<0.001$), and sowing dates ($P = 0.003$) (Table 1). The 12 May (mid season) sowing date had the greatest grain yield overall, with a mean yield of 1.68 t/ha. The late season sowing was the lowest yielding with a mean of 1.50 t/ha.

Table 1. Grain yield and flowering date of 16 barley varieties from three sowing dates at Condobolin, 2017.

Variety	SD1: 24 April 2017		SD2: 12 May 2017		SD3: 25 May 2017	
	Grain yield (t/ha)	Flowering date (GS55)	Grain yield (t/ha)	Flowering date (GS55)	Grain yield (t/ha)	Flowering date (GS55)
AGTB0015	1.86	28 Aug	1.73	9 Sep	1.69	16 Sep
Biere	1.45	12 Aug	1.48	30 Aug	1.36	10 Sep
Bottler	1.94	8 Sep	1.57	17 Sep	1.48	21 Sep
Commander	1.85	9 Sep	1.95	20 Sep	1.79	25 Sep
Compass	1.78	25 Aug	1.90	10 Sep	1.59	22 Sep
Fathom	1.72	24 Aug	1.86	8 Sep	1.86	15 Sep
Hindmarsh	1.11	20 Aug	1.55	8 Sep	1.36	14 Sep
Banks	1.81	11 Sep	1.72	18 Sep	1.38	23 Sep
IGB1512	0.99	18 Aug	1.73	8 Sep	1.71	16 Sep
La Trobe	1.61	20 Aug	1.82	8 Sep	1.54	17 Sep
RGT Planet	1.88	4 Sep	1.56	12 Sep	1.56	18 Sep
Rosalind	1.36	17 Aug	1.38	7 Sep	0.95	23 Sep
Spartacus CL	1.32	19 Aug	1.61	7 Sep	1.46	18 Sep
Urambie	1.74	17 Sep	1.41	22 Sep	1.39	26 Sep
Westminster	1.60	17 Sep	1.68	22 Sep	1.18	26 Sep
WI4952	1.48	7 Sep	1.96	10 Sep	1.73	17 Sep
Mean (SD)	1.59	31 Aug	1.68	13 Sep	1.50	21 Sep
l.s.d. ($P<0.05$) sowing date 0.09 t/ha; variety 0.24 t/ha						

The mid May sowings yielded significantly better than the early- and late-sown treatments overall, although varieties AGTB0015, Bottler$^{\Phi}$, Banks$^{\Phi}$, RGT Planet$^{\Phi}$ and Urambie$^{\Phi}$ all yielded significantly higher when sown on 24 April. All varieties, except Fathom$^{\Phi}$ and RGT Planet$^{\Phi}$, incurred a yield penalty from the later sowings compared with the mid season. Fathom$^{\Phi}$ demonstrated the greatest yield stability over the three sowing dates. This experiment and experiments in previous years indicate that for the central west of NSW, the target flowering window is the last week of August to the first week of September in order to avoid frost-induced yield losses and ensure sufficient soil moisture for grain fill (Figure 1). It is important to note that decisions on varieties and sowing dates require knowledge of multi-year trends, as a single season might not represent the typical regional growing environment.

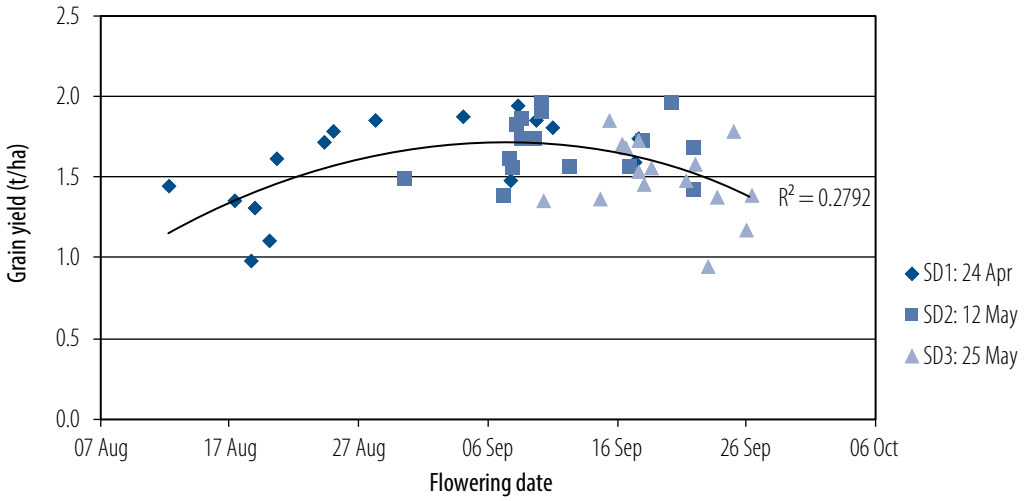

Figure 1. Flowering date and grain yield of 16 barley varieties sown on three dates at Condobolin in 2017.

Grain quality

There were significant differences between sowing dates and varieties for grain protein, test weight, screenings (<2.2 mm) and retention (>2.5 mm) with a significant interaction occurring in all quality components apart from grain protein. The grain quality results for all varieties averaged across sowing dates are displayed in Table 2.

Table 2. Average grain quality parameters of 16 barley varieties sown on three dates at Condobolin in 2017.

Variety	Protein (%)	Hectolitre weight (kg/hL)	Screenings (% <2.2 mm)	Retention (% >2.5 mm)	Thousand grain weight (g)
AGTB0015	12.4	68.12	4.80	68.09	37.54
Biere	13.2	71.39	3.57	71.81	37.84
Bottler	11.8	69.83	3.33	76.83	36.71
Commander	12.0	69.75	2.13	85.95	40.08
Compass	12.3	67.38	3.67	69.37	40.75
Fathom	12.5	70.52	4.12	67.05	34.80
Hindmarsh	12.1	69.94	8.34	48.91	31.06
Banks	12.4	71.42	5.54	52.97	35.10
IGB1512	12.5	69.48	2.46	76.50	36.33
La Trobe	12.0	70.25	4.52	66.41	35.09
RGT Planet	11.8	69.90	5.34	64.84	37.59
Rosalind	12.7	69.92	5.45	68.60	36.26
Spartacus CL	12.9	71.37	2.46	76.99	35.86
Urambie	12.8	69.97	21.05	16.89	35.92
Westminster	13.0	73.34	3.22	62.79	36.73
WI4952	12.1	70.14	2.82	80.30	35.67
l.s.d. ($P = 0.05$)	1.2	0.31	1.18	3.75	0.78

In order to achieve malt status, 70% of grain must be >2.5 mm in plumpness (retention), and <7% narrower than 2.2 mm (screenings). Figure 2 charts the change in retention and screening over sowing dates and illustrates the effect from later sowing dates on grain quality. Due to poor rainfall conditions, later sowings significantly decreased grain plumpness. In the late sowing date, long season varieties Banks$^{\Phi}$, Bottler$^{\Phi}$ and Urambie$^{\Phi}$ were most affected. The varieties that maintained the largest grain size despite late sowing and moisture stress at grain fill were Compass$^{\Phi}$, Commander$^{\Phi}$, and WI4952, all three of which have genetically plump grain and are early–mid season types.

Yield components

Grain yield is a function of grain weight, grains per tiller, and the number of tillers per metre square. There were significant varietal and sowing date differences with interactions observed in number of tillers per metre square and thousand grain weight. There was no direct relationship between final grain yield and the three yield components. There was, however, a strong relationship between total grains per metre square and grain yield (Figure 3), indicating it is a varietal specific combination of tiller numbers and grains per tiller that are the major determinants of yield, with individual grain weight contributing to a lesser degree.

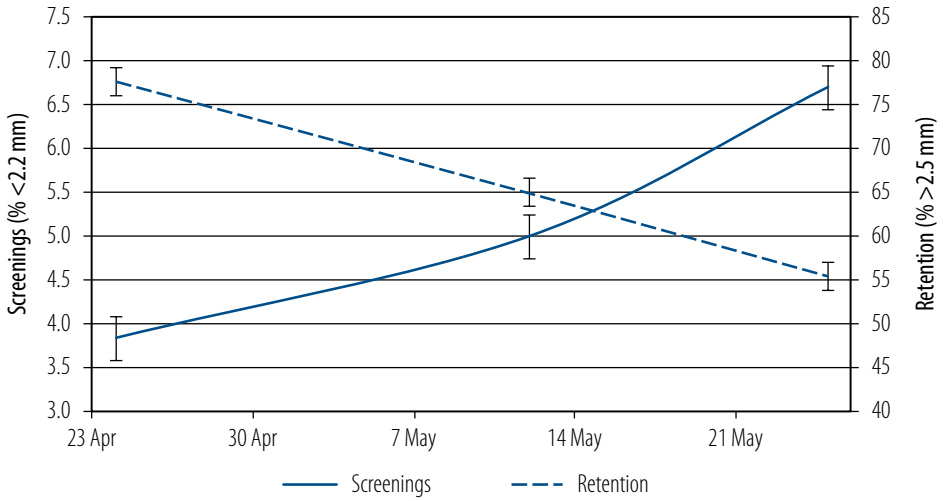

Figure 2. Effect of sowing date on barley grain screening and retention rates from 16 barley varieties sown at Condobolin in 2017.

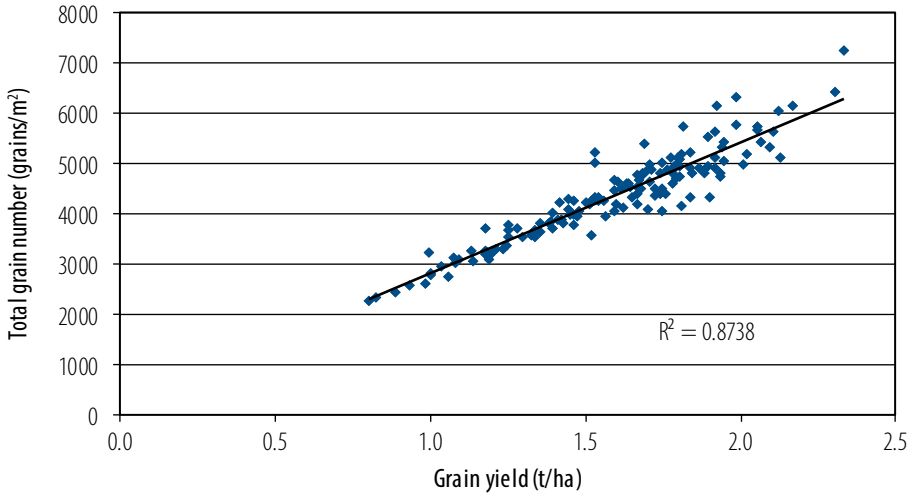

Figure 3. Individual grains per square metre vs total grain yield for 16 barley varieties sown at Condobolin NSW in 2017.

Conclusions

While early faster maturity varieties such as Hindmarsh(ℓ) and La Trobe(ℓ) and early sowing dates have predominated in the past several years, 2017 illustrated the risk of early flowering dates exposing the crops to frost damage during critical periods. By targeting a flowering period of early September, crops were provided with the best opportunity to avoid frost while ensuring sufficient time for grain fill in the event of moisture stress in spring.

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