

Optimising barley phenology: flowering response to sowing time in Central West NSW

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Key findings

- » Flowering time is determined by plant genetics and interacts with time of sowing and the environment.
- » Matching variety and time of sowing to ensure flowering occurs at an optimal time in spring is critical to maximising yield.
- » Sow longer-season varieties mid-April to May and shorter-season varieties May to June.

Introduction

This experiment was designed to determine the phenological response (flowering time) to sowing time for a range of barley varieties. Identifying an optimum flowering time for a given location is critical, as grain yield is bound by the risk of early frost damage and later by heat and moisture stress. In the Condobolin region, growers have a selection of commercial barley cultivars available ranging in maturity (days from sowing to anthesis). Matching varietal maturity with appropriate sowing times allows flowering and grain fill during a period that optimises the probability of maximum grain yield and minimises the likelihood of significant stress events.

Site details

The experiment was conducted at Condobolin Agricultural Research and Advisory Station, NSW under rain-fed conditions (Table 1). Seventeen barley varieties, varying in maturity (Table 2) were sown at five sowing times. The experiment was conducted in a bird exclusion cage and varieties sown in individual rows 30 cm apart. Plants were spaced 5 cm apart in order to simulate a typical cropping environment. Time of flowering was recorded for each variety by sowing time combination.

Table 1. Experimental site details.

Average annual rainfall	454.7 mm
Growing season rainfall (Apr–Oct)	267.4 mm
Soil type	Red-brown earth
Previous crop	Barley
Soil pH _{Ca}	4.7 (0–10 cm), 5.7 (10–60 cm)
Nitrogen (0–100 cm)	27 mg/kg
Phosphorus (0–100 cm)	15 mg/kg

Treatments

Varieties	Bass ^{db} Buloke ^{db} Commander ^{db} Compass ^{db} Fathom ^{db} Fleet ^{db}	Flinders ^{db} Gairdner ^{db} GrangeR ^{db} Hindmarsh ^{db} La Trobe ^{db} Navigator ^{db}	Oxford ^{db} Schooner Scope ^{db} Westminster ^{db} IGB1334T
Times of sowing	TOS 1: 17 April TOS 2: 8 May TOS 3: 1 June	TOS 4: 23 June TOS 5: 14 July	

Results

Faster maturing varieties such as Hindmarsh^{db}, LaTrobe^{db}, IGB1334T and Fathom^{db} flowered earlier across all sowing times, whilst slower maturing varieties such as Westminster^{db}, Oxford and Navigator^{db} flowered later (Table 2). Faster maturing varieties have a shorter growing season and are more suited to later sowings, whilst slower maturing varieties have a longer growing season and are more suited to earlier sowings.

The optimal estimated flowering window for Condobolin, simulated using SOWMAN (part of GRDC's CropMate package), is 20 August to 19 September (Figure 1). SOWMAN allows users to consider wheat phenology, climate variability and risks of frost and heat at a specific location. The phenology model integrates temperature, photoperiod and vernalisation for predicting flowering. An update of varietal information in SOWMAN is currently under consideration. When complete, the software will allow growers to set parameters such as location, variety and a risk profile for yield potential to determine the optimal flowering window, and calculate an appropriate sowing time to achieve this.

Table 2. Flowering dates for 17 barley varieties at five times of sowing (TOS) at Condobolin 2015*.

	TOS 1: 17/4/15		TOS 2: 8/5/15		TOS 3: 1/6/15		TOS 4: 23/6/15		TOS 5: 14/7/15	
1	Hindmarsh (F)	18 Aug	IGB1334T (F)	7 Sep	Hindmarsh (F)	19 Sep	Fathom (F)	2 Oct	Scope (M)	11 Oct
2	La Trobe (F)	18 Aug	Hindmarsh (F)	8 Sep	La Trobe (F)	19 Sep	Hindmarsh (F)	2 Oct	Hindmarsh (F)	14 Oct
3	Buloke (F)	21 Aug	La Trobe (F)	10 Sep	Fathom (F)	20 Sep	IGB1334T (F)	3 Oct	La Trobe (F)	14 Oct
4	Bass (M)	22 Aug	Buloke (F)	11 Sep	IGB1334T (F)	20 Sep	La Trobe (F)	3 Oct	IGB1334T (F)	15 Oct
5	Scope (M)	22 Aug	Fathom (F)	13 Sep	Compass (M)	22 Sep	Commander	6 Oct	GrangeR (M)	16 Oct
6	Compass (M)	25 Aug	Compass (M)	15 Sep	Buloke (F)	23 Sep	Buloke (F)	7 Oct	Buloke (F)	18 Oct
7	Fleet (M)	25 Aug	Scope (M)	15 Sep	Commander (M)	25 Sep	GrangeR (M)	7 Oct	Commander (M)	18 Oct
8	Gairdner (M)	25 Aug	Commander (M)	16 Sep	GrangeR (M)	25 Sep	Schooner (M)	8 Oct	Compass (M)	18 Oct
9	Fathom (F)	26 Aug	Fleet (M)	16 Sep	Schooner (M)	25 Sep	Westminster (L)	8 Oct	Fathom (F)	18 Oct
10	Schooner (M)	27 Aug	Schooner (M)	16 Sep	Scope (M)	25 Sep	Fleet (M)	9 Oct	Schooner (M)	18 Oct
11	Flinders (L)	29 Aug	Bass (M)	17 Sep	Gairdner (M)	26 Sep	Gairdner (M)	9 Oct	Navigator (L)	19 Oct
12	GrangeR (M)	30 Aug	Gairdner (M)	17 Sep	Bass (M)	27 Sep	Bass (M)	10 Oct	Bass (M)	20 Oct
13	Oxford (L)	30 Aug	Westminster (L)	17 Sep	Flinders (L)	27 Sep	Compass (M)	10 Oct	Westminster (L)	20 Oct
14	Commander (M)	31 Aug	Flinders (L)	19 Sep	Westminster (L)	29 Sep	Scope (M)	11 Oct	Gairdner (M)	22 Oct
15	Westminster (L)	31 Aug	GrangeR (M)	19 Sep	Fleet (M)	4 Oct	Flinders (L)	12 Oct	Fleet (M)	23 Oct
16	Navigator (L)	3 Sep	Oxford (L)	20 Sep	Navigator (L)	4 Oct	Oxford (L)	14 Oct	Oxford (L)	23 Oct
17	IGB1334T (F)	*	Navigator (L)	22 Sep	Oxford (L)	7 Oct	Navigator (L)	19 Oct	Flinders (L)	29 Oct

Varities are ranked (1–17) for each sowing time, from earliest to latest flowering date. Letters in brackets indicate relative maturity of variety (F = fast, M = mid, L = late). Italicised flowering dates fall within the optimum flowering window based on SOWMAN model simulation.

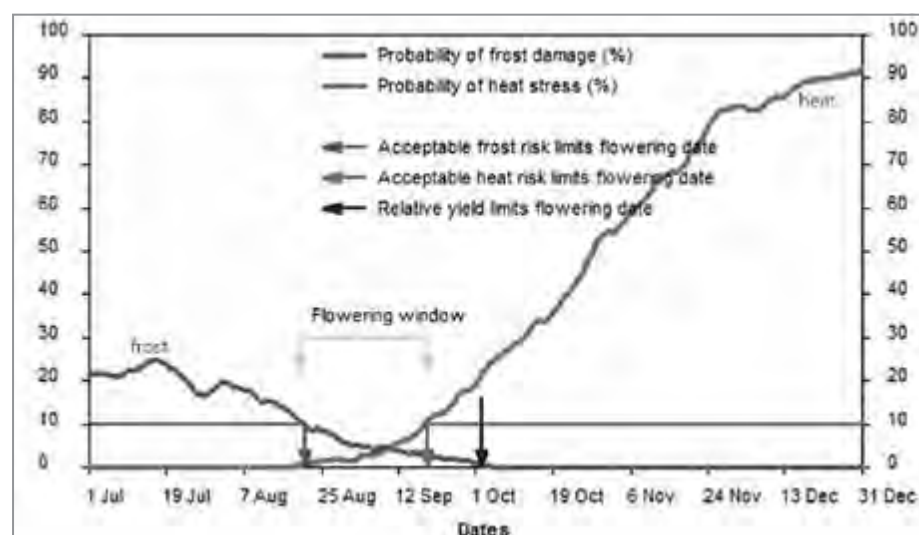


Figure 1. Output of the SOWMAN simulation model predicting the optimum flowering window at Condobolin. The optimum flowering window is determined by the probability of frost damage and heat stress (%).

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