

# Cereal phenology and yield responses to sowing time – Dirnaseer 2021

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## Key findings

- Mild temperatures, combined with unlimited soil moisture through the season provided optimal conditions for crop growth and development, resulting in very high grain yields in 2021.
- There were significant differences in grain yield responses across sowing dates, with many newly released wheat and barley genotypes achieving higher grain yields compared with current industry benchmarks.
- The barley genotypes flowering window was 15 days earlier compared with the wheat genotypes; barley had higher yields than wheat at comparable flowering dates.
- Rain, combined with cool temperatures during the grain filling stages, had a significant effect on grain quality. There were significant genotype × sowing date interactions, with earlier sowing treatments recording lower falling numbers compared with the late May sowing.

## Keywords

wheat, barley, flowering, grain quality, yield, falling number, Dirnaseer, phenology, 2021

## Introduction

A field experiment was conducted at Dirnaseer in 2021 to evaluate the differences between wheat and barley for phenology, grain yield and quality in response to sowing time. This paper presents the results and discusses the influence of sowing date on the phenology, grain yield and quality for 24 wheat and 12 barley varieties.

## Site details

<b>Location</b>	Dirnaseer
<b>Soil type</b>	Red chromosol
<b>Paddock history</b>	Canola (2020), faba bean (2019)
<b>Sowing</b>	Direct drilled with DBS tynes spaced at 250 mm using a GPS auto-steer system.
<b>Target plant density</b>	140 plants/m <sup>2</sup> .
<b>Soil pH<sub>Ca</sub></b>	5.2 (0–5 cm); 4.6 (5–10 cm); 5.0 (10–15 cm); 5.0 (15–20 cm).
<b>Mineral nitrogen (N)</b>	153 kg N/ha at sowing (1.5 m depth).
<b>Fertiliser</b>	<ul style="list-style-type: none"> <li>• 100 kg/ha mono-ammonium phosphate (MAP) (at sowing).</li> <li>• 46 kg N/ha applied as urea on 30 June, 55 kg N/ha applied as urea on 10 August.</li> </ul>

<b>Weed control</b>	<p>Knockdown: Musta 450 (glyphosate 450 g/L) at 1.2 L/ha (23 April, before sowing).</p> <p>Pre-emergent: Boxer Gold® at 2.5 L/ha, Avadex® Xtra at 1.6 L/ha and TriflurX® at 1 L/ha, incorporated by sowing at each sowing date (SD).</p> <p>In-crop: MCPA LVE 570 at 630 mL/ha, Paradigm® at 25 g/ha and 0.5% Uptake® spray oil (31 May – SD1; 9 July – SD2 and SD3).</p>
<b>Disease and pest management</b>	<p>Seed: treated with Hombre® Ultra and Evergol® Energy.</p> <p>Fertiliser: treated with Flutriafol (250 g/L) at 400 mL/ha.</p> <p>In-crop: Fungicide sprays throughout the season were applied for all sowing dates:</p> <ul style="list-style-type: none"> <li>• Amistar®Xtra (400 mL/ha) on 9 July</li> <li>• Prosaro® 420 SC (300 mL/ha) on 10 September and 8 October</li> <li>• Bumper® 625 EC (200 mL/ha) on 22 October.</li> </ul> <p>Note: fungicide strategy to minimise effects from disease with variable phenology types.</p>
<b>Harvest dates</b>	<ul style="list-style-type: none"> <li>• 6 December (barley, all SDs).</li> <li>• 8 December (wheat, SD1).</li> <li>• 18 December (wheat, SD2 and SD3).</li> </ul>
<b>Rainfall</b>	<ul style="list-style-type: none"> <li>• In-crop (23 April–30 October): 362.6mm.</li> <li>• During the grain filling period (1 October–18 December): 180 mm, including 70 mm in one event (24–27 November).</li> </ul>

## Treatments

Twenty-four wheat (Table 1) and 12 barley cultivars (Table 2) varying in phenology responses were sown on 3 sowing dates in 2021:

- SD1: 23 April
- SD2: 13 May
- SD3: 31 May.

Table 1 Expected phenology response of wheat genotypes, based on Australian Crop Breeders Ltd *An industry guide for wheat variety maturity description*.

Phenology type	Genotypes
Winter (W)	Illabo <sup>Ⓛ</sup>
Very slow (VS)	Sunmax <sup>Ⓛ</sup>
Slow (S)	LongReach Lancer <sup>Ⓛ</sup> , Sunflex <sup>Ⓛ</sup> , Valiant CL Plus <sup>Ⓛ</sup> , LongReach Raider <sup>Ⓛ</sup> , LongReach Stealth <sup>Ⓛ</sup>
Mid–slow (MS)	EGA Gregory <sup>Ⓛ</sup> , Coota <sup>Ⓛ</sup> , Catapult <sup>Ⓛ</sup> , Rockstar <sup>Ⓛ</sup>
Mid (M)	LongReach Trojan <sup>Ⓛ</sup> , Sunmaster <sup>Ⓛ</sup> , Suntop <sup>Ⓛ</sup> , Sheriff CL Plus <sup>Ⓛ</sup> , Sunblade CL Plus <sup>Ⓛ</sup>
Mid–quick (MQ)	Scepter <sup>Ⓛ</sup> , Boree <sup>Ⓛ</sup> , Ascot
Quick (Q)	LongReach Hellfire <sup>Ⓛ</sup> , LongReach Mustang <sup>Ⓛ</sup>
Very quick (VQ)	Vixen <sup>Ⓛ</sup> , Borlaug 100

Table 2 Expected phenology response of barley genotypes.

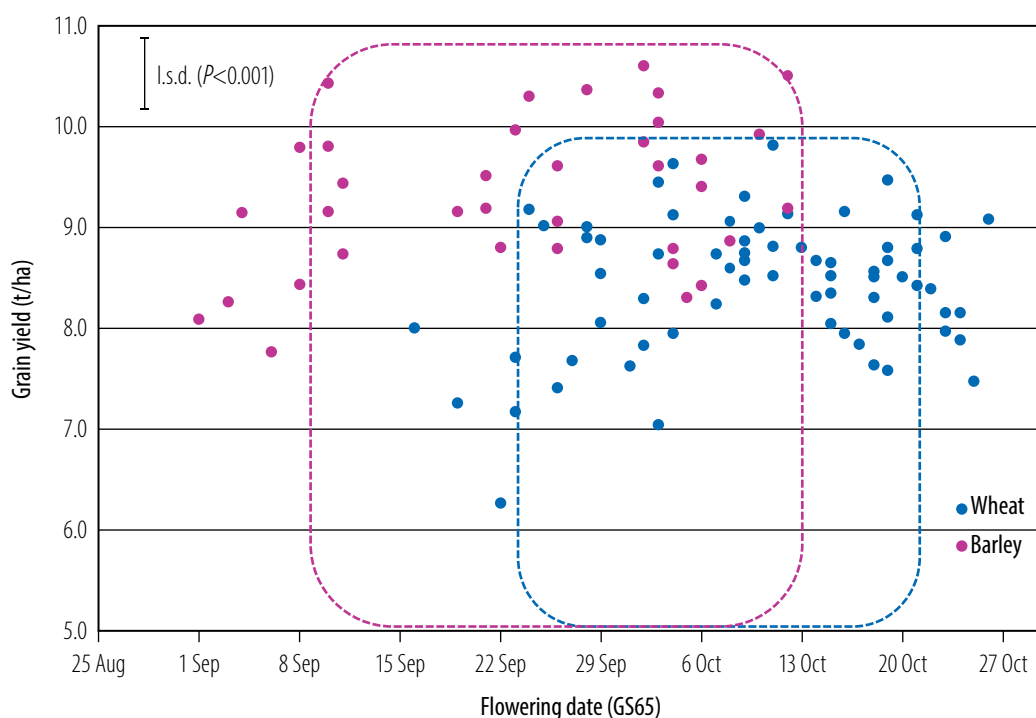
Phenology type	Genotypes
Winter (W)	Urambie <sup>Ⓛ</sup>
Mid–slow spring (MS)	Nitro <sup>Ⓛ</sup>
Mid spring (M)	Laperouse <sup>Ⓛ</sup> , Yeti <sup>Ⓛ</sup> , RGT Planet <sup>Ⓛ</sup> , Minotaur <sup>Ⓛ</sup>
Quick spring (QS)	Leabrook <sup>Ⓛ</sup> , Cyclops <sup>Ⓛ</sup> , Beast <sup>Ⓛ</sup> , Rosalind <sup>Ⓛ</sup> , Maximus CL <sup>Ⓛ</sup> , Spartacus CL <sup>Ⓛ</sup>

## Results

### Phasic development

In 2021, the flowering windows for wheat and barley spanned 40 and 41 days respectively. Despite this, the flowering window was 15 days earlier for barley (1 September to 12 October) than for wheat (16 September to 26 October). Barley also achieved higher grain yields than wheat at a comparable flowering date (Figure 1). This data supports previous observations that the optimal flowering period (OFP) for maximum yield potential for barley is earlier than for wheat.

There was significant variation in phenology responses to sowing date amongst the wheat and barley varieties (Figure 2 and Figure 3). Earlier flowering dates were recorded by quicker developing spring types that progressed quickly for SD1 and flowered earlier than the OFP. For example, Spartacus CL<sup>Ⓛ</sup> was the quickest barley variety to flower (1 September) for SD1 (23 April). However, when sown on SD2 (13 May) or SD3 (31 May), which aligns with the recommended sowing window, Spartacus CL<sup>Ⓛ</sup> flowered on 19 September (SD2) and 4 October (SD3), within the OFP.



Note: Blue box represents optimal flowering period (OFP) for wheat, pink box represents an indicative OFP for barley at Dirnaseer.

Figure 1 Relationship between flowering date and grain yield at Dirnaseer, 2021.

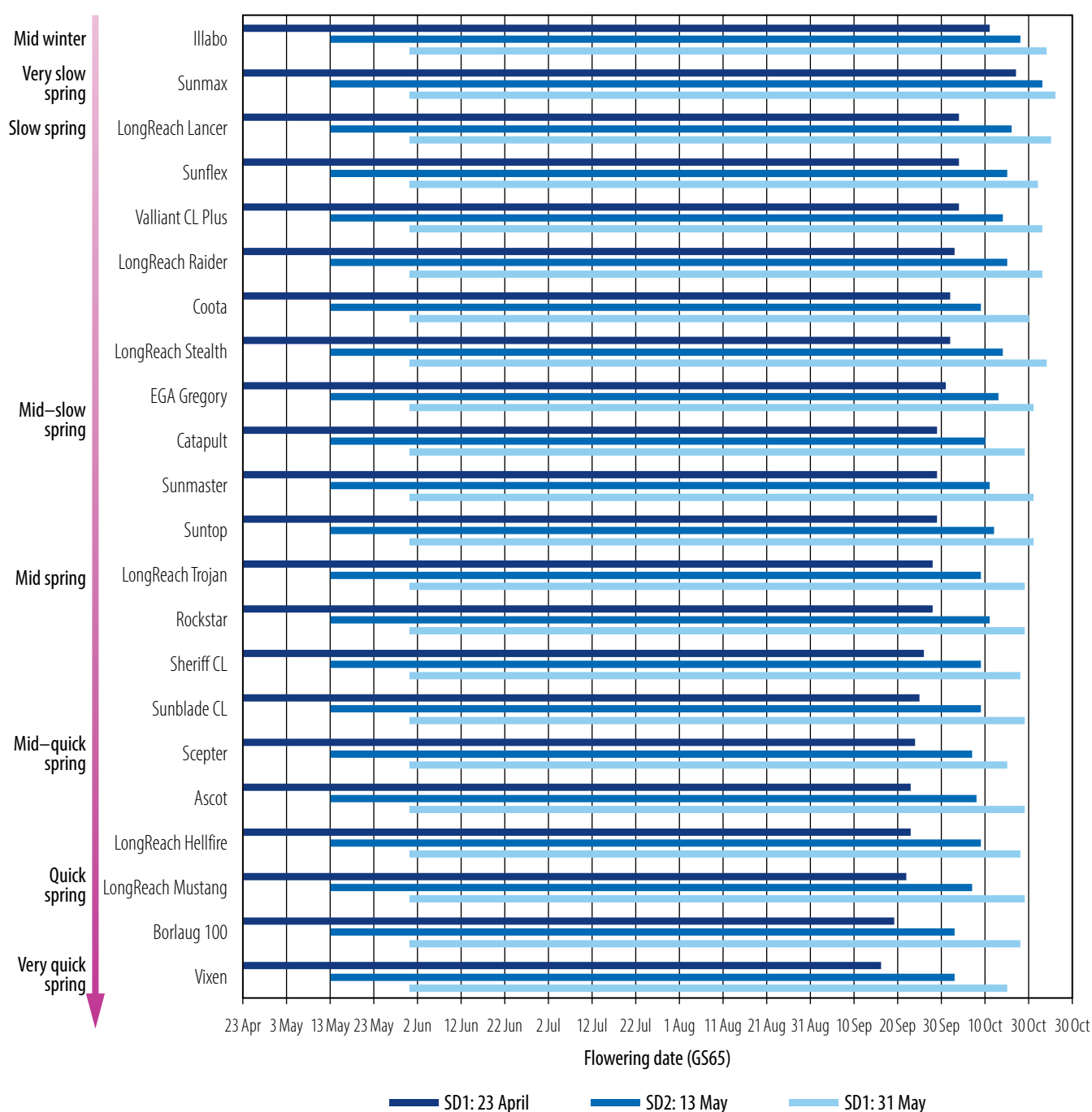


Figure 2 Wheat flowering responses to sowing time at Dirnaseer, 2021. Days from sowing to flowering (GS65) for SD1 (23 April), SD2 (13 May) and SD3 (31 May).

## Grain yield

Grain yields and genotype rankings varied significantly across the sowing dates (late April to late May), with many new released wheat and barley genotypes achieving higher grain yields compared with industry benchmarks. The highest yielding wheat varieties included Boree<sup>®</sup>, Rockstar<sup>®</sup>, Valliant CL Plus<sup>®</sup> and Vixen<sup>®</sup>, with yields greater than 9.4 t/ha. RGT Planet<sup>®</sup> achieved consistently high yields for all sowing dates with the new genotypes Cyclops<sup>®</sup>, Minotaur<sup>®</sup> and Nitro<sup>®</sup> also achieving yields greater than 10 t/ha for some sowing dates.

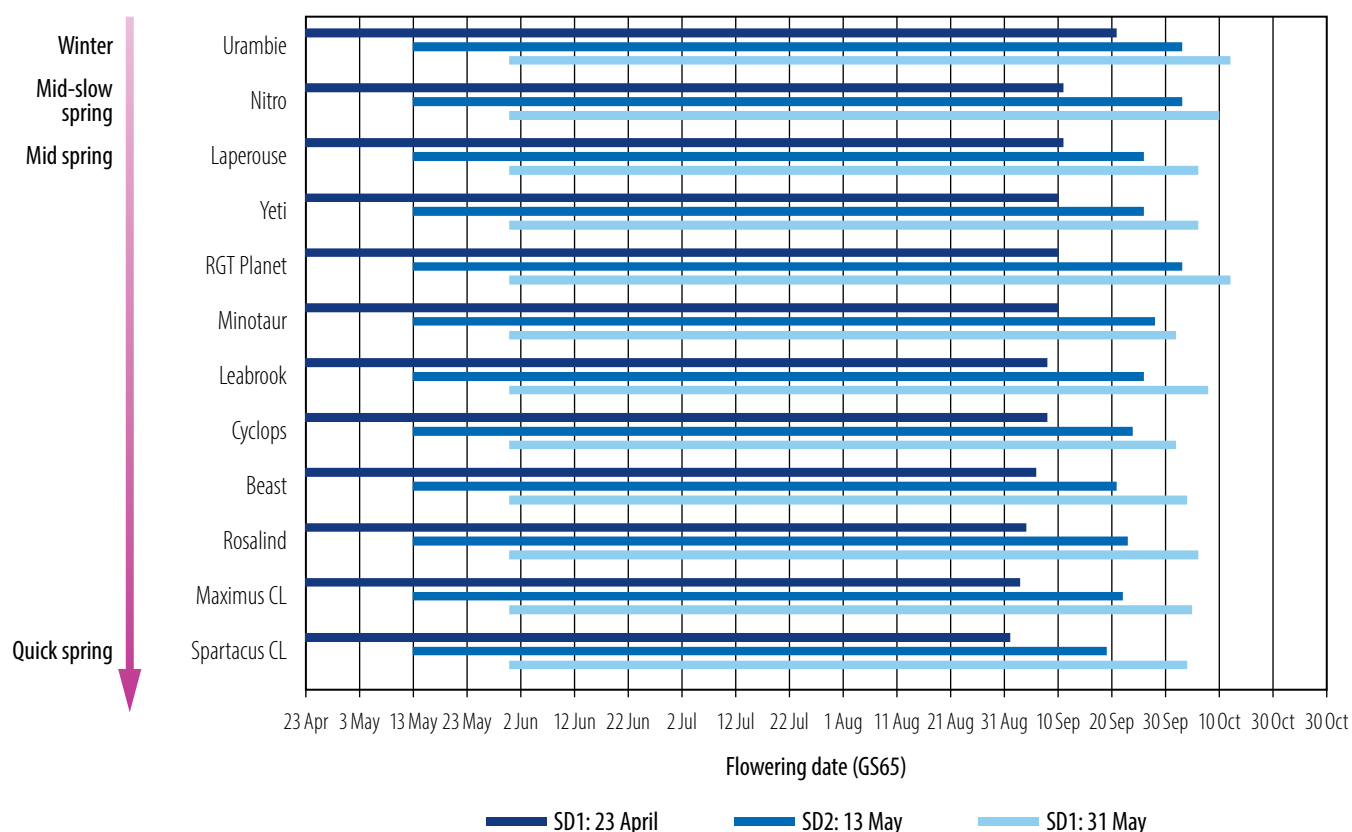


Figure 3 Barley flowering responses to sowing time at Dirnaseer, 2021. Days from sowing to flowering (GS65) for SD1 (23 April), SD2 (13 May) and SD3 (31 May).

Table 3 Grain yield for wheat and barley genotypes evaluated at Dirnaseer, 2021. Genotype ranking for each sowing date in parentheses.

Genotype	Grain yield (t/ha)					
	SD1: 23 April		SD2: 13 May		SD3: 31 May	
Wheat						
Ascot	7.72	(18)	9.08	(6)	8.81	(5)
Boree	8.65	(10)	9.46	(3)	9.56	(1)
Borlaug 100	7.26	(21)	7.05	(23)	8.58	(9)
Catapult	8.56	(11)	9.01	(7)	8.81	(6)
Coota	8.30	(12)	8.68	(14)	8.52	(11)
EGA Gregory	7.64	(19)	8.82	(10)	9.14	(3)
Illabo	8.83	(8)	8.52	(17)	7.90	(20)
LongReach Hellfire	7.18	(22)	8.49	(18)	7.65	(21)
LongReach Lancer	7.96	(15)	7.95	(22)	7.48	(23)
LongReach Mustang	6.27	(23)	8.26	(21)	7.59	(22)
LongReach Raider	8.75	(9)	8.66	(15)	8.16	(16)
LongReach Stealth	7.84	(17)	8.33	(20)	8.17	(15)
LongReach Trojan	8.91	(6)	8.76	(11)	8.69	(8)
Rockstar	9.02	(5)	9.84	(1)	9.48	(2)
Scepter	9.19	(2)	8.75	(12)	8.06	(18)
Sheriff CL	7.42	(20)	8.88	(9)	8.32	(14)

Genotype	Grain yield (t/ha)					
	SD1: 23 April		SD2: 13 May		SD3: 31 May	
Sunblade CL	9.03	(4)	9.32	(4)	8.12	(17)
Sunflex	9.14	(3)	8.36	(19)	8.40	(13)
Sunmaster	8.89	(7)	8.54	(16)	8.44	(12)
Sunmax	7.85	(16)	8.92	(8)	9.09	(4)
Suntop	8.07	(13)	9.16	(5)	8.81	(7)
Valiant CL Plus	9.65	(1)	8.69	(13)	7.98	(19)
Vixen	8.02	(14)	9.47	(2)	8.53	(10)
<b>Barley</b>						
Beast	7.77	(12)	9.20	(8)	8.65	(10)
Cyclops	9.82	(3)	10.32	(3)	10.62	(1)
Laperouse	8.75	(8)	8.80	(12)	8.43	(11)
Leabrook	8.45	(9)	9.63	(7)	8.88	(8)
Maximus CL	8.27	(10)	8.82	(11)	8.31	(12)
Minotaur	9.83	(2)	10.39	(1)	9.86	(4)
Nitro	9.45	(5)	10.06	(4)	9.94	(3)
RGT Planet	10.45	(1)	10.36	(2)	10.53	(2)
Rosalind	9.16	(7)	9.98	(5)	9.69	(5)
Spartacus CL	8.10	(11)	9.18	(9)	8.81	(9)
Urambie	9.53	(4)	9.63	(6)	9.20	(7)
Yeti	9.18	(6)	9.07	(10)	9.43	(6)
Mean (Wheat)	8.22		8.70		8.43	
Mean (Barley)	9.06		9.62		9.36	
I.s.d. (Genotype)	0.40					
I.s.d. (SD)	0.12					
I.s.d. (Genotype × SD)	0.70					

### Grain quality

Favourable seasonal conditions minimised any physical grain quality effects. Screenings increased as sowing date was delayed, however they were within the industry delivery benchmark (<5%) across all varieties and sowing dates. Test weights were lower for the earlier sowing dates, however, only a few quicker developing wheat varieties (e.g. Vixen<sup>®</sup>, LongReach Mustang<sup>®</sup>) for SD1 were below the delivery threshold of 76 kg/hL. Barley test weights were more stable across the 3 sowing dates.

As with much of the region, the experiment site received 180 mm rain during the grain filling period (1 October – 18 December) with 70 mm in one event (24–27 November) which, combined with cool temperatures, influenced falling numbers. There was a significant genotype × sowing date interaction, with earlier sowing treatments showing lower falling numbers compared with the late May (SD3) sowing treatment (Table 1; Figure 4). Despite this, some genotypes recorded consistently high falling numbers (e.g. Wheat: Coota<sup>®</sup>, LongReach Raider<sup>®</sup>, and LongReach Mustang<sup>®</sup>; Barley: Cyclops<sup>®</sup>, Minotaur<sup>®</sup>, RGT Planet<sup>®</sup>, Spartacus CL<sup>®</sup> and Urambie<sup>®</sup>). There were also differences between wheat and barley, with barley generally having higher falling numbers compared with wheat at similar harvest dates.

Table 4 Grain protein (GP), test weight (TWT), retention (RET), screenings (SRN) and falling number (FN) for all genotypes across sowing dates at Dirnaseer, 2021.

Genotype	SD1: 23 April 2021					SD2: 13 May 2021					SD3: 31 May 2021				
	GP (%)	TWT (kg/hL)	RET (%)	SCRN (%)	FN (sec)	GP (%)	TWT (kg/hL)	RET (%)	SCRN (%)	FN (sec)	GP (%)	TWT (kg/hL)	RET (%)	SCRN (%)	FN (sec)
<b>Wheat</b>															
Ascot	13.4	75.2	-	1.0	74	11.5	81.7	-	2.6	254	11.5	84.2	-	2.4	345
Boree	12.3	78.6	-	1.1	171	10.6	82.4	-	3.0	264	10.3	82.4	-	3.4	370
Borlaug 100	14.0	77.0	-	1.0	98	11.8	80.8	-	3.7	114	11.2	84.2	-	3.4	278
Catapult	12.4	79.7	-	0.9	136	10.2	83.1	-	2.4	298	10.8	82.1	-	3.2	339
Coota	12.9	79.7	-	0.6	354	11.2	82.5	-	2.5	379	10.9	83.0	-	2.7	367
EGA Gregory	11.8	81.1	-	0.7	287	11.3	82.9	-	2.5	343	11.4	84.2	-	2.2	344
Illabo	12.2	79.5	-	0.4	273	10.6	80.5	-	1.6	150	11.2	79.9	-	1.8	278
LongReach Hellfire	14.5	79.1	-	0.7	188	12.4	83.3	-	2.0	354	11.7	83.9	-	1.6	355
LongReach Lancer	12.9	77.9	-	1.0	111	11.8	82.5	-	2.2	237	11.8	83.7	-	1.4	291
LongReach Mustang	13.5	75.9	-	1.0	320	11.5	81.3	-	3.3	354	11.6	82.4	-	5.1	367
LongReach Raider	12.2	76.2	-	1.3	327	11.3	80.1	-	2.6	377	11.4	80.6	-	2.5	356
LongReach Stealth	12.5	78.3	-	1.1	108	11.3	83.0	-	2.8	325	11.5	82.9	-	1.7	328
LongReach Trojan	12.2	79.0	-	0.7	287	11.1	83.7	-	2.3	364	10.7	84.2	-	1.8	372
Rockstar	12.5	76.4	-	1.0	90	10.6	81.6	-	2.6	154	10.3	82.2	-	2.5	307
Scepter	11.9	79.7	-	0.8	158	10.9	83.5	-	2.9	345	10.4	82.8	-	3.8	346
Sheriff CL	13.3	76.2	-	0.6	120	11.4	83.0	-	1.4	304	10.9	83.3	-	2.6	285
Sunblade CL	11.9	79.5	-	1.3	162	10.7	82.2	-	3.1	321	10.7	82.5	-	3.7	329
Sunflex	12.1	80.8	-	0.9	114	11.5	82.6	-	3.3	218	11.4	83.4	-	2.9	327
Sunmaster	12.5	79.9	-	0.6	157	11.1	83.0	-	1.7	318	10.7	82.6	-	2.3	320
Sunmax	10.7	81.7	-	2.4	321	10.4	83.0	-	3.6	279	10.9	82.6	-	3.5	249
Suntop	12.2	79.6	-	1.3	171	11.0	83.2	-	1.9	289	11.0	83.0	-	2.6	297
Valiant CL Plus	12.1	81.5	-	0.6	192	11.2	84.5	-	1.3	296	11.2	83.8	-	1.9	272
Vixen	13.2	75.9	-	0.7	81	11.3	80.6	-	2.5	179	10.8	81.1	-	3.7	268
<b>Barley</b>															
Beast	12.2	67.0	65.5	0.6	327	11.1	66.9	66.4	0.3	364	11.5	65.9	65.0	0.6	297
Cyclops	12.2	68.2	65.8	0.7	298	11.3	67.9	65.5	0.7	351	11.0	67.7	64.5	1.0	369
Laperouse	12.4	68.3	65.3	0.8	192	11.2	68.2	67.1	0.6	196	10.5	68.0	66.7	0.7	293
Leabrook	11.3	66.8	65.4	0.6	116	11.1	66.7	65.9	0.6	301	11.0	66.6	64.9	0.6	344
Maximus CL	12.0	67.7	64.8	0.7	300	12.0	66.6	64.0	0.6	289	10.8	68.0	65.0	0.7	364
Minotaur	11.5	67.6	66.5	0.5	372	10.9	67.0	66.0	0.5	349	10.6	68.7	67.5	0.5	357
Nitro	11.2	68.3	65.5	0.8	201	10.2	68.1	67.0	0.4	335	10.2	67.6	64.3	0.9	339
RGT Planet	10.6	66.4	64.5	0.6	372	9.9	67.0	65.8	0.4	376	9.9	67.6	65.4	0.8	328
Rosalind	11.8	67.6	65.0	0.7	267	11.1	66.9	64.8	0.7	290	10.8	67.2	65.3	0.6	283
Spartacus CL	12.7	67.4	63.3	0.8	344	12.0	67.3	64.5	0.5	417	11.7	67.6	60.4	1.2	405
Urambie	10.6	66.1	58.5	2.0	362	10.7	67.1	61.2	1.2	398	11.5	67.5	57.0	1.4	394
Yeti	11.5	66.7	64.6	0.8	286	12.0	67.1	65.8	0.7	291	11.5	66.8	65.3	0.7	306
Mean (Wheat)	12.5	78.6	-	0.9	187	11.2	82.4	-	2.5	283	11.1	82.8	-	2.7	321
Mean (Barley)	11.7	67.3	64.6	0.8	286	11.1	67.2	65.3	0.6	330	10.9	67.4	64.3	0.8	340

Genotype	SD1: 23 April 2021					SD2: 13 May 2021					SD3: 31 May 2021				
	GP (%)	TWT (kg/hL)	RET (%)	SCRN (%)	FN (sec)	GP (%)	TWT (kg/hL)	RET (%)	SCRN (%)	FN (sec)	GP (%)	TWT (kg/hL)	RET (%)	SCRN (%)	FN (sec)
I.s.d. (Genotype)	0.4	0.7	1.4	0.5	30										
I.s.d. (SD)	0.1	0.2	0.1	0.2	9										
I.s.d. (Genotype × SD)	0.6	1.2	2.4	0.8	52										

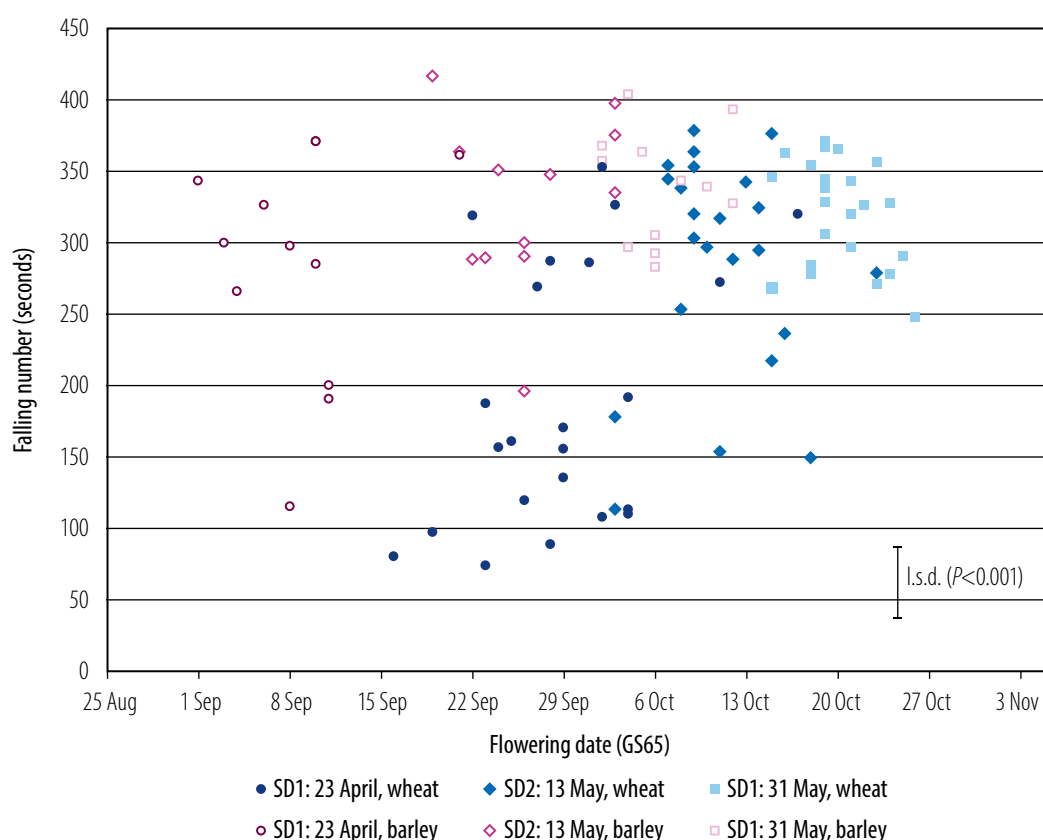


Figure 4 Relationship between flowering date and falling number response for wheat and barley genotypes across 3 sowing dates at Dirnaseer, 2021.

## Acknowledgements

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