Early sowing options: sowing date influence on phenology and grain yield of long-season wheat genotypes – Wallendbeen 2017

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Key findings

- New winter genotypes had different phenology responses compared with current commercial genotypes.
- Frost significantly affected phenology and grain yield responses in 2017.
- The highest grain yields were achieved through various sowing date × variety combinations.
- Best management practice is matching varietal phenology with sowing date, however, pre-flowering phases had a significant influence on grain yield responses.

Introduction

Recent trends of earlier sowing have renewed grower interest in winter wheats and breeder focus on selecting and releasing new winter genotypes suited to southern NSW farming systems. In 2017, field experiments were conducted at Wallendbeen, southern NSW and Wongarbon, central NSW to evaluate current commercial genotypes in conjunction with new breeder lines suited to early sowing. This paper presents results from the Wallendbeen site, focusing on the influence that sowing date had on the phenology, grain yield and quality of 12 wheat genotypes.

Site details

Location	'Braeside', Wallendbeen, NSW
Soil type	Red kandasol
Previous crop	Canola
Sowing	Direct drilled with DBS tynes spaced at 250 mm using a GPS auto-steer system
Target plant density	140 plants/m^2
Soil pH$_{Ca}$	4.5 (0–10 cm)
Mineral nitrogen (N)	144 kg N/ha at sowing (1.8 m depth)
Fertiliser	80 kg/ha mono-ammonium phosphate (MAP) (sowing) Urea 108 kg/ha (spread 19 May) Urea 108 kg/ha (spread 17 July)
Weed control	Knockdown: glyphosate (450 g/L) 2 L/ha + Ally® 7 g/ha Pre-emergent: Sakura® 118 g/ha + Logran® 35 g/ha + Avadex® Xtra 1.6 L/ha In-crop: Precept® 500 mL/ha + Lontrel™ 750 SG 40 g/ha (11 July)
Disease management	Seed treatment: Hombre® Ultra 200 mL/100 kg Flutriafol-treated fertiliser (400 mL/ha) In-crop: Prosaro® 300 mL/ha (11 July)
In-crop rainfall	279 mm (April–October) (long-term average – 370 mm) 112 mm recorded between harvest dates

Harvest date	30 November 2017 11 December 2017 Cutlass$^{\phi}$, Scepter$^{\phi}$, LongReach Trojan$^{\phi}$ (SD1 and SD2); Manning$^{\phi}$ (SD1, SD2 and SD3) due to delayed maturity.

Treatments

Twelve wheat genotypes with varying responses to vernalisation and photoperiod were sown on three sowing dates: 28 March, 12 April and 1 May 2017 (Table 1).

Table 1. Expected phenology types of experimental genotypes at Wallendbeen, 2017.

Phenology type	Genotypes
Winter	RGT Accroc$^{\phi}$ (slow), Manning$^{\phi}$ (slow), ADV08.0008, ADV11.9419, EGA Wedgetail$^{\phi}$, V09150-01, LongReach Kittyhawk$^{\phi}$, Longsword$^{\phi}$ (fast)
Spring	LPB14-0392 (slow), Cutlass$^{\phi}$ (mid–slow), LongReach Trojan$^{\phi}$ (mid), Scepter$^{\phi}$ (fast)

Results

Phasic development

Generally, the genotype and sowing date combinations that flower early to mid to late October at Wallendbeen achieve the highest grain yields. Early stem frost damage directly influenced the flowering window at Wallendbeen in 2017, which resulted in significant tiller death, and late tiller regrowth in faster-developing spring genotypes on the first two sowing dates (e.g. Scepter$^{\phi}$, LongReach Trojan$^{\phi}$ and Cutlass$^{\phi}$). This consequently influenced recorded flowering date and maturity uniformity within plots, which delayed harvest (Figure 1). In contrast, the winter types all had a prolonged vegetative phase, due to their vernalisation requirement; and flowering dates were relatively stable across sowing dates (Figure 1).

There was significant variation in genotype pre-flowering stages with respect to sowing time (Figure 1), which influenced the flowering by grain yield responses. Faster-developing spring types (with minimal response to vernalisation), sown early (when temperatures are warmer and days longer), progressed quickly and recorded significant frost damage. For example, Scepter$^{\phi}$ sown on 28 March 2017 at Wallendbeen, started stem elongation (GS30) on 16 May, 49 days after sowing. However, when sown on 1 May (within an appropriate sowing window for its given phenology type), Scepter$^{\phi}$ reached GS30 on 25 July (85 days after sowing) and recorded no frost damage.

Among the winter types, there were differences in phasic duration, indicating varied phenology responses across the new winter cultivars (Figure 2). Newly released, fast winter type Longsword$^{\phi}$ had a similar vegetative period to EGA Wedgetail$^{\phi}$, though had hastened development thereafter, and did record some stem frost damage (and later maturity) on the first sowing date. In 2017, despite LongReach Kittyhawk$^{\phi}$ flowering 1–3 days later than EGA Wedgetail$^{\phi}$ across the sowing dates, we observed GS30 eight days earlier from the first sowing date (28 March), while it was 2–4 days slower in the later two sowing dates. There was also variation among the slower winter types, with RGT Accroc$^{\phi}$ flowering 3–8 days earlier than Manning$^{\phi}$, and despite having a similar grain-filling duration, reached physiological maturity before the rain that delayed its harvest (Figure 2).

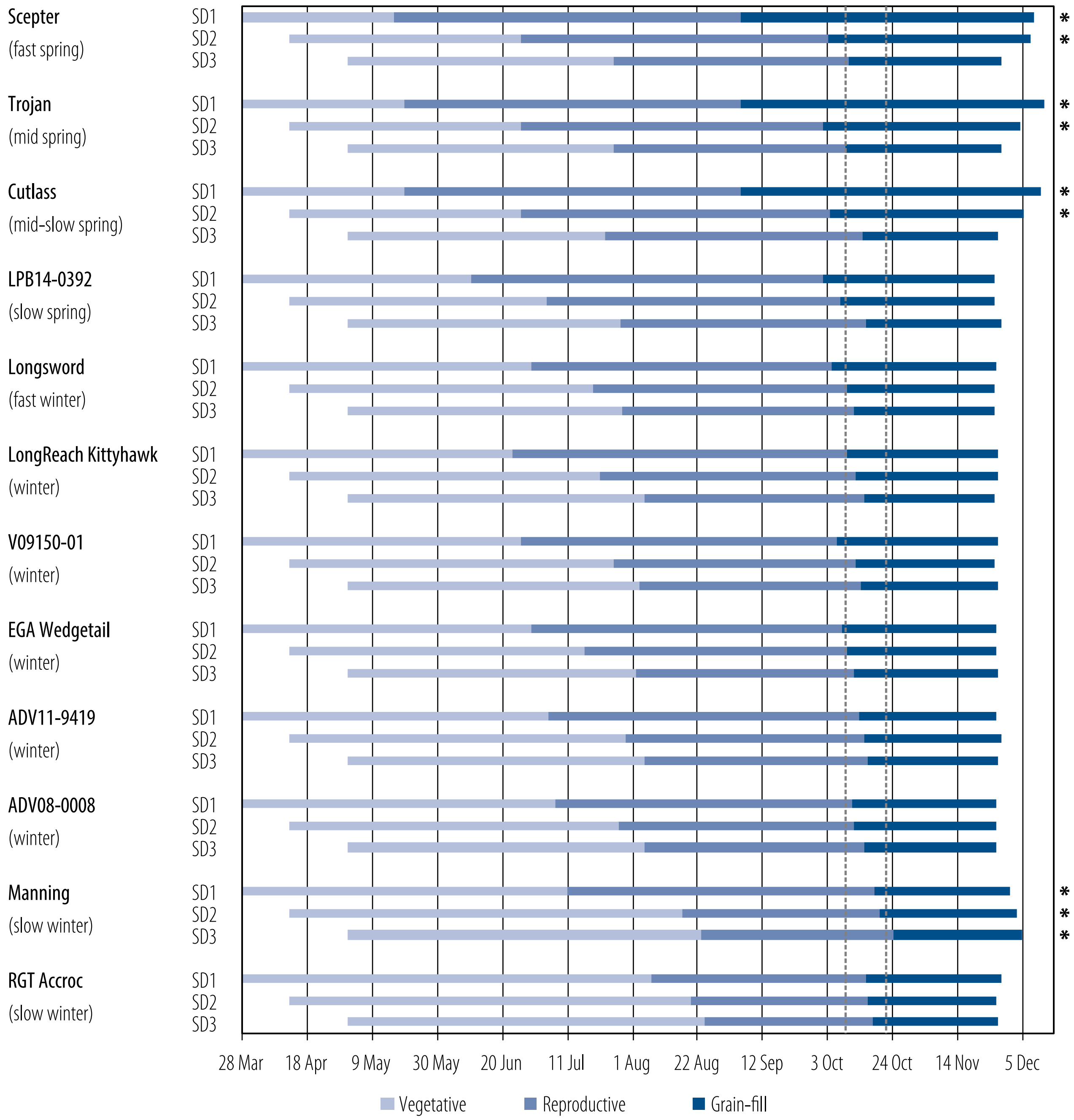

Figure 1. Sowing date influence on phasic development of 12 genotypes of wheat sown 28 March (SD1), 12 April (SD2) and 1 May (SD3) at Wallendbeen, 2017. Vegetative phase (sowing to GS30); reproductive phase (GS30 to flowering); grain-fill phase (flowering to maturity).

Note: Grey dotted lines indicate optimal flowering window; asterisk indicates treatments with delayed maturity which were harvested following rain.

Grain yield

In 2017, the winter genotypes achieved consistently high yields across sowing dates at the Wallendbeen site, with new winter genotypes indicating a possible yield advantage compared with benchmark variety EGA Wedgetail⁽ᵗʰ⁾ (Figure 2, Table 2). However, the accelerated development of spring genotypes, when sown early, highlighted the severe yield penalty associated with a lack of biomass accumulation and increased frost risk.

Table 2. Grain yield of genotypes across three sowing dates at Wallendbeen in 2017.

Genotype	Grain yield (t/ha)		
	SD1: 28 March	SD2: 12 April	SD3: 1 May
ADV08-0008	6.16	6.56	5.53
ADV11-9419	7.38	6.24	5.90
Cutlass	1.20	2.85	6.54
EGA Wedgetail	6.12	5.78	5.89
LongReach Kittyhawk	6.69	6.18	5.56
LPB14-0392	4.80	6.57	5.95
Manning	6.64	6.32	5.78
Longsword	2.87	4.67	5.82
RGT Accroc	7.86	6.36	6.37
Scepter	0.79	2.34	6.83
LongReach Trojan	0.45	3.96	6.09
V09150-01	4.92	6.03	5.80
Mean (Spring types)	1.81	3.93	6.35
Mean (Winter types)	6.08	6.02	5.83
l.s.d. (genotype × sowing date) 0.92 t/ha			

Grain quality

Genotype, sowing date and the interaction between sowing date and genotype significantly affected grain protein and test weight (Table 3). With the exception of Manning$^{\Phi}$, RGT Accroc$^{\Phi}$ and LongReach Kittyhawk$^{\Phi}$ (SD2), all commercial genotypes achieved greater than 11.5% grain protein. All genotypes harvested before rain (30 November) achieved a test weight of >76 kg/hL, with the exception of Longsword$^{\Phi}$ (SD1). Some genotype × sowing date treatments had delayed maturity and were harvested after significant rain on 11 December (grey shading, Table 3), they also had significantly lower test weights. There was only a main effect of genotype on screenings, with no significant effect of sowing date or interaction of sowing date by genotype (Table 3).

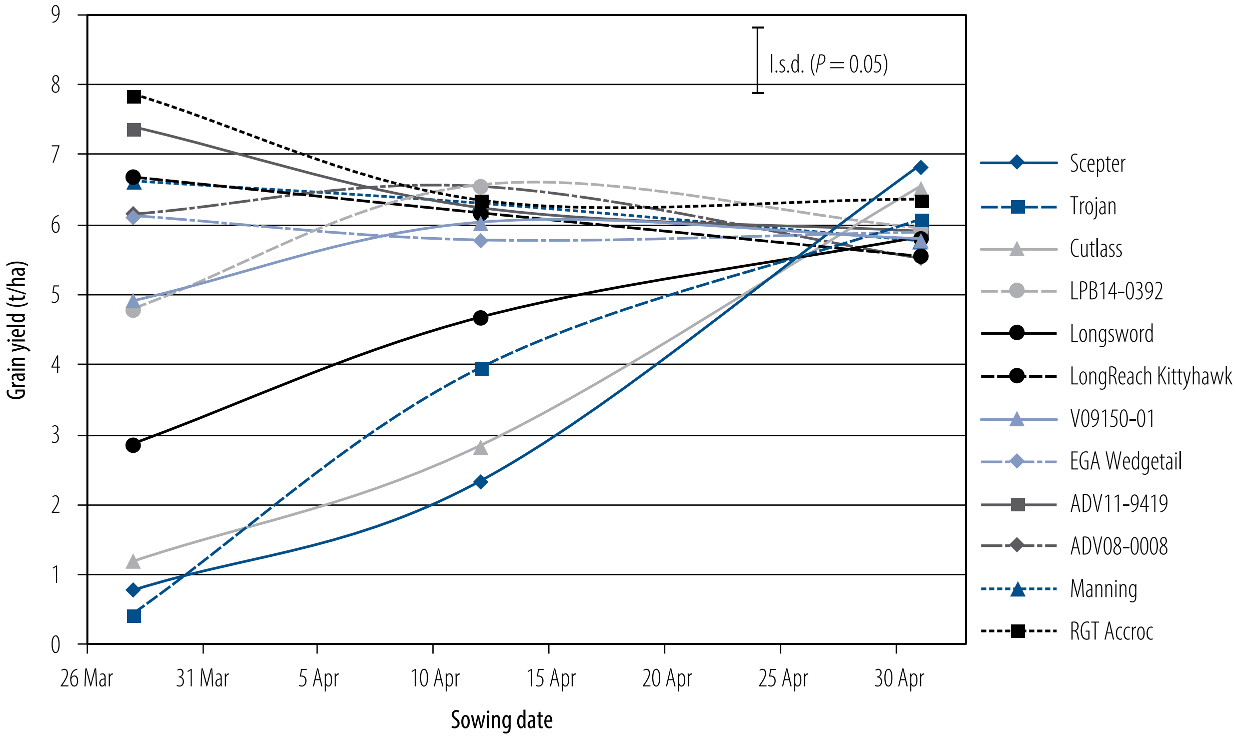

Figure 2. Grain yield responses across three sowing dates: 28 March, 12 April and 1 May at Wallendbeen, 2017.

Table 3. Protein (%), screenings % (SCRN) and test weight (kg/hL) (TWT) of genotypes across three sowing dates (SD) at Wallendbeen in 2017.

Genotype	SD1: 28 March			SD2: 12 April			SD3: 1 May		
	Protein (%)	TWT (kg/hL)	SCRN (%)	Protein (%)	TWT (kg/hL)	SCRN (%)	Protein (%)	TWT (kg/hL)	SCRN (%)
ADV08-0008	11.0	77.6	10.8	11.6	79.3	10.6	10.6	80.3	8.4
ADV11-9419	10.6	81.3	3.3	9.1	81.5	9.3	9.3	81.1	2.9
Cutlass	14.2	76.2	3.4	13.1	76.7	9.1	9.1	80.2	5.0
EGA Wedgetail	14.5	76.2	3.3	12.4	76.8	11.5	11.5	79.2	3.8
LongReach Kittyhawk	11.7	81.9	7.0	10.7	82.5	12.1	12.1	83.7	4.9
Longsword	17.0	75.0	1.1	15.6	77.9	13.5	13.5	79.7	2.2
LPB14-0392	15.5	78.8	3.3	11.5	78.3	12.1	12.1	81.6	4.1
Manning	9.2	77.2	4.0	8.7	77.4	9.7	9.7	78.1	3.1
RGT Accroc	11.2	78.6	5.8	10.7	79.7	10.2	10.2	79.1	6.5
Scepter	12.2	73.0	5.9	12.7	75.3	12.3	12.3	80.3	9.3
LongReach Trojan	13.3	71.1	3.1	13.2	76.6	11.7	11.7	80.6	6.1
V09150-01	13.3	74.7	4.0	13.2	77.2	12.0	12.0	79.8	4.7
l.s.d.									
genotype	0.8	0.9	2.8						
sowing date	0.4	0.5	ns						
genotype × sowing date	1.4	1.6	ns						

ns – not significant; shaded treatments were harvested following 112 mm rain due to delayed maturity.

Summary

High grain yields were achieved from various genotype × sowing date combinations, with winter genotypes generally stable across sowing dates from late March to early May. Frost had a significant effect on phasic development and grain yield in 2017, and while fast-developing spring genotypes were not suited to early sowing, they were able to achieve comparable grain yields when sown at an optimal time (e.g. Scepter⫛ SD3). These results highlight the importance of matching genotype and sowing time to achieve flowering at an appropriate time as an effective management strategy in optimising grain yields.

Acknowledgements

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