Effect of sowing date on grain yield of 36 wheat varieties – Wagga Wagga 2015

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Key findings

- Grain yield was maximised by matching variety phenology with the correct sowing time to target the optimal flowering period.
- Early maturing spring types sown on 16 April suffered frost damage and reduced grain yield.
- Long season varieties sown on 28 May had reduced grain yield as a result of higher moisture and heat stress conditions at flowering.
- The highest yielding variety was Sunvale$^{\Phi}$ (6.3 t/ha) sown on 16 April.
- Beckom$^{\Phi}$ sown on 7 May yielded 6.2 t/ha and Condo$^{\Phi}$ sown on 28 May yielded 4.9 t/ha.

Introduction

This experiment was designed to assess the effect of early, mid and late sowing times on the phenology, grain yield and grain protein of several newer wheat varieties grown in southern NSW. Wheat varieties respond differently to sowing time. There are different responses in flowering time and relative grain yield with changes in time of sowing. The results presented here from the Wagga Wagga experiment is one in a series of experiments aimed at establishing variety responses to sowing time and phenological development.

Site details

Location	Wagga Wagga NSW
Trial period	2015
Soil type	Red chromosol
Previous crop	Canola
Stubble management	Full cut cultivation
Planter	Plot air seeder, DBS tynes
Harvest date	1 December 2015
Fertiliser	100 kg/ha diammonium phosphate (DAP) + 100 kg urea 10 July
Soil tests	pH 4.8$_{Ca}$
Nitrogen	121 kg N/ha tested 0–30 cm
Phosphorus	57 mg/kg
Herbicides	Knockdown: Roundup CT 1.5 L/ha, Pre-emergent: Logran 35 g/ha + Sakura 118 g/ha Post-emergent: Precept 500 mL/ha + Lontrel 150 mL/ha. Axial 150 mL/ha.
Fungicide	Flutriafol 400 mL/ha on fertiliser at sowing
In-crop rainfall (Apr–Oct)	332 mm

Treatments

Thirty-six varieties and crossbreds likely to be released (Table 1) sown at three dates.

Sowing dates	16 April 7 May 28 May

Table 1. Wheat varieties and phenology group.

Phenology group	Variety or breeding line	
Winter	EGA_Wedgetail$^{\Phi}$	LPB11-0140
Very slow	EGA_Eaglehawk$^{\Phi}$, Sunlamb$^{\Phi}$	VO7176-69
Slow	Bolac$^{\Phi}$ Kiora$^{\Phi}$	Lancer$^{\Phi}$ Suntime$^{\Phi}$
Mid	Flanker$^{\Phi}$ EGA_Gregory$^{\Phi}$ Gauntlet$^{\Phi}$ HRZ08-0062 Janz	Mitch$^{\Phi}$ Sunvale$^{\Phi}$ Trojan$^{\Phi}$ Viking$^{\Phi}$
Mid–fast	Beckom$^{\Phi}$ Cosmick$^{\Phi}$ Elmore CL PLUS$^{\Phi}$ Harper$^{\Phi}$	Merlin$^{\Phi}$ Sunguard$^{\Phi}$ Suntop$^{\Phi}$
Fast	ADV03-0056 Corack$^{\Phi}$ Emu Rock$^{\Phi}$ Livingston$^{\Phi}$	LPB09-0358 Mace$^{\Phi}$ Spitfire$^{\Phi}$ Sunmate$^{\Phi}$
Very fast	Condo$^{\Phi}$ Dart$^{\Phi}$	LPB10-0018

Results

Flowering

Thirty-six commercial and unreleased wheat lines with a range of maturities were sown at Wagga Wagga in 2015 (Table 1). The highest grain yields were achieved from the earliest sowing date when varieties flowered between late September and early October (Figure 1). The optimum flowering window (2015) was bound by early frost events and later heat and soil moisture stress. This emphasises the importance of matching phenology, variety type and sowing time to optimise yield where the trade-offs are frost (early stress) and high temperatures and low soil water availability (late stress). When these constraints are considered, an optimal flowering period can be determined for maximising the probability of achieving high grain yields (Figure 1).

Variety, sowing time and the interaction between variety and sowing time were significant for grain yield (P <0.001) (Figure 1). Fast maturing spring varieties sown on 16 April flowered in mid-September and were exposed to frost during the vulnerable boot and growth stages. There was a significant decrease in grain yield from the 28 May sowing date.

Grain yield

Variety and sowing date had significant effects on grain yield (P <0.001). The interaction between variety and sowing date was also significant (P <0.001). The hotter temperatures in the first week of October reduced the grain yield of the late (28 May) sowing time by 1.07 t/ha compared with the mid-season (7 May) sowing time (Table 2). Early sowing (16 April) consistently produced higher grain yields for varieties with a maturity classification of either 'winter', 'very slow', 'slow' and 'mid' (Figure 2). For varieties classified as 'mid–fast', 'fast' and 'very fast', the best sowing time to maximise grain yield was early May (7 May). Late sowing (28 May) consistently produced lower grain yields. Variety choice was only partly able to compensate for the late sowing time (Figure 2).

Table 2. Average grain yield of 36 wheat varieties sown on three dates at Wagga Wagga in 2015.

Sowing date	Grain yield (t/ha)
16 April	5.14
7 May	5.20
28 May	4.13
l.s.d. (P <0.05) = 0.2 t/ha	

Grain protein

Variety (P <0.001) and sowing date (P <0.05) were significant for grain protein (Table 3). Screenings were significant for variety and sowing date, however, there was no interaction between sowing date and variety (Table 3). There was a strong decrease in grain protein associated with grain yield increases for the first time of sowing ($y = -0.5164x + 14.048$, $R^2 = 0.56$), which could be due to protein dilution. Conversely, the highest grain proteins were generally achieved by the late sowing time, probably because the lower grain yields would have concentrated more protein in the grain. This is probably a reflection of the hot dry spring in Wagga Wagga in 2015.

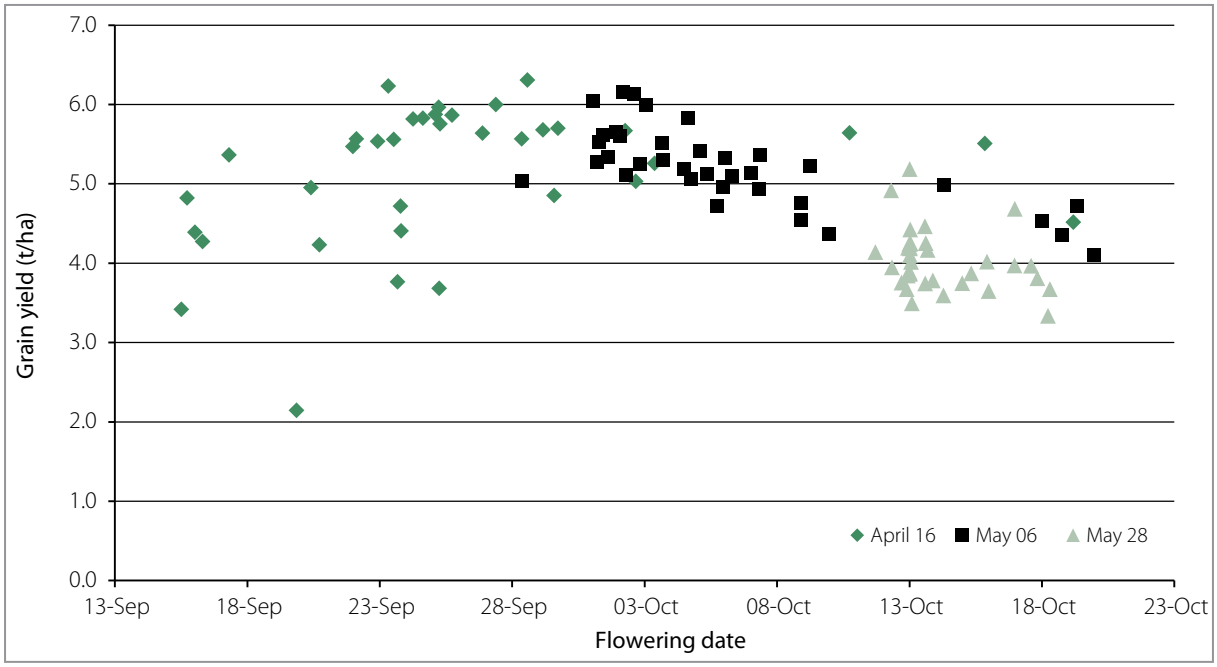

Figure 1. Anthesis date and grain yield of 36 wheat varieties sown at three dates near Wagga Wagga in 2015.

The first week of October had six days above 33 °C. Screenings were generally low across all sowing dates; there was a slight trend towards increased screenings from the longer maturity varieties sown on 28 May. Bolac and Cosmick had high screenings at all sowing dates and Beckom, sown on 28 May, had high screenings.

When assessing the pros and cons of new varieties, the rankings for grain yield at each sowing date is a good indicator of the performance of varieties in any one season (Table 3). A single year's result does not provide an adequate insight into the optimum flowering period. However, to estimate the optimal flowering period, SOWMAN (a part of the CropMate software) is used to simulate frost, heat and soil moisture stress over a 40-year period. This provides an estimate of the optimal flowering period. The ideal variety and sowing time combination is shown in Table 3. These estimates suggest that in the longer-term, growers need to not only consider grain yield, protein and screenings, but also the likely flowering period.

Table 3. Grain yield, protein and screenings of 36 wheat varieties sown on three dates near Wagga Wagga in 2015.

Genotype	Sowing date 16 April				Sowing date 7 May				Sowing date 28 May			
	Yield (t/ha)	Protein (%)	Screenings (%)	Yield rank	Yield (t/ha)	Protein (%)	Screenings (%)	Yield rank	Yield (t/ha)	Protein (%)	Screenings (%)	Yield rank
ADV03-0056	4.9	10.9	5.4	24	5.6	10.4	0.9	8	4.0	11.6	2.2	17
Beckom	5.8	10.8	4.4	8	6.2	10.3	6.5	1	4.2	11.6	11.5	8
Bolac	5.7	11.8	11.3	12	4.8	11.3	10.6	29	3.7	12.5	8.3	30
Condo	4.8	11.1	7.3	26	6.0	10.6	2.0	3	4.9	11.9	1.8	2
Corack	4.3	11.4	4.0	31	6.1	10.9	0.7	2	4.7	12.1	1.3	3
Cosmick	5.4	10.8	5.9	21	5.7	10.3	7.5	6	4.2	11.6	10.4	6
Dart	3.4	12.9	4.4	35	5.0	12.4	2.1	25	3.7	13.6	6.3	31
EGA_Eaglehawk	5.7	11.1	9.5	11	4.5	10.6	9.4	33	3.8	11.8	9.2	26
EGA_Gregory	6.0	11.1	6.4	3	5.1	10.6	4.2	21	4.2	11.8	4.3	13
EGA_Wedgetail	5.6	11.6	7.1	13	4.7	11.1	5.1	31	3.6	12.3	3.0	33
Elmore CL PLUS	5.8	11.3	5.4	7	5.1	10.8	4.1	23	3.9	12.0	7.3	22
Emu_Rock	3.7	12.7	5.3	34	5.6	12.2	2.6	7	4.5	13.4	2.6	4
Gauntlet	5.8	11.2	5.6	9	5.3	10.7	2.5	14	4.2	11.9	4.1	12
Harper	5.5	11.1	7.7	18	5.3	10.6	3.7	17	3.9	11.8	6.4	20
HRZ08-0062	5.9	11.4	6.2	5	4.5	10.9	6.4	32	3.5	12.2	8.9	35
Janz	5.9	10.8	3.5	6	5.1	10.3	4.4	24	3.8	11.6	7.2	25
Kiora	5.7	11.2	5.7	10	5.1	10.7	6.0	20	3.6	12.0	9.4	34
Lancer	4.8	11.9	4.0	25	5.2	11.4	1.6	18	4.0	12.7	3.5	18
Livingston	2.1	13.1	3.4	36	5.1	12.5	5.4	22	4.1	13.8	5.6	15
LPB09-0358	5.5	10.7	5.3	20	6.0	10.2	1.2	4	4.2	11.4	3.5	11
LPB10-0018	4.4	11.6	3.7	30	5.3	11.1	3.2	16	5.2	12.4	5.7	1
LPB11-0140	5.5	10.9	8.1	19	5.0	10.4	4.8	26	4.0	11.7	8.6	19
LRPB Flanker	6.0	10.7	3.1	4	5.4	10.2	3.2	12	4.2	11.5	5.0	10
Mace	4.7	11.2	2.5	27	5.5	10.7	5.3	9	4.1	11.9	4.5	14
Merlin	4.4	12.3	2.9	29	5.3	11.8	2.5	13	4.0	13.1	4.5	16
Mitch	5.6	10.8	7.2	16	4.7	10.3	6.5	30	3.8	11.6	7.8	28
Spitfire	4.2	12.1	3.5	32	5.2	11.6	3.2	19	3.9	12.9	3.2	23
Sunguard	5.6	11.0	6.5	14	5.3	10.5	1.6	15	4.2	11.7	4.9	9
Sunlamb	4.5	11.8	9.4	28	4.1	11.3	5.3	36	3.3	12.6	5.1	36
Sunmate	3.8	11.4	5.9	33	5.5	10.9	2.0	10	3.9	12.2	9.8	21
Suntime	5.0	11.2	8.9	23	4.4	10.7	7.2	34	3.7	11.9	9.2	29
Suntop	5.6	10.9	6.8	15	5.4	10.4	5.6	11	4.4	11.6	4.9	5
Sunvale	6.3	11.9	4.4	1	4.9	11.4	4.1	28	3.8	12.7	8.6	27
Trojan	6.2	10.6	5.3	2	5.8	10.1	1.6	5	4.2	11.3	7.9	7
V07176-69	5.3	11.7	7.8	22	4.4	11.2	5.5	35	3.7	12.5	8.1	32
Viking	5.6	11.2	1.8	17	5.0	10.7	6.7	27	3.9	11.9	5.6	24
l.s.d. (P <0.001)	0.57	0.94	0.62									

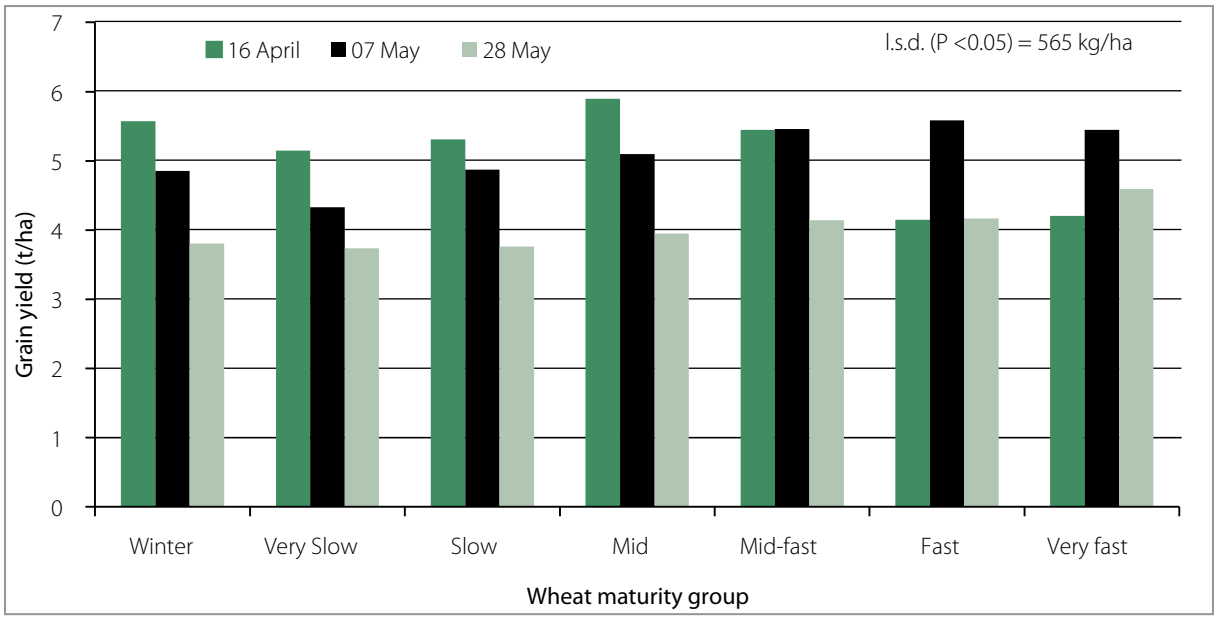

Figure 2. Average grain yield of wheat varieties grouped into seven different maturity classifications and sowing on three different dates near Wagga Wagga in 2015.

Summary

The high average grain yields from the first two sowing dates (16 April and 7 May) coincided with flowering times falling within the optimal flowering period of late September to early October. The later sowing date of 28 May resulted in varieties flowering later in October, which reduced grain yields, particularly in the longer-season varieties. The variation in flowering dates ranged from 37 days for the first sowing date to only seven days for the late sowing on 28 May. Delaying sowing in 2015 past the middle of May resulted in a decrease in grain yield of 1.2 t/ha averaged across all varieties. Beckom, Corack, Trojan and Condo were the highest yielding varieties averaged across all the sowing dates. Varieties such as Beckom, Trojan, Flanker and Corack appear to be less sensitive to the sowing date and yielded higher than other varieties across a range of sowing dates. Sowing times that target the optimal flowering period resulted in the highest grain yield in this experiment.

Acknowledgements

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