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Sowing date effect on the phenology and grain yield of thirty-two wheat varieties – Condobolin 2018

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Key findings

- The central west of NSW had one of its driest winter growing seasons in 2018 resulting in lower than average grain yields.
- Optimum yield was obtained when varieties flowered in the third week of September.
- The most successful phenology type were the mid to slow varieties at all sowing dates, with fast varieties proving to be more competitive at the later sowing dates.

Introduction

In 2018 a wheat experiment was conducted at Condobolin to examine the interaction between sowing date, flowering time and yield. Thirty-two wheat genotypes (Table 1) representing a number of phenology types were sown on three dates to simulate early, main season and late sowings representing farming practices in the central west of NSW. The following paper presents the findings of the experiment, discussing sowing date and genotype selection and its effect on optimising yield.

Site details

Location	Condobolin Agricultural Research and Advisory Station
Soil type	Red chromosol
Previous crop	2017 wheat (stubble intact), 2016 field peas
Fallow rainfall	220.6 mm (October–April)
In-crop rainfall	63 mm (April–September)
Soil nitrogen (kg N/ha)	24.7 (0–10 cm), 52.5 (10–60 cm), 18 (60–100 cm)
Starter fertiliser	70 kg/ha mono-ammonium phosphate (MAP) (11% nitrogen [N], 22.7% phosphorus [P], 2% sulfur [S]) at sowing.
Supplementary watering	The site was treated with 25 mm of supplementary water at each sowing date in order to establish germination. A further 20 mm was applied on 20 September to ensure plant survival.

Treatments

Varieties	32 wheat genotypes with a range of phenology types (Table 1)
Sowing date (SD)	SD1: 20 April SD2: 7 May SD3: 21 May

Table 1. Wheat genotypes and phenology types included in the experiment at Condobolin, 2018.

Phenology type	Sub-category	Genotype
Winter	Mid–slow	DS Bennett$^{\Phi}$
	Mid	EGA Wedgetail$^{\Phi}$, LongReach Kittyhawk$^{\Phi}$
	Fast	Longsword$^{\Phi}$
Spring	Very slow	EGA Eaglehawk$^{\Phi}$, Sunlamb$^{\Phi}$, Sunmax$^{\Phi}$
	Slow	Cutlass$^{\Phi}$
	Mid–slow	Coolah$^{\Phi}$, DS Pascal$^{\Phi}$, EGA Gregory$^{\Phi}$, LongReach Lancer$^{\Phi}$, LongReach Trojan$^{\Phi}$, Mitch$^{\Phi}$
	Mid	Beckom$^{\Phi}$, Janz, Sunvale$^{\Phi}$
	Mid–fast	Suntop$^{\Phi}$, LongReach Reliant$^{\Phi}$
	Fast	Corack$^{\Phi}$, LongReach Hellfire$^{\Phi}$ (LPB14-3634), LongReach Mustang$^{\Phi}$, LongReach Spitfire$^{\Phi}$, Mace$^{\Phi}$, RAC2388, Scepter$^{\Phi}$, Sunprime$^{\Phi}$
	Very fast	Condo$^{\Phi}$, H45$^{\Phi}$, LongReach Dart$^{\Phi}$, TenFour, Vixen$^{\Phi}$

Results

Grain yield and phenology

2018 was one of the lowest rainfall seasons on record, with an April–September rainfall of 63 mm. Fifty-three frosts (temperatures below 2 °C) were recorded throughout the growing period. There was no significant difference in yield between SD1 and SD2, but there was a significant increase in SD3 (Table 2). Overall, the mid–slow flowering phenotypes yielded the highest, with yield penalties for the fast and winter types. There was a significant yield difference between genotypes in all sowing dates, with the highest yielding variety being the very slow Sunmax$^{\Phi}$ in SD1, and slow Cutlass$^{\Phi}$ in SD2 and SD3. It should be noted that sowing decisions should not be made based on one year of data alone, due to seasonal variability.

Peak yields were obtained when genotypes flowered in the third week of September, after major frosts had concluded (Figure 1). Later flowering dates, especially from winter varieties, had decreased yield possibly due to heat and moisture stress during grain fill.

Table 2. Grain yield and flowering dates of genotypes sown across three sowing dates at Condobolin, 2018. Figure in parentheses shows grain yield rank per sowing date.

Variety	SD1: 20 April			SD2: 7 May			SD3: 21 May		
	Yield (t/ha)		Flowering date (GS65)	Yield (t/ha)		Flowering date (GS65)	Yield (t/ha)		Flowering date (GS65)
Beckom	1.06	(14)	14 Sep	1.18	(8)	19 Sep	1.31	(16)	19 Sep
Condo	1.01	(16)	15 Sep	0.91	(26)	15 Sep	1.36	(11)	18 Sep
Coolah	1.39	(2)	22 Sep	1.20	(6)	27 Sep	1.13	(24)	29 Sep
Corack	1.03	(15)	16 Sep	0.98	(23)	19 Sep	1.16	(21)	23 Sep
Cutlass	1.32	(6)	25 Sep	1.41	(1)	27 Sep	1.58	(1)	1 Oct
DS Bennett	0.63	(32)	7 Oct	0.57	(32)	6 Oct	0.81	(32)	7 Oct
DS Pascal	1.15	(10)	22 Sep	0.95	(25)	24 Sep	1.11	(25)	29 Sep
EGA Eaglehawk	1.30	(7)	29 Sep	1.22	(5)	1 Oct	1.13	(23)	2 Oct
EGA Gregory	1.36	(3)	20 Sep	1.22	(4)	23 Sep	1.34	(13)	27 Sep
EGA Wedgetail	1.18	(9)	29 Sep	0.85	(27)	1 Oct	0.81	(31)	4 Oct
H45	0.77	(30)	10 Sep	1.12	(12)	13 Sep	1.23	(19)	17 Sep
Janz	0.99	(18)	16 Sep	1.23	(3)	21 Sep	1.37	(10)	25 Sep
LongReach Dart	0.99	(17)	15 Sep	0.84	(28)	15 Sep	1.20	(20)	17 Sep
LongReach Hellfire	1.18	(8)	18 Sep	1.01	(21)	26 Sep	1.57	(2)	29 Sep
LongReach Kittyhawk	0.95	(22)	26 Sep	0.82	(30)	1 Oct	1.02	(29)	2 Oct
LongReach Lancer	1.11	(11)	23 Sep	0.99	(22)	24 Sep	1.11	(26)	1 Oct
LongReach Mustang	0.86	(26)	15 Sep	1.07	(15)	15 Sep	1.32	(14)	20 Sep
LongReach Reliant	0.98	(19)	19 Sep	1.12	(11)	18 Sep	1.47	(6)	23 Sep
LongReach Spitfire	0.85	(28)	17 Sep	1.04	(16)	19 Sep	1.41	(8)	25 Sep
LongReach Trojan	1.07	(13)	17 Sep	1.17	(9)	23 Sep	1.51	(4)	25 Sep
Longsword	0.96	(21)	27 Sep	1.33	(2)	26 Sep	1.45	(7)	27 Sep
Mace	0.86	(27)	14 Sep	1.03	(17)	18 Sep	1.35	(12)	22 Sep
Mitch	1.36	(4)	19 Sep	1.19	(7)	22 Sep	1.32	(15)	27 Sep
RAC2388	0.89	(25)	14 Sep	0.84	(29)	15 Sep	1.29	(17)	19 Sep
Scepter	0.96	(20)	18 Sep	1.09	(13)	19 Sep	1.39	(9)	23 Sep
Sunprime	0.94	(23)	12 Sep	0.97	(24)	14 Sep	1.50	(5)	16 Sep
Sunlamb	0.76	(31)	4 Oct	0.75	(31)	4 Oct	0.90	(30)	5 Oct
Sunmax	1.40	(1)	26 Sep	1.07	(14)	30 Sep	1.15	(22)	1 Oct
Suntop	1.35	(5)	21 Sep	1.01	(20)	22 Sep	1.56	(3)	25 Sep
Sunvale	1.09	(12)	22 Sep	1.17	(10)	23 Sep	1.09	(28)	1 Oct
TenFour	0.77	(29)	12 Sep	1.03	(19)	15 Sep	1.24	(18)	18 Sep
Vixen	0.92	(24)	12 Sep	1.03	(18)	15 Sep	1.10	(27)	15 Sep
Average	1.04		21 Sep	1.04		23 Sep	1.26		27 Sep

l.s.d. ($P = 0.05$) genotype 0.21 t/ha; sowing date 0.07 t/ha.

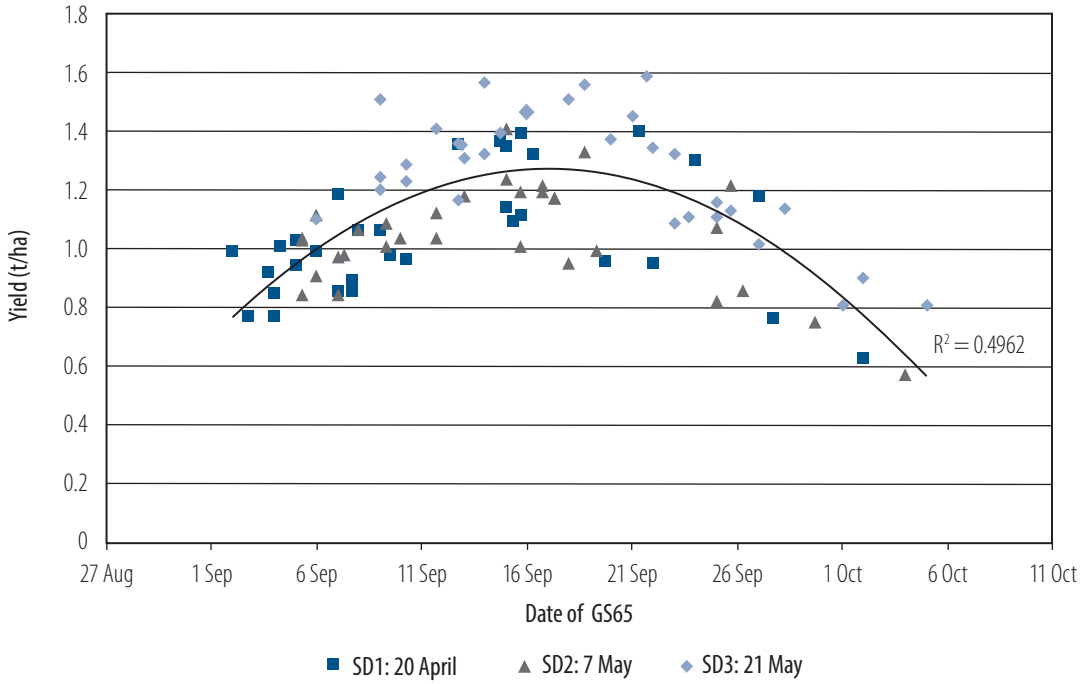

Figure 1. Grain yield vs GS65 dates for 32 varieties of wheat sown on three dates at Condobolin, 2018.

Grain quality

Grain weight decreased significantly at SD3, while screenings (percentage <2 mm) increased. Genotype significantly affected both traits (Table 3). The only genotypes to exceed 5% screenings were Sunlamb$^{\Phi}$ and DS Bennett$^{\Phi}$ in SD3.

Protein significantly decreased from SD1 to SD2, and there was a significant genotype difference. The highest protein concentration was from Spitfire$^{\Phi}$, with an average protein concentration of 12.6%. While genotype produced a significant difference in hectolitre weights, there was no difference from sowing dates. The harvest index significantly increased with sowing date.

Table 3. Grain quality of 32 wheat varieties sown at Condobolin, 2018. Values presented are from the highest yielding sowing date, SD3: 21 May.

Variety	Protein (%)	Hectolitre weight (kg/hL)	Screenings (% <2 mm)	Harvest index
Beckom	10.6	79.8	2.5	0.45
Condo	11.6	81.6	4.3	0.43
Coolah	10.1	78.2	4.5	0.40
Corack	11.6	81.7	2.4	0.35
Cutlass	10.1	82.4	2.0	0.46
DS Bennett	10.7	78.7	5.0	0.41
DS Pascal	10.8	78.4	2.7	0.39
EGA Eaglehawk	10.8	82.3	2.2	0.38
EGA Gregory	10.1	79.4	3.5	0.39
EGA Wedgetail	12.9	75.5	2.0	0.31
H45	10.4	81.3	2.7	0.43
Janz	11.2	80.8	2.0	0.40
LongReach Dart	10.9	81.8	3.3	0.41
LongReach Hellfire	12.1	83.3	2.9	0.40
LongReach Kittyhawk	11.5	80.3	2.6	0.37
LongReach Lancer	11.5	82.0	2.3	0.46
LongReach Mustang	10.5	81.9	3.3	0.43
LongReach Reliant	9.7	81.1	3.6	0.45
LongReach Spitfire	11.9	84.2	3.6	0.42
LongReach Trojan	10.4	83.6	2.2	0.40
Longsword	10.6	81.3	2.0	0.47
Mace	9.9	81.6	2.7	0.45
Mitch	10.4	78.5	2.9	0.41
RAC2388	9.9	80.4	2.9	0.43
Scepter	10.0	81.1	3.2	0.47
Sunprime	11.8	81.2	3.6	0.41
Sunlamb	12.0	79.2	5.6	0.37
Sunmax	11.6	81.4	3.5	0.43
Suntop	10.2	81.6	2.9	0.41
Sunvale	11.9	81.2	2.1	0.42
TenFour	11.0	78.3	2.8	0.45
Vixen	12.0	78.9	4.5	0.37
Average	11.0	80.7	3.1	0.41
l.s.d. ($P = 0.05$)	1.5	1.3	0.9	0.06

Yield components

Yield is driven by tiller number (Table 4), number of grains per tiller and grain size. There was a significant difference in all three yield components for both genotype and sowing date, although there was no interaction. Grain size decreased in SD3, but an increase in the number of grains per tiller compensated. There was no relationship between grain yield, and any single yield component, although a relationship was observed between grain yield and the number of grains per square metre (Figure 2).

Table 4. Yield components of 32 wheat varieties sown at Condobolin, 2018. Data shown is from the highest yielding sowing date, SD3: 21 May.

Genotype	Grain number (grains/ear)	Grain weight (mg/grain)	Tiller number (tillers/m^2)
Beckom	73.4	31.5	303
Condo	76.9	41.3	259
Coolah	74.5	31.4	258
Corack	69.7	43.3	283
Cutlass	88.4	34.4	291
DS Bennett	103.4	29.6	258
DS Pascal	67.7	30.4	316
EGA Eaglehawk	74.4	33.9	271
EGA Gregory	85.4	33.3	270
EGA Wedgetail	70.2	34.0	264
H45	99.7	31.3	220
Janz	68.7	32.6	291
LongReach Dart	88.9	34.3	248
LongReach Hellfire	60.3	39.4	329
LongReach Kittyhawk	78.7	36.1	264
LongReach Lancer	62.6	35.3	237
LongReach Mustang	71.5	35.3	286
LongReach Reliant	87.9	32.7	272
LongReach Spitfire	80.0	38.2	268
LongReach Trojan	63.7	38.0	331
Longsword	54.9	36.8	291
Mace	81.2	36.0	275
Mitch	81.5	32.6	269
RAC2388	69.4	38.1	292
Scepter	79.8	36.8	213
Sunlamb	114.4	26.5	238
Sunmax	70.8	36.7	246
Sunprime	80.4	36.7	270
Suntop	76.1	35.9	294
Sunvale	62.2	32.5	315
TenFour	88.9	35.7	242
Vixen	63.7	45.0	273
Average	77.2	35.2	273
l.s.d. ($P = 0.05$)	10.9	1.9	44

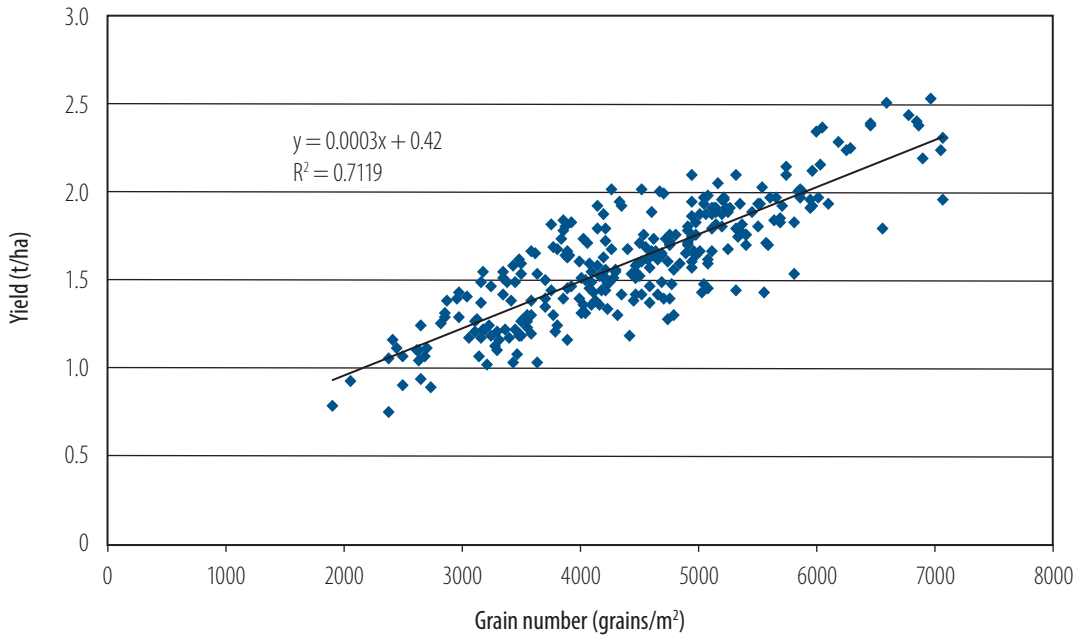

Figure 2. Relationship between grain yield and grain number/m^2 for 32 genotypes of wheat sown at Condobolin, 2018.

Discussion

The 2018 growing season presented many challenges for growers in the central west of NSW. Genotypes flowering in the third week of September achieved the highest yield, with mid to slower varieties out-yielding fast and winter varieties. Frosts during August and the beginning of September coincided with stem elongation and early variety flowering, affecting their yield performance.

Fast-flowering genotypes are often favoured in the central west region of NSW in order to maximise the grain filling period in the event of terminal drought. In this experiment, however, mid to slow flowering varieties demonstrated a yield advantage over faster varieties due to frost affecting the early flowering types in SD1 and SD2. Of the varieties yielding above average in SD3, half were fast phenology types, while the top four varieties were mid to slow. Supplementary watering in the third week of September and the October rainfall might have provided a grain-filling advantage to the later flowering genotypes. While this experiment reports on a single year of results, it demonstrates the risk of early sowing, and the necessity to better match phenology type with sowing date.

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