Effect of nitrogen rate and sowing time on grain yield and grain protein of six wheat varieties – Condobolin 2015

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Key findings

- Yield was reduced by dry and hot conditions during flowering for both times of sowing.
- Spitfire yielded highest in time of sowing 1 (1.55 t/ha) and Condo$^{\Phi}$ yielded highest in time of sowing 2 (1.15 t/ha).
- The nil nitrogen treatment yielded highest (1.01 t/ha); increasing nitrogen rate decreased grain yield for both times of sowing.

Introduction

This experiment evaluated the effect of time of sowing (TOS) and nitrogen rate on grain yield and grain quality for six current wheat varieties in the low rainfall zone of central western NSW.

Site details

Location	Condobolin Agricultural Research and Advisory Station (Condobolin ARAS)
Soil type	Red-brown earth
Previous crops	Pasture 2012, wheat 2013 and 2014
Fertiliser	70 kg/ha MAP + Jubilee at 400 mL/ha (fungicide on fertiliser)
Available nitrogen (N)	68 kg/ha (0–60 cm)
In-crop rainfall (1 April–30 September)	198.2 mm
Harvest date	TOS1: 9 November TOS2: 10 November

Treatments

Wheat varieties	Condo$^{\Phi}$	Spitfire$^{\Phi}$
	EGA_Gregory$^{\Phi}$	Suntop$^{\Phi}$
	Lancer$^{\Phi}$	Viking$^{\Phi}$
Nitrogen rates	0, 20, 40, 80, 40 + 40 split* and 160 kg N/ha * Split application 40 kg N/ha at sowing + 40 kg N/ha at first node stage (GS 31)	
Sowing times	TOS 1: 5 May TOS 2: 26 May	

Seasonal conditions

Growing season rainfall at the experiment site was just below average with the Condobolin ARAS recording 198.2 mm. The long-term average (LTA) in-crop rainfall is 209 mm. The rain was spread across the first five months of the growing season. Rainfall in May was 11.6 mm (LTA 34.4 mm) and in September 6.2 mm (LTA 29.1 mm), which fell in the first week of September. The next substantial rainfall of 16 mm was not until 22 October (Table 1).

High daytime temperatures at Condobolin (33–38 °C) and hot winds during the first week of October coincided with flowering and contributed to the lower yields in TOS 2.

The experiments were sown into adequate moisture and established quickly and evenly. The experiment was weed-free and very even throughout the season.

Table 1. Monthly rainfall at the Condobolin ARAS 2015.

Condobolin ARAS rainfall for 2015 (mm)														
Dec 2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	In-crop
88.8	59.2	35.9	0.2	64.7	11.6	31.8	41.6	42.3	6.2	65.2	67.3	28.5	454.5	198.2

Results

Grain yield

The experiments were sown into retained stubble with 68 kg N/ha (0–60 cm) of available N. There was a significant difference (P <0.05) between the grain yields of six varieties (Table 2) and the response of grain yield to applied nitrogen (Table 3). At the first time of sowing (5 May), Spitfire (1.55 t/ha), Condo (1.46 t/ha) and Suntop (1.43 t/ha) were the highest yielding varieties. At the second time of sowing (26 May) Condo (1.15 t/ha), Dart (1.06 t/ha) and Spitfire (0.93 t/ha) were the highest yielding varieties. Lancer (1.09 t/ha at TOS 1 and 0.38 t/ha at TOS 2) yielded the least.

Table 2. Grain yield (t/ha) of six wheat varieties sown on 5 May and 26 May at Condobolin 2015. (Note: the l.s.d. represents the difference within each TOS only).

Variety	Grain yield (t/ha)	
	TOS 1: 5 May	TOS 2: 26 May
Condo	1.46	1.15
Dart	1.36	1.06
EGA_Gregory	1.19	0.55
Lancer	1.09	0.37
Spitfire	1.55	0.93
Suntop	1.43	0.89
l.s.d. (P <0.05)	0.07	0.07

There was a significant difference (P <0.05) between N rates (Table 3) averaged across all varieties at both sowing times. Grain yield decreased with increasing N rate. The nil N treatment yielded the highest across both sowing times (Table 3).

Table 3. Grain yield (t/ha) averaged across all varieties at six N rates, sown on 5 May and 26 May at Condobolin 2015 (Note the l.s.d. represents the difference within each TOS only).

Nitrogen rate (kg N/ha)	Grain yield (t/ha)	
	TOS 1: 5 May	TOS 2: 26 May
0	1.43	1.01
20	1.40	0.89
40	1.37	0.84
80	1.34	0.77
40 + 40 split	1.31	0.70
160	1.23	0.71
l.s.d. (P <0.05)	0.07	0.08

Grain quality

There was a significant interaction (P <0.05) in grain quality between variety, sowing time and nitrogen treatments. There was a significant difference in grain protein, screening and test weights for the six varieties (Table 4) and the six N treatments (Table 5).

The dry conditions in spring would have contributed to the low yields, high grain protein and high screenings in TOS 2.

There was an increase in grain protein between TOS 1 and TOS 2 across all varieties (Table 4). Grain protein increased across all nitrogen treatments between the two sowing times (Table 5).

Spitfire achieved the highest grain nitrogen yield (41.4 kg N/ha) and test weight (70.0 kg/hL) in TOS 1. Lancer had the lowest screenings (6.9%) and the highest test weight (78.9 kg/hL) for TOS 2. Lancer grain N yield was low (11.5 kg N/ha) for the TOS 2 due to the low grain yield achieved from the 26 May sowing time (Table 4).

Table 4. Grain quality of six wheat varieties at two times of sowing at Condobolin 2015.

Variety	TOS 1: 5 May				TOS 2: 26 May			
	Grain protein (%)	Grain nitrogen yield (kg N/ha)	Screenings (%)	Test weight (kg/hL)	Grain protein (%)	Grain nitrogen yield (kg N/ha)	Screenings (%)	Test weight (kg/hL)
Condo	14.1	36.0	22.2	66.7	16.0	32.2	34.6	66.7
Dart	15.0	35.6	41.2	66.1	17.1	31.8	45.3	64.8
EGA_Gregory	14.3	29.8	23.2	67.8	16.5	15.8	18.5	76.8
Lancer	15.7	29.9	26.1	68.5	17.9	11.5	6.9	78.9
Spitfire	15.3	41.4	22.9	70.0	17.8	28.8	33.2	70.9
Suntop	13.7	34.1	32.3	69.6	15.8	24.5	36.9	74.6
l.s.d. (P <0.05)	0.001	NA	2.1	0.8	0.3	NA	2.8	2.1

Table 5. Grain quality of wheat at six N rates and two times of sowing at Condobolin 2015.

Nitrogen rate (kg N/ha)	TOS 1: 5 May				TOS 2: 26 May			
	Grain protein (%)	Grain nitrogen yield (kg N/ha)	Screenings (%)	Test weight (kg/hL)	Grain protein (%)	Grain nitrogen yield (kg N/ha)	Screenings (%)	Test weight (kg/hL)
0	12.3	30.6	18.5	71.1	15.0	26.5	22.6	73.7
20	13.2	32.3	22.2	70.2	16.0	25.0	24.5	73.1
40	14.3	34.1	26.2	68.7	16.5	24.4	30.4	72.1
80	15.4	36.0	30.3	67.8	17.2	23.3	31.2	71.5
40 + 40 split	16.2	37.2	34.1	66.0	18.2	22.3	34.0	71.2
160	16.9	36.3	36.8	65.4	18.2	22.7	32.6	71.1
l.s.d. (P <0.05)	0.001	NA	2.1	0.8	0.3	NA	2.7	0.9

Summary

Growing season rainfall was slightly lower than average with the majority falling in April, July and August. The dry weather during September (6.2 mm) coupled with high temperatures in September and October contributed to the low grain yields for the 26 May sowing time as the plants 'hayed off'. The above-average October rainfall did not benefit the plants as they could not recover from the earlier dry conditions.

The shorter season varieties such as Condo, Dart and Spitfire had the highest grain yields for both sowing times. These varieties were able to fill grain before the drier conditions during spring affected the plants. The longer season varieties (EGA_Gregory and Lancer) yielded lowest for both times of sowing as the dry spring affected grain filling.

The low yield achieved for both times of sowing is attributed to the varieties flowering during late September (16–22 September) when moisture was limited and temperatures were increasing.

The grain quality results showed that the dry spring conditions affected both sowing times.

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